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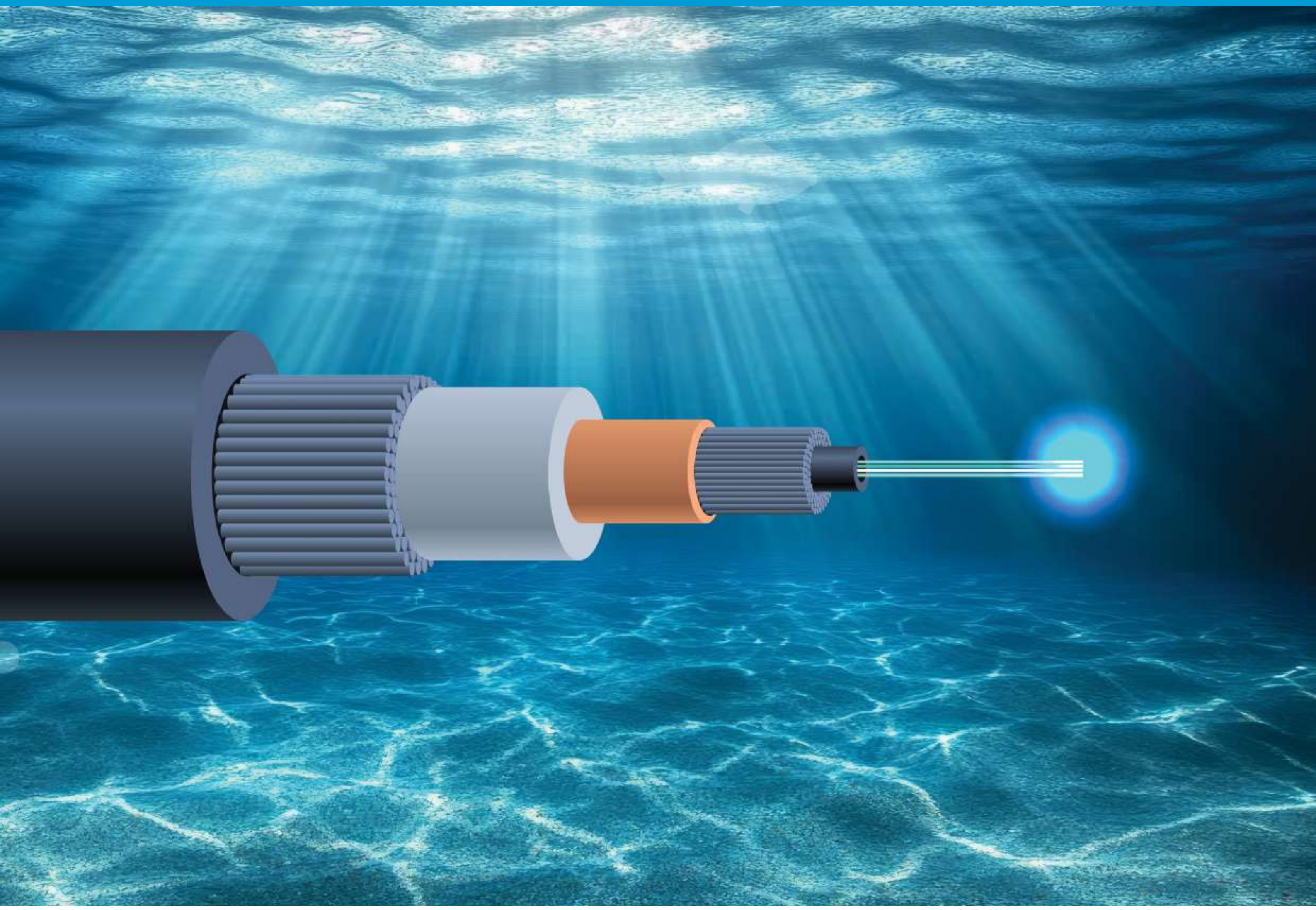
INTERNATIONAL ADVISORY BODY ON SUBMARINE CABLE RESILIENCE

REPORT OF THE WORKING GROUPS

2026



In partnership with:

International Cable Protection Committee

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ISBN

978-92-61-40561-8 (PDF version)
978-92-61-40571-7 (EPUB version)

INTERNATIONAL ADVISORY BODY ON SUBMARINE CABLE RESILIENCE

Report of the Working Groups

2026

In partnership with:

ACKNOWLEDGEMENTS

This report has been prepared as part of the work of the International Advisory Body on Submarine Cable Resilience (IAB or Advisory Body), established by the International Telecommunication Union (ITU) in partnership with the International Cable Protection Committee (ICPC), to enhance the resilience of submarine cable infrastructure.

In response to the continuing reliance on submarine telecommunications cables for international connectivity and the risks of damage these cables face from natural and human causes, the Advisory Body established three thematic working groups. These groups were tasked with identifying challenges, reviewing best practices and proposing practical, action-oriented recommendations.

This report reflects the work of the IAB Working Groups, which brought together experts from government policy-making and regulation, industry, international organizations, and academia. It provides a set of findings, guidelines and proposed actions to address the identified topic area and contribute to the broader goals of submarine cable resilience in accordance with national and international legal and policy frameworks.

The work of the IAB is supported by the leadership of its Co-Chairs from Nigeria and Portugal, and by the ITU and ICPC Secretariats. Special appreciation is extended to **Mr Manuel da Costa Cabral (Portugal)** and **Mr Osibo Imhoitsike (Nigeria),** as well as to colleagues from ITU – **Ms Sulyna Abdullah, Mr Preetam Maloor, Ms Sadhvi Saran, Mr Andrés Fígoli, Ms Rebecca Mzungu Saeluzika – and Mr John Wrottesley (ICPC), as well as the co-facilitators of the Working Groups,** for their valuable contributions.

Please consider the environment before printing this report.

FOREWORD

Submarine telecommunications cables are the invisible backbone of our digital world. They carry over 99 per cent of intercontinental data traffic and underpin financial systems, public institutions, and communications on which people, businesses, and governments depend every day.

When these services are disrupted, the consequences are immediate and significant. Communities can be isolated, emergency responses hindered, and trust in digital transformation shaken. In a digitally integrated world, the resilience of submarine cable infrastructure is an imperative of global development and cooperation.

It is in this context that the International Telecommunication Union (ITU), in partnership with the International Cable Protection Committee (ICPC), established the International Advisory Body on Submarine Cable Resilience (IAB) in 2024. This initiative brings together governments, regulators, industry, and experts to strengthen the resilience of this critical infrastructure. It also aligns closely with the theme of World Telecommunication and Information Society Day (WTISD) 2026: Digital lifelines.

This publication reflects a shared commitment to advancing practical, action-oriented solutions, with each IAB Working Group addressing a distinct dimension of submarine cable resilience. The first Working Group report highlights the importance of timely deployment and repair, streamlined permitting, stronger coordination, and improved access to repair resources. The second focuses on risk identification, monitoring and mitigation, examining the evolving range of risks and the importance of enhanced monitoring, reporting, and coordination mechanisms. The third explores fostering geographic diversity, addressing structural and investment challenges and identifying pathways to strengthen redundancy and expand resilient connectivity, particularly for vulnerable regions.

Taken together, these dimensions demonstrate that submarine cable resilience is our shared responsibility. Strengthening it will depend on coordinated action across governments, industry, international organizations and the broader maritime community. It also depends on sustained attention across the full lifecycle of cable systems, from planning and deployment to protection, maintenance, repair, and long-term adaptation. For ITU, this work directly supports our mandate to advance meaningful connectivity and to promote resilient, inclusive, and sustainable digital development for all people.

I am grateful to the IAB Co-Chairs, Minister Bosun Tijani and Professor Sandra Maximiano; the Co-Facilitators of the three Working Groups; and the IAB Executive Secretaries, ITU Deputy Secretary-General Tomas Lamanauskas and ICPC Legal Adviser Kent Bressie. I also extend my sincere thanks to the 175 experts who helped shape this important body of work.

The task ahead is to translate these insights into action. By working together across sectors, borders, and disciplines, we can build a more resilient, inclusive and sustainable global connectivity ecosystem for the benefit of everyone, everywhere.

Doreen Bogdan-Martin
Secretary-General
International Telecommunication Union

FOREWORD


Submarine cables are the invisible backbone of the global digital economy. They support communications, financial systems, public services, and international connectivity across the world. Strengthening the resilience of this infrastructure is therefore a shared global responsibility and an increasingly important priority for governments, regulators, industry, and international organizations.

In this context, it has been a true privilege to co-chair the International Advisory Body on Submarine Cable Resilience. Since its establishment in 2024 by the International Telecommunication Union (ITU) and the International Cable Protection Committee (ICPC), the IAB has brought together experts from governments, industry, and international organizations with a common objective: to strengthen the resilience, security, and sustainability of submarine cable systems worldwide.

The final Declarations of the Abuja and Porto Summits on Submarine Cable Resilience, held in February 2025 and 2026, respectively, reflect a shared international commitment to protecting and strengthening this vital global infrastructure.

Alongside these Declarations, the IAB, through its Working Groups, agreed on a set of recommendations providing practical guidance to accelerate cable deployment and repair through the strengthening of legal and regulatory frameworks, the mitigation of risks to cable infrastructure, support for innovation and capacity-building, and the promotion of investment and route diversity worldwide.

Enhancing connectivity, stimulating innovation, and promoting the resilience of submarine cables are multifaceted tasks that require collaboration among governments, industry, academia, and international organizations. In addition, in the event of a significant disruption, the effects can spread rapidly across different systems, often exceeding the capacity of any individual country to predict or control them.

No region, country, or stakeholder can address the challenges we face alone. Cooperation is not an option; it is indispensable in an interconnected world.

For Portugal and Nigeria, the outcomes of the IAB are extremely valuable in improving our policies and practices. Moreover, the spirit of cooperation that guided the activities of the IAB has been an inspiring example of how collaborative efforts can bring **fruitful and impactful results.**

As the Advisory Body's final report has now been published and made accessible to all, the focus shifts from endorsement to implementation, stakeholder engagement, and the translation of the agreed recommendations into concrete policies and operational practices. We therefore encourage all stakeholders to take these outcomes into consideration when developing their strategies, policies and practices to enhance the resilience of submarine cable systems.

We acknowledge the IAB Working Group co-facilitators and members, and give special thanks to Mr Manuel da Costa Cabral (Portugal), Mr Osibo Imhoitsike (Nigeria), ITU: Ms Sulyna Abdullah, Mr Preetam Maloor, Ms Sadhvi Saran, Mr Andrés Fígoli, Ms Rebecca Mzungu Saeluzika and Mr John Wrottesley (ICPC).

H.E. Minister Bosun Tijani
Co-Chair
Minister of Communications, Innovation and Digital Economy
Federal Republic of Nigeria

Prof. Sandra Maximiano
Co-Chair
Chairwoman, Board of Directors
Autoridade Nacional de Comunicações
(ANACOM)

FOREWORD

Formed in 1958, the International Cable Protection Committee (ICPC) is the world's leading non-governmental organisation devoted to submarine cable protection and resilience. Bringing together cable owners, cable ship operators, manufacturers, marine experts, and the scientific community – alongside governments participating as observers – the ICPC provides a unique forum for cooperation on the protection and resilience of submarine cables. For more than six decades, the Committee has worked collectively to address the practical, technical, environmental, and legal challenges associated with safeguarding the global submarine cable network that underpins international communications and digital connectivity.

The ICPC is pleased to have partnered with the International Telecommunication Union (ITU) to convene the International Advisory Body (IAB) on Submarine Cable Resilience and to collaborate closely in support of this important initiative. The partnership between the ITU, ICPC, governments, and industry reflects a shared recognition that submarine cable resilience is a global challenge requiring coordinated action. By bringing together expertise from across the public and private sectors, the IAB has created an effective platform for practical dialogue, evidence-based analysis, and the development of recommendations that can strengthen resilience worldwide.

From an industry perspective, resilience is built upon decades of operational experience, technical expertise, and continuous innovation. Submarine cable systems operate in some of the world's most challenging environments and are exposed to a wide range of risks, including fishing activity, anchoring, natural hazards, and increasing competition for access to the seabed. The industry's ability to maintain high levels of reliability depends upon the application of proven technical recommendations, effective route planning, risk mitigation measures, efficient maintenance arrangements, and the rapid mobilisation of repair capabilities when faults occur. The experience and knowledge of those who design, deploy, maintain, and repair submarine cables are therefore essential components of any effort to strengthen resilience.

The reports and recommendations produced by the IAB Working Groups represent an important contribution to this objective. They address practical challenges affecting the deployment, operation, protection, and repair of submarine cables and provide a valuable framework for enhancing resilience at national, regional, and global levels. From the perspective of the submarine cable industry, these reports offer constructive and actionable recommendations that can support improved coordination, reduce barriers to cable deployment and repair, strengthen preparedness, and promote greater awareness of the critical role submarine cables play in supporting economies, societies, and governments around the world.

The resilience of the global submarine cable network ultimately depends on effective cooperation among governments, industry stakeholders, international organisations, regulators, and other users of the marine environment. No single organisation or sector can address these challenges alone. Continued dialogue, information sharing, and practical collaboration are essential in ensuring that submarine cables can be laid, maintained, protected, and repaired efficiently in support of the world's growing connectivity needs.

As demand for digital infrastructure continues to grow, so too does the importance of ensuring that submarine cable systems remain resilient and capable of supporting the world's connectivity needs. The work of the IAB represents an important step forward; however, its true value will be measured through implementation. By translating recommendations into practical actions, reducing barriers to cable deployment and repair, and strengthening cooperation between governments, industry, and international organisations, we can deliver meaningful improvements in resilience.

The ICPC looks forward to continuing to engage with ITU and partners around the world to advance this shared agenda and to ensure that submarine cables continue to serve as reliable foundations of the global digital economy.

Mr Dean Ververka
Chairman
International Cable Protection Committee (ICPC)

EXECUTIVE SUMMARY

Submarine telecommunications cables form the backbone of the global digital economy. They carry over 99 per cent of intercontinental data traffic and support critical services including finance, government operations, cloud computing, education, healthcare, and emergency communications. As societies become increasingly reliant on digital connectivity, the resilience of submarine cable systems has become a matter of strategic importance for governments, industry, and the international community.

Recognizing the growing importance of these systems, the International Telecommunication Union (ITU), in partnership with the International Cable Protection Committee (ICPC), established the International Advisory Body on Submarine Cable Resilience (IAB) to strengthen cooperation between governments, industry and international organizations in identifying and promoting best practices for submarine cable resilience.

This executive summary has been prepared by the Secretariat to provide an overview of the key findings, cross-cutting themes, and recommendations emerging from the work of the three Working Groups.

This publication presents the outcomes of the work undertaken by the IAB's three Working Groups

- **Working Group 1:** Timely deployment and repair
- **Working Group 2:** Risk identification, monitoring and mitigation
- **Working Group 3:** Fostering connectivity and geographical diversity

Together, these Working Groups examined the technical, operational, regulatory, environmental, and economic factors that influence submarine cable resilience. Their analysis highlights the need for coordinated action across governments, industry, and international organizations to address evolving risks and ensure the reliability of global connectivity infrastructure.

KEY FINDINGS

The analysis conducted across the three Working Groups highlights several important findings regarding the current state of submarine cable resilience.

First, submarine cables remain highly exposed to a wide range of risks, including fishing activities, anchoring, natural hazards and infrastructure congestion. While many disruptions are accidental, their impact can be significant, particularly in regions where limited redundancy exists.

Second, restoration and repair timelines are increasing in some regions, often due to complex permitting processes, fragmented regulatory frameworks, the limited availability of repair vessels, and operational constraints. These delays can significantly extend the duration of service outages and increase the economic impact of cable failures.

Third, geographical concentration of infrastructure creates systemic vulnerabilities. A substantial share of global traffic passes through a limited number of maritime chokepoints and major cable corridors. Disruptions in these areas can therefore affect connectivity across multiple regions simultaneously.

Fourth, many countries – particularly small island developing States (SIDS), Least Developed Countries (LDCs), and other underserved regions – remain highly dependent on a small number of cable systems. This makes them particularly vulnerable to connectivity disruptions.

Fifth, changing weather patterns and environmental pressures are emerging as important risk factors, affecting coastal landing infrastructure, seabed stability, and long-term network planning.

Finally, the Working Groups found that submarine cable resilience depends on a complex ecosystem of stakeholders. This system includes governments, regulators, cable owners and operators, maritime authorities, development finance institutions, research organizations and international bodies. Effective resilience strategies therefore require coordinated multi-stakeholder cooperation.

CROSS-CUTTING THEMES EMERGING FROM THE THREE WORKING GROUPS

Although each Working Group examined different aspects of submarine cable resilience, several common themes emerged from their work.

1. Strengthened coordination between governments and industry

Effective protection, deployment and repair of submarine cables requires close cooperation between public authorities and private sector operators. Many of the challenges identified, including permitting delays, information gaps and incident response coordination, can be addressed through stronger institutional mechanisms for dialogue and collaboration.

2. Streamlined regulatory and permitting processes

Timely deployment of new cable systems and rapid repair of damaged infrastructure are critical to maintaining global connectivity. Opportunities exist for governments to improve regulatory efficiency through clearer procedures, improved inter-agency coordination, and more predictable permitting frameworks.

3. Improved risk identification and monitoring

A proactive approach to risk management is essential. Advances in monitoring technologies, improved data sharing, enhanced seabed mapping and better reporting of cable incidents can help stakeholders anticipate risks and respond more effectively.

4. Greater route diversity and infrastructure redundancy

Increasing geographic diversity of submarine cable routes is a key element of long-term resilience. Diversification reduces reliance on heavily-trafficked corridors and chokepoints and helps ensure continuity of connectivity during disruptions.

5. Strengthening preparedness and response capabilities

Effective response to cable disruptions depends on operational readiness across multiple actors. This includes access to repair vessels and specialized equipment, clear emergency procedures and strong coordination between governments, operators and maritime authorities.

6. Addressing the needs of vulnerable regions

Many developing countries, particularly SIDS and geographically isolated states, face structural challenges in achieving resilient connectivity. Targeted policy support, innovative financing models, regional cooperation and capacity-building initiatives are essential.

7. Integrating climate and environmental considerations

Changing weather patterns and environmental conditions are increasingly shaping the risk environment for submarine cables. Long-term resilience strategies must integrate climate risk assessments, environmentally responsible deployment practices and adaptive infrastructure planning.

OVERVIEW OF THE WORK CARRIED OUT BY THE THREE WORKING GROUPS

Building on the mandate of the IAB, the three Working Groups conducted analytical and consultative work across the technical, operational, regulatory, environmental and economic dimensions of submarine cable resilience.

Through a combination of expert consultations, exchange of operational experience and review of existing frameworks and practices, the Working Groups developed a set of action-oriented recommendations to address the challenges identified and strengthen the resilience of the submarine cable infrastructure, worldwide.

The recommendations reflect a multi-stakeholder perspective and aim to support improved coordination, enhanced risk management and more resilient connectivity across regions.

Further details on the composition, methodology and outputs of the Working Groups are provided in Chapter 5 and Annex B and C.

OVERVIEW OF RECOMMENDATIONS

Based on their analysis, the three Working Groups developed a comprehensive set of recommendations aimed at strengthening submarine cable resilience across the technical, operational, regulatory, and investment dimensions.

These recommendations include:

- Strengthening mechanisms for risk identification, monitoring and incident response.
- Promoting greater route diversity and redundancy in global cable networks.
- Enhancing cooperation between governments, industry and international organizations.
- Supporting investment and financing mechanisms for resilient infrastructure.
- Building capacity and technical expertise, particularly in developing countries and vulnerable regions.
- Strengthening the protection of submarine cable infrastructure within broader critical infrastructure frameworks.

Detailed recommendations developed by the three Working Groups are presented in the respective sections of this report.

Taken together, these recommendations provide governments, regulators, industry stakeholders and development partners with a practical framework to strengthen submarine cable resilience and ensure the continued reliability of global connectivity infrastructure.

Kent Bressie
Co-Secretary
Legal Adviser
International Cable Protection Committee

Tomas Lamanauskas
Co-Secretary
Deputy Secretary-General
International Telecommunication Union

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1. INTRODUCTION

MANDATE AND CREATION OF THE INTERNATIONAL ADVISORY BODY ON SUBMARINE CABLE RESILIENCE (IAB)

Submarine telecommunications cables have underpinned international connectivity for more than a century and a half. The first submarine telegraph cable was laid in 1850 between Dover in England and Cap Gris-Nez in France. Although this initial attempt failed within days, a successful cable installed in 1851 marked the beginning of sustained, international submarine communications.

With this background, the IAB was established in 2024, pursuant to agreed Terms of Reference (see Chapter 5). Its aim is to support global efforts to strengthen the resilience and sustainability of the submarine telecommunications cable infrastructure.

Recognizing the critical role that submarine cables play in enabling international connectivity, digital transformation and economic development, the IAB brings together senior experts from governments, industry, international organizations, academia, and other relevant stakeholder communities. Its objective is to provide forward-looking advice and practical recommendations to enhance international cooperation, policy coordination and operational preparedness.

The Advisory Body serves a two-year term, starting in November 2024, and is co-chaired by:

- H.E. Minister Bosun Tijani, Minister of Communications, Innovation and Digital Economy of the Federal Republic of Nigeria
- Prof. Sandra Maximiano, Chair of the Board of Directors of ANACOM, Portugal

The full list of members is provided in Annex B.

Members were selected on the basis of expertise and leadership in areas such as submarine cable technology and markets, telecommunications policy, law and digital infrastructure. Selection criteria also included geographical and gender diversity, balanced representation of public and private sector perspectives, and demonstrated commitment to the Advisory Body's mission.

Five intergovernmental organizations, or their units, participated in the work of the Body in a consultative capacity:

- The United Nations, through its Division for Ocean Affairs and the Law of the Sea. Office of Legal Affairs (UNDOALOS)
- The Food and Agriculture Organization (FAO)
- The International Maritime Organization (IMO)
- The United Nations Institute for Disarmament Research (UNIDIR)
- The United Nations Office on Drugs and Crime (UNODC).

WORKING GROUPS AND OUTPUTS

In May 2025, the Advisory Body established three Working Groups to address key dimensions of submarine cable resilience:

- WG1: Timely deployment and repair

  Co-facilitators:

  - Mr Zhiguo Zhao, Leading Expert on Submarine Cables, Ministry of Industry and Information Technology, **China**
  - Mr Kevin Adams, Director, Digital Infrastructure, Department of Science, Innovation and Technology, **United Kingdom.**

- WG2: Risk identification, monitoring and mitigation

  Co-facilitators:

  - Ms Nonkqubela Thathakahle Jordan-Dyani, Director-General of the Department of Communications and Digital Technologies, **South Africa**
  - Mr Andy Palmer-Felgate, Vice President of **North American Submarine Cable Association**-NASCA.

- WG3: Fostering connectivity and geographical diversity

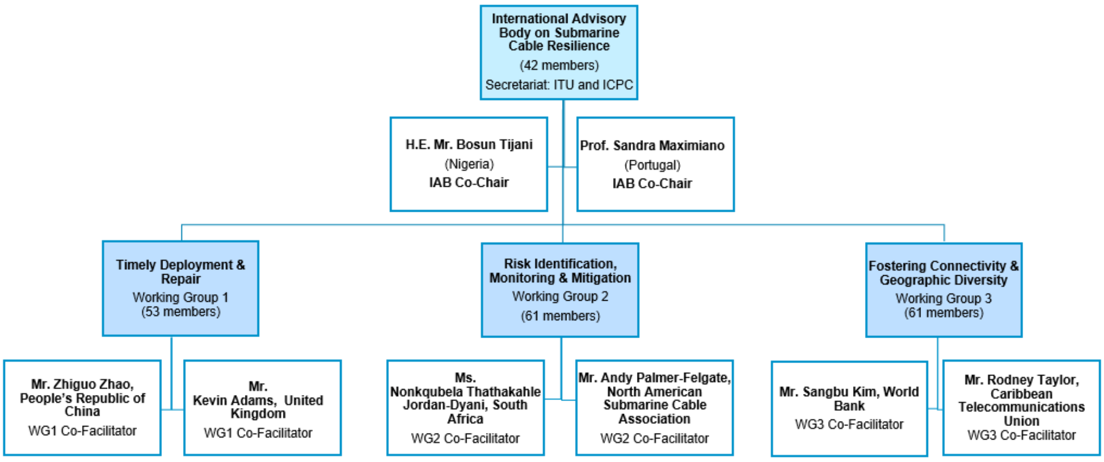
  Co-facilitators:

  - Mr Sangbu Kim, VP Digital & AI at the **World Bank**
  - Mr Rodney Taylor, Secretary-General – **Caribbean Telecommunications Union** (CTU).

The Working Groups brought together more than 175 expert participants nominated by governments, industry, academia, and international organizations from different regions of the world.

Through thematic analysis, consultations and exchange of operational experience, the Working Groups developed action-oriented recommendations aimed at enhancing the resilience of submarine cable infrastructure worldwide. These recommendations were endorsed by IAB members on 2 February 2026. Explanatory reports providing further detail on the recommendations and relevant good practices were subsequently approved on 10 July 2026, as further described in Chapter 3.

International Advisory Body for Submarine Cable Resilience



METHODOLOGY OF THE WORKING GROUPS

The three Working Groups conducted their work through a combination of virtual meetings, written consultations, and exchanges among members and external stakeholders. Their analyses drew on existing studies, operational experience, policy frameworks, and practical examples from different regions.

Each Working Group identified priority themes within its mandate, examined key challenges and good practices, and developed recommendations aimed at strengthening submarine cable resilience. While approaches were adapted to the specific focus of each group, efforts were made to ensure a broadly consistent analytical logic and to facilitate coherence across outputs.

This collaborative and evidence-informed process enabled the Working Groups to reflect a diversity of perspectives while advancing areas of emerging convergence.

INTERNATIONAL DIALOGUE AND MILESTONES

The work of the Advisory Body has been supported by a series of international engagements.

In February 2025, the International Submarine Cable Resilience Summit was held in Abuja, Nigeria. This marked the first in-person gathering of IAB members and facilitated dialogue across governments, industry, and international organizations. The meeting concluded with a Summit Declaration (see Chapter 4) outlining commitments and priority actions.

A second summit was convened in February 2026 in Porto, Portugal, hosted by the National Authority for Communications (ANACOM) and jointly organized by ITU and the International Cable Protection Committee (ICPC). With participation from more than 350 stakeholders from over 70 countries, the event reaffirmed the importance of strengthening international cooperation to protect submarine cable infrastructure. It also endorsed a set of recommendations developed by the IAB.

The event concluded with a Declaration, offering guidance to bolster international cooperation across the public and private sectors to boost the resilience of this vital shared infrastructure (see Chapter 4).

Each year, the United Nations General Assembly adopts an updated omnibus resolution on Oceans and the Law of the Sea, reaffirming earlier annual texts and addressing new developments. In its latest, Resolution 80/110 of 9 December 2025,[1] the ITU Advisory Body and its 3 Working Groups were specifically mentioned:

> "[The General Assembly] notes the ongoing work of the International Advisory Body for Submarine Cable Resilience, established in November 2024 by the International Telecommunication Union in partnership with the International Cable Protection Committee, whose objective is to serve as a platform for international multi-stakeholder collaboration to identify, develop and promote government and industry best practices for submarine cable resilience, and invites States to share their views on the various aspects of this topic with the Advisory Body and its three working groups;"

THE ROLE OF ITU

ITU has been fostering international cooperation on connectivity infrastructure since the 19th century, starting soon after the very first subsea cables were laid in the 1850s. Today, one quarter of the world remains unconnected. As the United Nations agency for digital technologies, ITU facilitates international connectivity in communication networks and works to close the digital divide.

For ITU, the stability of the global communications infrastructure is essential. The world's interconnected digital ecosystems cannot function without resilience. In addition, ITU provides a platform for governments, regulators, and industry stakeholders to collaborate and set international standards for telecommunications infrastructure, including cables.

Submarine cables are an essential piece of connectivity and are built on ITU standards, which were developed by ITU's Standardization Sector, specifically Study Group 15. These standards have enabled the capacity of optical networks to grow by an average of 40 per cent per year for the past 40 years.

ITU has also issued specific guidance on reliability (resilience against failures) under its design guidelines for submarine cable systems. ITU standard G.979, for instance, specifically addresses monitoring systems for submarine cable systems.

In addition to standards, the work of ITU on emergency telecommunications – both in supporting the development of national telecommunication development plans, as well as providing specific communications' support in the operation of networks – makes an impact and plays a key role when critical infrastructure like subsea cables face disruption.

1 See United Nations General Assembly, *Resolution adopted by the General Assembly on 9 December 2025, 80/110 Oceans and the law of the sea*, United Nations, https://docs.un.org/en/A/RES/80/110 (accessed 7 July 2026).

Finally, ITU is instrumental in fostering international dialogue and partnerships, helping nations align policies and share resources in efforts to enhance the security and resilience of submarine cables. This includes capacity building initiatives to ensure that countries and regions, especially developing countries, can effectively manage and protect their networks.

THE ROLE OF THE ICPC

Founded in 1958, the ICPC is the world's leading non-governmental organization promoting submarine cable protection and resilience. It has more than 270 members from more than 75 nations, including cable operators, owners, manufacturers, and industry service providers, as well as government observers. As a non-governmental organization, the ICPC works with its members, governments, international organizations, other marine industries, and the scientific community on a number of key initiatives:

- It works to identify and mitigate risks of natural and human damage to cables, maintaining the leading global database of cable faults and cable repair timeframes.
- It develops technical and operating recommendations for the submarine cable industry that cover the entire cable project lifecycle.
- It promotes best practices for industry and governments, including its *Government Best Practices for Protecting and Promoting Resilience of Submarine Telecommunications Cables*, first launched in 2021 and regularly updated.
- It promotes peer-reviewed scientific research regarding cables in the marine environment, including the landmark 2025 report, *Submarine cables and marine biodiversity,* UNEP-WCMC and ICPC (2025).
- It promotes the rule of law for the oceans, participating in the work of the International Law Association Committee on Submarine Cables and Pipelines and providing faculty and writing competition sponsorship for the Rhodes Academy of Oceans Law and Policy.
- It represents submarine cable interests in a wide variety of regional and multilateral processes, including the International Seabed Authority, the Conference of Parties of the United Nations Convention on the Law of the Sea, and the Biodiversity Beyond National Jurisdictions (BBNJ) treaty processes, many U.N. agencies (including but not limited to ITU), and the International Hydrographic Organization.

2. SUMMARY OF RECOMMENDATIONS

OBJECTIVES OF THE PUBLICATION

This publication presents the outcomes of the work undertaken by the IAB in highlighting the key challenges affecting submarine cable resilience, identifying good practices, and proposing recommendations to enhance coordination, policy frameworks, and operational preparedness at the national, regional, and international levels.

In line with its mandate, the IAB established three Working Groups focusing on distinct, but interrelated dimensions of submarine cable resilience. These Working Groups brought together approximately 165 experts from a wide range of institutions, including national administrations, regional and international organizations, submarine cable operators and suppliers, industry associations, financial institutions, research and academic bodies, and other relevant stakeholders from different regions of the world.

Through consultations, thematic analyses, and exchanges of experience, the Working Groups examined issues related to deployment and repair processes, protection and resilience measures, and investment and connectivity considerations. The findings and recommendations developed by the Working Groups form the core of this publication and reflect a collaborative and multi-stakeholder effort to support more robust and resilient global connectivity.

3. WORKING GROUP REPORTS

WORKING GROUP REPORT 1: TIMELY DEPLOYMENT AND REPAIR

RECOMMENDATIONS[2]

WORKING GROUP 1
TIMELY DEPLOYMENT & REPAIR

	Streamline Permitting, Approval and Regulation
1	**Encourage governments to streamline permitting and regulatory processes** to reduce cable deployment and repair timelines, including: (a) establishing transparent and predictable permitting frameworks (e.g., by publishing i. clear guidelines on permitting requirements and permitting timelines, and ii. Information on the regulatory bodies and application/permitting documents necessary for installation and repair); (b) reducing regulatory barriers (e.g., by, where permitted by national laws, facilitating customs clearance and cabotage procedures, removing or exempting customs duties, allowing pre-clearance of ship and crew, ensuring emergency repairs can proceed expeditiously, etc.); and (c) designating a government body to be the Single Point of Contact (''SPOC''), where permitted by national laws, to facilitate coordination across government agencies.
2	**A voluntary database or directory indicating countries' SPOCs** to provide the industry with a centralized and definitive point of reference who can communicate permitting requirements and timelines.
3	**Encourage the utilization of existing regional forums or, where permissible, intergovernmental cooperation frameworks, and foster new ones if none already exist (e.g., an industry regional cable protection committee or CPC in Asia),** to discuss submarine cable resilience to support local cooperation and promote regulatory alignment. This would help mitigate against operators having to navigate differing regulatory requirements across the region. As part of this, encourage government engagement with regional submarine cable associations and ICPC best practices.
	Strengthen Global Repair Architecture
4	**Encourage the creation or expansion of incentives to expand repair assets from a diversity of companies and countries** (that consider vessels and spare parts) which may also help address needs in high-risk or remote areas and to reduce mobilization time for emergency repairs. This could include removal of regulatory barriers as referenced in recommendation 1.

[2] The wording of these recommendations is as it was approved in the original document, unedited.

(continued)

5	**Consider establishing plans for shallow-water rapid-response units**: To have plans in hand for using small modular teams with lightweight gear and shallow-water remotely operated vehicles (ROVs) for near-shore incidents.
6	**Promote mutual assistance and shared infrastructure models:** Continue to strengthen maintenance-zone and private-agreement cooperation for shared vessels and spare pooling where feasible under the commercial arrangement. Encourage jointly funded/multi-contracted vessels based at critical hubs which may also help address needs in regions with insufficient repair resources.
7	**Global Repair Asset Optimization Framework (GRAOF)**: Encourage industry associations to map global coverage gaps to help clarify where repair resource shortfalls exist and to support investment decisions. Encourage cable owners and cable repair & maintenance companies to promote long-term maintenance contracts, joint vessel funding, and encourage public–private partnerships (PPPs) maintenance hubs in underserved regions.
8	**Encourage maintenance agreements to collaborate on industry best practices (**e.g., through ICPC Recommendations for repair best practices on topics such as safety, proximity, coordination, etc.), to support an effective approach to cable repair/maintenance.
9	**Encourage training & knowledge platforms**: Encourage the development of training opportunities (for jointing, deep-sea operations, ROV, HSE or (Health, Safety and Environment) and cable engineering) and contribute to existing digital repositories for best practices.
	Strengthen Public-Private Partnership and Regional Cooperation
10	**Encourage voluntary data sharing:** Encourage governments, industry and regional organizations to share best practices. This should leverage existing mechanisms where possible, e.g. existing ICPC efforts for data sharing between industry and governments.
11	**Encourage national public-private cooperation mechanisms (e.g., fora/platforms/committees)** between competent authorities and cable owners/operators to support predictable coordination for deployment, protection and repair, including to: **(a)** maintain a designated "single front door" interface for operational coordination (aligned with national arrangements e.g. the designated SPOC as per recommendation 1); **(b)** maintain validated 24/7 contact lists and escalation paths; **(c)** support periodic multi-stakeholder exercises and post-incident learning; and **(d)** maintain a light set of practical artefacts (notification templates, decision pathways, agreed evidence packs)

*Any reference to "national" or "government" is understood to extend to regional economic integration organizations (REIOs) within their respective area of competence.

CHAPTER 1: SUBMARINE CABLE DEPLOYMENT AND REPAIR: CURRENT STATUS

In January 2022, a volcanic eruption struck Tonga, severing the country's only submarine cable. For weeks, the nation was left almost entirely offline, as Tonga's remote location, the limited availability of ships, and hazardous conditions caused delays in repair. The incident highlighted the fragility of single-cable dependencies and the profound societal and economic consequences of prolonged outages.

Speed in both cable deployment and repair is therefore strategically vital. Fast deployment ensures redundancy and extends coverage to underserved regions, while rapid fault localization and vessel mobilization are essential in minimizing downtime during repairs.

In today's interconnected world, speed is no longer a luxury; it is a necessity in safeguarding the digital backbone of the modern global economy.

1.1 DEPLOYMENT AND REPAIR TIMELINES

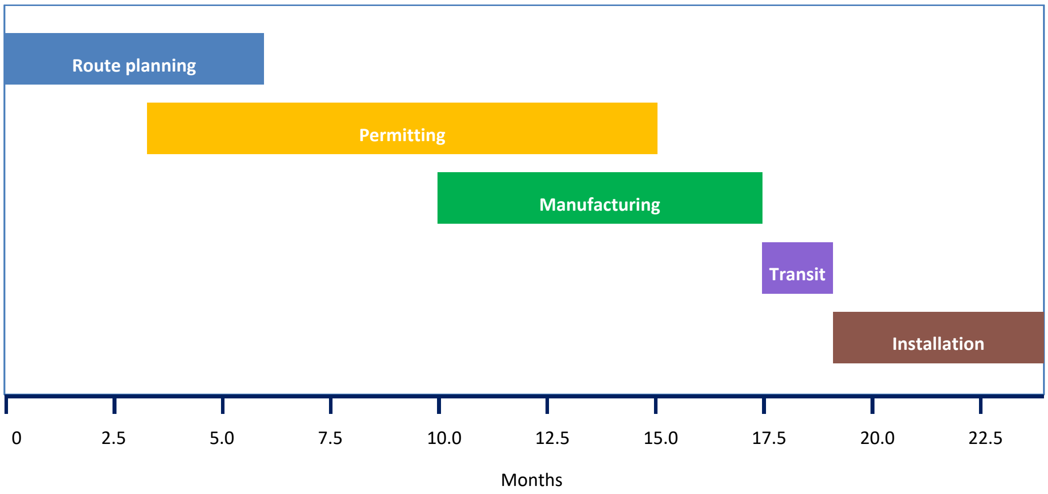
The deployment timeline

The complexity of cable deployment varies significantly according to topology, ownership structure, and geography. A simple point-to-point cable between two countries is far less complex than a multi-branch system with multiple cable landings. Similarly, deployments by a single owner are more straightforward than consortium-led projects, which require aligning diverse stakeholder interests through a contract management agreement (CMA). Regulatory environments also play a key role: for instance, laying a cable in the Mediterranean, which is bordered by numerous countries with overlapping territorial waters and exclusive economic zones (EEZs), is considerably more complex administratively than a long-haul route across the Pacific from Japan to the United States. In the latter case, fewer jurisdictions means that the permitting processes is more streamlined, despite the greater distance.

As a general guideline, the deployment time for a transoceanic cable can be around 30 months or less. For a cable connecting an archipelago to its mainland, the timeline is around 16-24 months, depending on the length. Festoon cables may fall within this latter scenario.[3] Figure 1 is a schematic representation of the different stages of a typical project timeline.

[3] Festoon subsea cable systems are typically networks of shorter individual cables connecting multiple islands or population centres along a coastline.

Figure 1: Transoceanic cable deployment timeline (months)



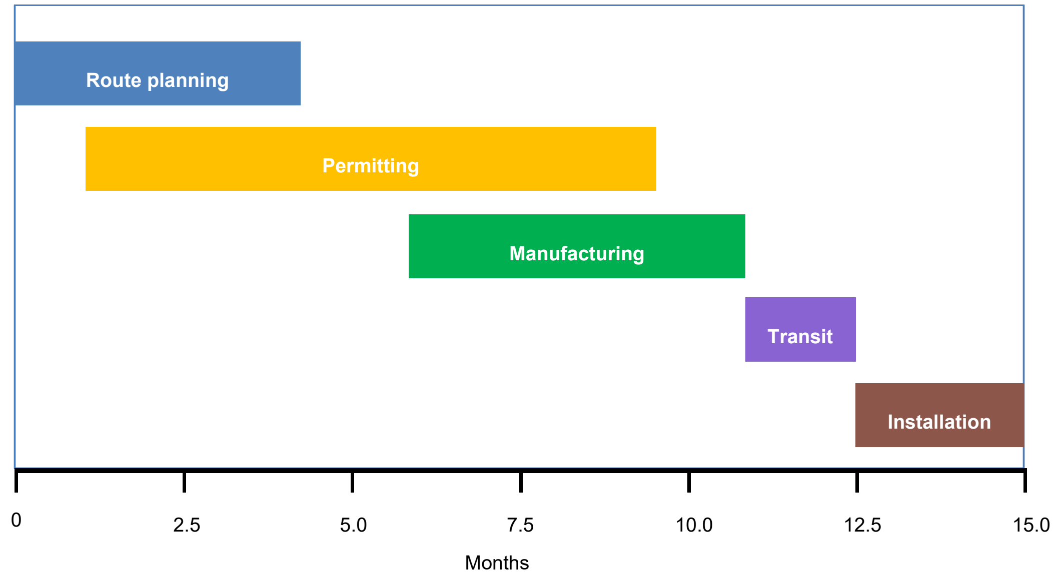
Source: Telxius

Timeline key:

- **Route planning**: This is a period of between 3 and 6 months. The final route is decided based on a suitability survey of the potential routes.
- **Permitting**: This period averages between 6 and 12 months. This is the longest and most critical phase. It is often prolonged by factors such as restrictive policies, protectionist measures, lack of transparency and regulatory predictability, fragmented jurisdictional requirements, and delays in inter-agency coordination. In some projects, the permitting period can even extend to almost the end of the installation.
- **Manufacturing:** This period is usually between 6 and 9 months. Once the route design is finalized, the types of cable to be used and the length in kilometres of each type are adjusted to the final route. The cable that has been assessed as necessary for the installation can also be manufactured, along with any spare parts for the final system, repeaters and/or branching units, or other optical elements that are within the system architecture.
- **Transit:** This stage usually takes between 1 and 2 months. This potentially includes the transit time from the installation ship to the factory, or an intermediate warehouse. It also includes the time taken loading the already manufactured system, then loading the system into the ship's tanks, then the navigation time to the point where the submarine cable laying will begin. The transit time is highly dependent on both the location where the cable system is loaded and the location of the project itself.
- **Installation:** Depending on the length of the system, a period of between 3 and 6 months is indicated. The installation time includes both the installation of the cable at the moorings and its laying in the ocean. The landing installation can also be separated from the laying of the cable route at sea, if deemed necessary. The period of time spent on this stage will also be influenced by the work schedules of the installation vessels, and/or by any special characteristics of the landing that require a specific vessel.

For non-transoceanic cables, the timeline in Figure 2 is suggested.

Figure 2: Non-transoceanic cable deployment timeline (months)



Source: Telxius

Timeline key:

This timeline contains the same general deployment phases:

- **Route planning:** A period of 4 months.
- **Permitting:** A period of 8 months.
- **Manufacturing:** A period of 5 months.
- **Transit:** A period of between 1 and 2 months.
- **Installation:** A period of 2 months.

Key bottlenecks

Many factors may introduce additional delays into the project timeline. Table 1 sets out some of the most common.

Table 1: Key bottlenecks in submarine cable deployment

Category	Key factors that can introduce delays	Estimated time impact (months)
Regulatory and permitting delays	• Obtaining landing rights and environmental approvals can take 6-12 months or more. • Differences between national and international regulations create incompatibilities. • Multilateral processes in areas with multiple jurisdictions, such as the Mediterranean and South-east Asia, add complexity.	6-12+ months
Geopolitical and security restrictions	• Tensions between countries that can block strategic routes. • Restrictions in sensitive territorial waters or military zones.	Variable (0-6+ months)

Table 1: Key bottlenecks in submarine cable deployment (continued)

Category	Key factors that can introduce delays	Estimated time impact (months)
Manufacturing constraints	• Limited capacity in cable and repeater factories. • High simultaneous demand for global projects creating extended lead times.	3-6 months
Logistical challenges	• Limited availability of installation vessels. • Adverse weather conditions, such as monsoon seasons and hurricanes.	1-3 months
Landing requirements	• Horizontal directional drilling (HDD) in shore ends where traditional landing techniques may be impractical. This can introduce lengthy permitting delays and be expensive and complex, depending on the geology and environmental approach taken towards palliative measures.	From 6 months onwards
Environmental and social impact assessments	• Lengthy environmental impact studies are sometimes required in certain jurisdictions. • Requirements to protect marine ecosystems and comply with local regulations. • Archaeological studies.	3-6 months
Coordination among multiple stakeholders	• Consortia with divergent interests delay decision-making. • Lack of alignment between governments,[4] operators, and international bodies.	2-4 months

The repair timeline

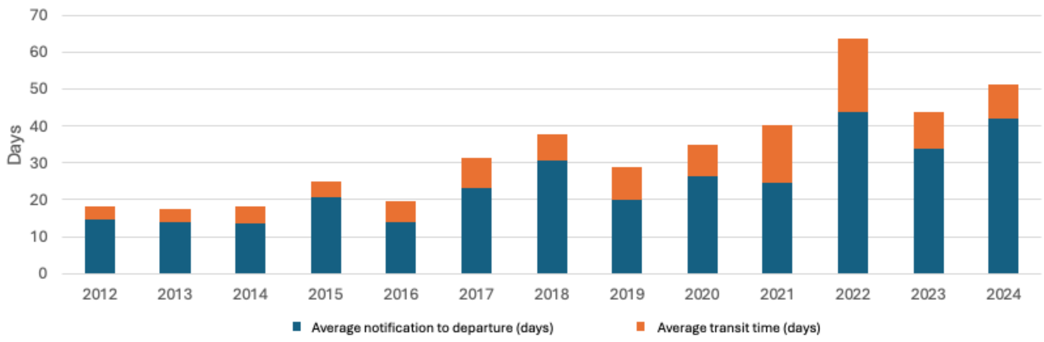
In recent years, the number of repairs per year and the number of repair vessels available have both remained stable, according to the ICPC.[5] However, between 2012 and 2024, the average repair response time more than doubled, from less than 20 days to more than 50 days (see Figure 3).

Response times also vary according to geography. The areas with the highest frequency of repairs are in East Asia, Europe and North America. It should be noted that a high occurrence of repairs can increase the time it takes to serve each of them, if repair queues start to form.

[4] Any reference to “national” or “government” is understood to extend to regional economic integration organizations (REIOs) within their respective area of competence. Any reference to "governments" or "states" is otherwise intended to refer to individual governments or states.

[5] See the *ICPC Plenary Global Repair Report*, ICPC, April 2025 for data up to 2024. This is updated annually and the latest annual report is available on request from the ICPC by e mailing: icpcinfo@iscpc.org

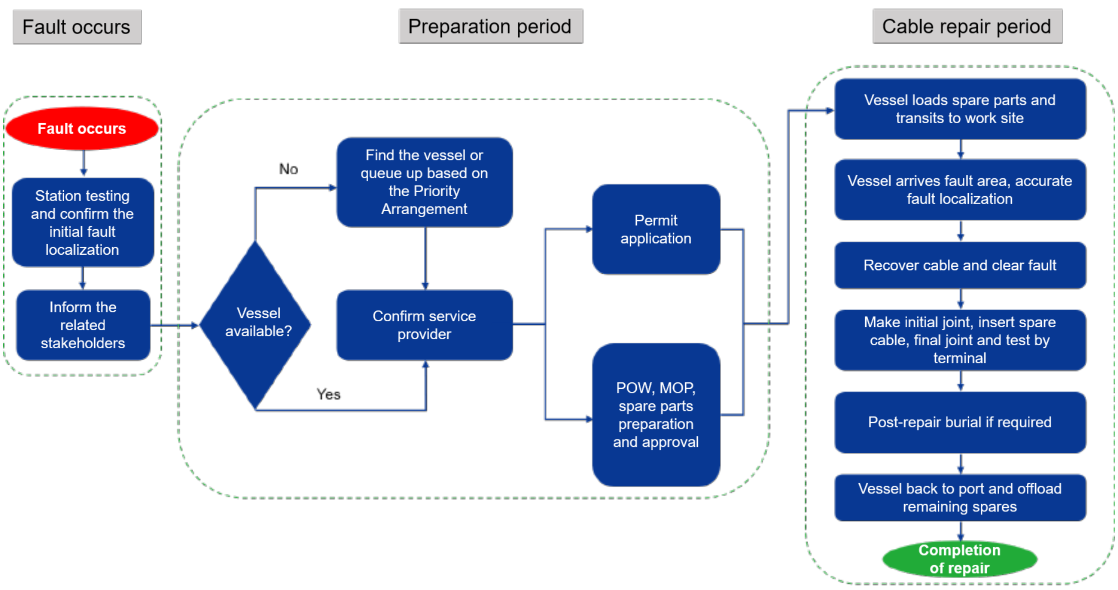
Figure 3: Global mean response time to commence repair, 2012-2024



Source: ICPC

Similar to cable deployment, the cable repair process is also intricate, requiring coordination across multiple stages. To optimize repair efficiency, an understanding of critical pathways and typical bottlenecks is key. Figure 4 represents the usual repair process schematically.

Figure 4: The typical cable repair process: From fault occurrence to repair completion



Source: S.B. Submarine Systems.

Note: MOP = method of procedure; POW = plan of work

The repair process can be broken down further into the following phases:

Phase 1: Fault detection and initial localization

Faults fall into a few main categories, such as shunt faults, fibre or cable breaks, and open cable faults. These are typically identified using optical time domain reflectometer (OTDR) and power-feeding equipment tests.

The key points to note during this phase are:

- Accurate localization at landing stations and network operations centres (NOCs) reduces search time offshore and ensures the correct spares are loaded.

- Shunt and open faults, especially in branched systems, can be difficult to locate precisely, sometimes leaving kilometre-scale uncertainty.
- The quality of this phase depends heavily on staff expertise and test procedures.

This phase has a typical duration of 1-3 days, depending on the complexity of the system and the experience available.

Phase 2: Vessel mobilization and dispatch

The maintenance provider checks vessel availability, prepares a plan of work and a list of spares, and obtains the necessary approvals.

The main bottlenecks in this phase are:

- Scheduling and prioritization when several faults compete for a limited number of ships.
- Permits (coastal state, port and environmental) and customs clearance for spares, which can significantly delay departure.

The mobilization phase for this phase typically takes 3-5 days, although it can be longer, depending on the logistical complexities involved and the permit lead time.

Phase 3: Transit to fault site

Transit time is driven almost entirely by the geographical positioning of vessels. This explains why outages in some regions last much longer than the on-site repair itself.

The key points to note regarding this phase are:

- In well-served regions with pre-positioned ships, transit may be only 1-3 days.
- In remote or under-served areas, transit alone can exceed 10 days.

The transit phase typically ranges between 2 and 5 days, depending on the vessel's proximity to the fault.

Example: Due to limited resources, there is only one permanent and wholly dedicated cable repair vessel in the whole of Africa. As this is positioned at Cape Town, if a cable fault occurs in the northern part of the continent, the transit will take more than 10 days, regardless of whether the fault is on the east or west coast.

Phase 4: Cable recovery and fault clearance

On site, the ship must locate and recover the cable section containing the fault, then remove the damaged portions.

During this phase, the key challenges are:

- Deep burial or difficult seabed terrain can require multiple grapnel or ROV operations.
- Deep-water repairs – those at depths greater than 5 000 metres – are very rare, accounting for less than 5 per cent of the total. Yet, when they do occur, they are time-consuming and high-risk, with each recovery cycle potentially taking many hours.

- Seismological events can both damage and displace cables, complicating recovery.

In straightforward shallow-water cases, this phase can be completed within hours. Yet, in complex deep-water, cable congested areas or following seismological events, this phase can extend to several days.

Example: On 11 March 2011, a cable fault off the south-east coast of Japan was caused by the '3/11' mega-earthquake. The fault was located in deep water in a cable congestion area and was likely buried by the earthquake. In the end, it took more than 10 days for the repair vessel to recover the cable. In addition, 42 kilometres of cable plus one repeater had to be abandoned on the seabed.

Phase 5: Jointing and splicing

Once the cable has been recovered and the fault cleared, the next step is to joint and splice the cable. This phase requires high precision and must be performed by well-trained and experienced people. It may also be impacted by environmental conditions, such as the sea state and bad weather.

The key challenges during this phase are:

- Cable jointers are highly trained personnel and need to be pre-qualified before they can undertake their work. They also need to professionally requalify every two years. In addition, even in periods of low activity, cable jointers have to continually practice their skills, or risk losing them.
- The time taken in testing during the jointing operation will also have a significant impact on the duration of the jointing time. Testing during the final splicing phase can be especially time consuming.
- In recent years, the development of high fibre count (HFC) and multi-core fibre (MCF) cable has also increased the time it takes to complete cable jointing. This is especially so regarding HFC cable.
- The cable jointing operation is a sensitive operation which requires good and stable environmental conditions. Each joint requires the repair ship to keep stationary for 24 hours or more, so a suitable weather window is needed to start the cable jointing operation.

The typical duration of this phase is between 1 and 3 days, but adverse weather can delay splicing efforts.

Phase 6: Redeployment and burial

After jointing and splicing, an ROV is used to redeploy and bury the cable. This is done in order to protect it from external threats, such as fishing gear or anchors. Where there is a harder sea bed and a plough can adequately bury the cable, an ROV may not be necessary, however. In such cases, further protection methods may be required, such as rock installation and mattresses. A guard boat is also usually required to be on station until further protection is completed.

This phase typical lasts 1-2 days.

Phase 7: Testing and service restoration

After the cable has been re-deployed, a final test is conducted to ensure signal integrity. If all systems are operational, service is restored. This phase can also be combined with the post-repair burial operation and typically takes less than 1 day, unless there is a power continuity issue.

The above breakdown of the repair process reveals that the most time-consuming steps are vessel mobilization, transit, jointing, and deepwater cable recovery. These phases present the most significant opportunities for improving repair efficiency. In these, too, the accuracy of cable fault localization plays an important role.

1.2 STAKEHOLDERS AND THEIR ROLE IN CABLE DEPLOYMENT AND REPAIR

As Table 2 outlines, a wide variety of stakeholders exists in the submarine cable ecosystem, each with its own particular role and dynamics.

Table 2: Stakeholders, roles, and dynamics in the submarine cable ecosystem

Stakeholder	Role	Interests	Influence	Potential conflicts
Governments	Define national telecom, regulatory and other relevant policies. Grant landing rights and regulate territorial waters.	Protect national jurisdiction and critical infrastructure. Control access to data and communications.	Can delay or block cable projects for strategic reasons. Can influence cable routes and landing station locations.	Geopolitical tensions over cable routes. Conflicts between commercial interests and national policies.
Regulators	Enforce technical, environmental, and telecom regulations. Issue licenses and monitor compliance.	Ensure fair competition and service quality. Protect marine environments.	Shape technical standards and operational requirements. Can impose conditions on cable deployment and operation.	Regulatory delays. Incompatibility between national and international standards.
Cable owners	Finance and own the cable infrastructure. Often organized as consortia of telecom operators or private firms.	Maximize return on investment. Maintain control over capacity and traffic.	Decide on cable routes, technologies, and partnerships. Influence maintenance and upgrade strategies.	Disputes among consortium members. Tensions with governments or local operators.

Table 2: Stakeholders, roles, and dynamics in the submarine cable ecosystem (continued)

Stakeholder	Role	Interests	Influence	Potential conflicts
Cable operators	Manage day-to-day operations and service delivery. Monitor performance and coordinate maintenance.	Ensure service continuity and reliability. Optimize traffic and operational efficiency.	Prioritize repairs and upgrades. Influence technical and commercial decisions.	Divergence from owners' strategic goals. Regulatory or governmental pressure over data access.
Installation vessels	Deploy and install submarine cables on the seabed. Handle complex marine operations during initial deployment and upgrades.	Ensure precise and timely installation.	Critical for project timelines and technical success. Can affect route feasibility and cost structure.	Weather or geopolitical restrictions delaying operations. Coordination issues with cable owners and regulators. Limited availability also impacts installation fleet.
Repair vessels	Conduct physical repairs on the seabed. Operate under regional maintenance agreements.	Efficient and timely response to faults. Access to affected areas without delay.	Prioritize repairs based on commercial agreements. Depend on governmental permissions for access.	Restricted access in sensitive maritime zones. Limited availability during multiple simultaneous faults.
International organizations	Bodies such as the International Telecommunication Union (ITU) and ICPC set global cable recommendations and promote cooperation.	Foster global connectivity and resilience. Protect marine ecosystems and infrastructure.	Promote best practices and technical harmonization.	Limited enforcement power. Conflicts between international norms and national laws.

CHAPTER 2: STREAMLINING PERMITTING, APPROVAL, AND REGULATION FOR DEPLOYMENT AND REPAIR

The resilience of the submarine cable network – the backbone of global digital connectivity – is not only undermined by physical threats, but also by a complex and often fragmented regulatory landscape. Indeed, regulatory processes for cable deployment and – most critically – repair are increasingly a source of significant delay, cost, and uncertainty.

This chapter analyses the permitting and regulatory barriers that impede the timely installation and maintenance of this critical infrastructure. It also explores the national considerations driving these regulations and provides actionable recommendations for creating a more efficient, predictable, and resilience-oriented framework.

2.1 THE GLOBAL REGULATORY LANDSCAPE: MULTI-JURISDICTIONAL AND MULTI-AGENCY CHALLENGES

The foremost challenge in regulating submarine cables is their inherent transboundary nature. A single cable project often spans thousands of kilometres, traversing the areas beyond national jurisdiction and crossing the maritime zones of numerous coastal states, each with its own distinct legal framework and domestic priorities.

The international legal regime governing submarine cables consists of different conventions and customary international law. These include the 1884 Convention and international law, as reflected in the 1982 United Nations Convention on the Law of the Sea (UNCLOS), which sets out the legal framework within which all activities in the oceans and seas must be carried out and is of strategic importance as the basis for national, regional and global action and cooperation in the marine sector. It is noted that UNCLOS prevails, as between States Parties, over the Geneva conventions on the Law of the Sea of 29 April 1958, among them the Convention on the High Seas and the Convention on the Continental Shelf. As of 30 June 2026, there were 172 States Parties to UNCLOS, including the European Union (EU). As to laying, maintenance and replacement of submarine cables, UNCLOS stipulates rights and obligations on States depending on the maritime zone in which cable-related activity is taking place. The maritime zones listed under UNCLOS are:

a. **Territorial seas**: Extending up to 12 nautical miles from the baseline, this is a zone of full sovereignty for a coastal State. Notwithstanding the fact that foreign vessels enjoy the right of innocent passage through such territorial seas, coastal States are authorized to impose conditions on any foreign vessels and infrastructure plying these territorial waters.

   Under Article 21 of UNCLOS (Laws and regulations of the coastal State relating to innocent passage), the coastal State may adopt laws and regulations, in conformity with the provisions of this Convention and other rules of international law, relating to innocent passage through the territorial sea, in respect, among other things, of the protection of cables […].

b. **Archipelagic waters:** The sovereignty of an archipelagic State extends to the waters enclosed by the archipelagic baselines, described as archipelagic waters, regardless of their depth or distance from the coast. This sovereignty extends to the air space over the archipelagic waters, as well as to their bed and subsoil, and the resources contained therein. An archipelagic State shall respect existing submarine cables laid by other States and passing through its waters without making a landfall. An archipelagic State shall permit the maintenance and replacement of such cables upon receiving due notice of their location and the intention to repair or replace them.

c. **Exclusive economic zones (EEZs):** In this zone, which may extend up to 200 nautical miles from the baselines from which the breadth of the territorial sea is measured, coastal States have sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters superjacent to the seabed and of the seabed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone. In the EEZ, all States, whether coastal or land-locked, enjoy, subject to the relevant provisions of UNCLOS, the freedoms referred to in Article 87 of UNCLOS (Freedom of the high seas) of navigation and overflight and of the laying of submarine cables and pipelines, and other internationally lawful uses of the sea related to these freedoms, such as those associated with the operation of ships, aircraft and submarine cables and pipelines, and compatible with the other provisions of UNCLOS.

d. **Continental shelf:** The continental shelf of a coastal State comprises the seabed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured where the outer edge of the continental margin does not extend up to that distance. The coastal State exercises over the continental shelf sovereign rights for the purpose of exploring it and exploiting its natural resources. All States are entitled to lay submarine cables and pipelines on the continental shelf. Subject to its right to take reasonable measures for the exploration of the continental shelf, the exploitation of its natural resources and the prevention, reduction and control of pollution from pipelines, the coastal State may not impede the laying or maintenance of such cables or pipelines. Nothing in the Part of UNCLOS on Continental Shelf affects the right of the coastal State to establish conditions for cables or pipelines entering its territory or territorial sea, or its jurisdiction over cables and pipelines constructed or used in connection with the exploration of its continental shelf or exploitation of its resources or the operations of artificial islands, installations and structures under its jurisdiction. When laying submarine cables or pipelines, States must have due regard to cables or pipelines already in position. In particular, possibilities of repairing existing cables or pipelines shall not be prejudiced.

e. **High seas:** These are all parts of the sea that are not included in the EEZ, in the territorial sea or in the internal waters of a State, or in the archipelagic waters of an archipelagic State. All States are entitled to lay submarine cables and pipelines on the bed of the high seas beyond the continental shelf. Every State has an obligation to adopt the laws and regulations necessary to provide that the breaking or injury by a ship flying its flag or by a person subject to its jurisdiction of a submarine cable beneath the high seas done wilfully or through culpable negligence, in such a manner as to be liable to interrupt or obstruct telegraphic or telephonic communications, and similarly the breaking or injury of a submarine pipeline or high-voltage power cable, shall be a punishable offence. This provision shall apply also to conduct calculated or likely to result in such breaking or injury. However, it shall not apply to any break or injury caused by persons who acted merely with the legitimate object of saving their lives or their ships, after having taken all necessary precautions to avoid such break or injury.

   Every State also has an obligation to adopt the laws and regulations necessary to provide that, if persons subject to its jurisdiction who are the owners of a submarine cable or pipeline beneath the high seas, in laying or repairing that cable or pipeline, cause a break in or injury to another cable or pipeline, they shall bear the cost of the repairs. Finally, every State has an obligation to adopt the laws and regulations necessary to ensure that the owners of ships who can prove that they have sacrificed an anchor, a net or any other fishing gear, in order to avoid injuring a submarine cable or pipeline, shall be indemnified by the owner of the cable or pipeline, provided that the owner of the ship has taken all reasonable precautionary measures beforehand.

While UNCLOS provides the overarching framework, the practical application of these rules may sometimes create friction in submarine cable activities. This is especially so when such activities conflict with coastal States' interests in their respective territorial seas and EEZs, or on continental shelves. This challenge can also be compounded by lack of coordination within the government of a coastal State. In such cases, a cable operator applying for permits may need to coordinate with a host of different domestic agencies, from telecommunications to maritime and port authorities. They may also need to comply with requirements from a variety of environmental protection agencies, defence or naval bodies, and customs departments. The consequences of this could include duplicate information requests, prolonged processes and unpredictable delays. These can all result in uncertainty for the operator's project planning and financing.

2.2 KEY REGULATORY BARRIERS DELAYING DEPLOYMENT AND REPAIR

Chapter 1 outlined how cable deployment and repair timelines have lengthened over the years. This is the result of various factors, such as regulatory barriers, supply chain and logistical constraints, technical challenges and coordination across multiple stakeholders. As outlined in Table 1, regulatory delays pose the most significant bottleneck in this process.

The following section looks in more detail at five key reasons for, and impacts of, regulatory delays.

a. **Prolonged timelines due to regulatory processes:** As mentioned above, data from the ICPC indicates that between 2012 and 2024, the average repair response time more than doubled, reaching over 50 days.[6] Given that repair volumes and the availability of repair vessels remained stable over the period, the key reason cited for this increase was regulatory, with hurdles including complex and lengthy permitting processes. In March 2024, for example, a pan-African telecom provider reported that approvals for repairs to its damaged submarine cable in the Red Sea could take up to 8 weeks – repairs that were subsequently completed in July 2024.[7] In October 2025, the European Subsea Cables Association (ESCA) and the International Marine Contractors Association (IMCA) therefore issued a joint statement warning that regulatory barriers, alongside a shortage of skilled workers and the absence of readily available technical solutions were undermining Europe's capacity to repair damaged subsea cables.[8]

b. **Restrictive policies and protectionist measures:** Some States apply policies to cable repair works that have been designed for other maritime industries, such as shipping or offshore energy. An example of this would be a cabotage policy that reserves coastal trade, such as cargo transport between domestic ports, for nationally flagged vessels. When such a policy is applied to highly specialized, foreign-flagged cable repair ships, time and resources may have to be spent in applying for an exemption or waiver, or even for the re-flagging of the vessel, in order for it to proceed with its repair work. Local crewing requirements and immigration controls, such as visa applications, are also sometimes imposed, introducing further delays. Finally, taxes and/or duties imposed on repair vessels, equipment, and spare parts add further friction and cost, hindering the rapid mobilization of repair vessels to carry out their work.

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6 The period went from less than 20 days in 2012 to more than 50 days in 2024, according to ICPC statistics from 2024 (see footnote 3 above).

7 See Swinhoe, D., "Subsea cable repairs in Houthi controlled waters in the Red Sea completed", *Data Centre Dynamics*, 25 June 2024, https://www.datacenterdynamics.com/en/news/subsea-cable-repairs-in-houthi-controlled-waters-in-the-red-sea-completed/ (accessed 27 May 2026).

8 See Grainger, I., "Critical undersea infrastructure at risk: Industry warns of repair gaps in Europe's digital and energy networks", IMCA, London, 11 August 2025, https://www.imca-int.com/news-events/imca-news/news/critical-undersea-infrastructure-at-risk-industry-warns-of-repair-gaps-in-europe-s-digital-and-energy-networks/ (accessed 27 May 2026).

c. **Lack of regulatory predictability:** Given that submarine cable systems are multi-year infrastructure projects involving significant amounts of investment, predictability is of paramount importance. Many regulatory environments are characterized by ambiguity, however. Operators sometimes face abrupt policy changes or undefined administrative processes that create uncertainty and risks for long-term project planning. In some jurisdictions, governments lack formalized permitting procedures for submarine cables, forcing operators into ad hoc negotiations for each deployment or repair.

d. **Lack of maritime spatial coordination:** According to the Organization for Economic Cooperation and Development (OECD) report, *The Ocean Economy in 2030,*[9] the ocean economy is becoming increasingly crowded. Besides the traditional maritime industries, submarine cables now compete with emerging sectors, such as offshore wind farms, aquaculture, and marine biotechnology. A lack of inter-agency coordination or holistic maritime spatial planning (MSP) to harmonize competing uses may lead to planned cable routes disrupted or even forced into costly re-routes. This problem is exacerbated by the absence of a submarine cable champion – a dedicated government agency or advocate. Such a body could present the critical importance of submarine cables to the other agencies overseeing permitting and application approvals, or infrastructure planning discussions, in order to ensure the inclusion of planning for submarine cable landing resources.

e. **Extra-jurisdictional permitting and notification requirements:** Another concerning trend is the imposition of permitting or notification requirements by some coastal States on vessels transiting their EEZ. For example, a repair vessel traveling through the EEZ of a particular State to a repair site in international waters may be stopped and requested to notify that State's authorities, or obtain a permit from them, even though the vessel has no intention of stopping or conducting any seabed activity within that State's EEZ. Such practices, which are not consistent with international law, as reflected in UNCLOS, add delays to response times, a factor that can be especially crucial when cable repairs are urgent.

[9] See the OECD website, https://www.oecd.org/en/publications/2016/04/the-ocean-economy-in-2030_g1g6439e.html (accessed 27 May 2026).

BOX 1: WHY REGULATIONS DIFFER BETWEEN NATIONS – AND HOW NATIONS CAN COLLABORATE

To promote closer collaboration between the industry and government, it is crucial to understand the underlying priorities and considerations shaping that government's policies and practices.

The critical importance of submarine cables for economic growth[10] – and the risks these cables pose for the economy and its resilience – has often led to countries trying to secure these critical assets through tighter, more complex regulations. Additionally, some countries have sought to reap the positive externalities of these cables domestically by using cabotage policies and mandates for local crew on repair and installation vessels. At the same time, while studies have found that submarine cables leave a relatively small footprint on the marine environment,[11] concerns over sensitive ecosystems such as coral reefs, may introduce complexity into the permitting processes, or to restrictions on routes.

While these approaches may be justifiable, they can translate into inconsistent or overlapping regulatory requirements across jurisdictions, impeding cable planning, deployment, and repair. Hence, there are opportunities for constructive partnerships between industry and government stakeholders that aim to reconcile these needs and facilitate more efficient operations.

Adopting approaches aligned with best practices, for example, can ensure safeguards are maintained while also accelerating timelines. Where vessel and personnel clearances are required, implementing pre-approval processes could reduce delays without compromising oversight. In the case of cabotage policy, for example, the Malaysian government has granted permanent exemption to foreign ships specializing in submarine cable installation, maintenance, and repair, enabling works to be carried out expeditiously. Other examples include the fast-tracking of approvals for minimal-impact, urgent tasks, and consolidated assessments that address environmental risks holistically.

Good examples of establishing best practices and cooperative frameworks through a shared commitment to collaboration have also been demonstrated by the countries of south-east Asia and the Caribbean.

10 According to a 2023 Analysis Mason report, in United States dollar (USD) terms, Google's submarine cable deployments in the Latin America and the Caribbean region (LAC) will lead to an estimated cumulative increase in regional gross domestic product (GDP) of USD 178 billion between 2017 and 2027. The report also estimated that this economic uplift would support the creation of around 740 000 additional jobs by 2027. See https://www.analysysmason.com/consulting/reports/impact-of-google-network-latam-caribbean-2023/ (accessed 27 May 2026).

11 See United Nations Environment Programme (UNEP) World Conservation Monitoring Centre (WCMC) and ICPC, *Submarine cables and marine biodiversity*, UNEP-WCMC, Cambridge, 2025, https://doi.org/10.34892/V9NB-TR83

(continued)

Recognising that digital connectivity is a regional necessity, the Member States[12] of the Association of Southeast Asian Nations (ASEAN) came together in 2019 to establish the *ASEAN Guidelines for Strengthening Resilience and Repair of the Submarine Cables* (known as the "2019 Guidelines")[13]. These are best practices aimed at streamlining the region's cable protection, maintenance, and repair processes. Collaboration efforts were deepened in 2024 when ASEAN formed the Working Group on Submarine Cables. This body served as an important platform for Member States to partake in the exchange of challenges and experiences, share information, and undertake joint capacity-building initiatives. The sharing of experiences and practices also facilitated ASEAN Member States in collectively enhancing the 2019 Guidelines with best practices concerning the protection of submarine cables. The reduction of regulatory requirements for timely submarine cable repairs was also facilitated by this process. Through the collaborative efforts of ASEAN Member States, the enhanced 2019 Guidelines (*Enhanced ASEAN Guidelines for Strengthening Resilience and Repair of Submarine Cables*)[14] were also successfully endorsed at the Sixth ASEAN Digital Ministers Meeting in January 2026.

For the Caribbean – an archipelagic region defined by the United Nations as consisting of small island developing States (SIDS) – digital transformation is heavily reliant on robust and resilient telecommunications infrastructure, with submarine cables forming a critical backbone. Recognizing threats from natural disasters and delays from fragmented national regulations, the Caribbean Telecommunications Union (CTU), a multi-stakeholder platform, has championed the establishment of cooperative frameworks and harmonized best practices. A core mechanism of the CTU's efforts in information and communication technology (ICT) is the Caribbean ICT Regulators Forum (CIRF). This is a high-level dialogue platform aiming to foster consensus and policy harmonization among the 21 Member States and Associate Members of the Caribbean Community (CARICOM). This commitment to a unified regional approach was then crystallised in the Harmonization of ICT Policies, Legislation and Regulatory Procedures (HIPCAR) project. In this, the CTU played a central role in developing legislative texts aimed at facilitating timely access and collocation at international gateways, including critical submarine cable landing stations. Beyond regulatory access, the CTU is also holistically focused on improving the resilience of the region's submarine cables and advancing its disaster preparedness and recovery protocols. The CTU is also focused on facilitating knowledge-sharing and dialogue among Caribbean stakeholders.

12 The ASEAN Member States are: Brunei Darussalam, the Kingdom of Cambodia, the Republic of Indonesia, the Lao People's Democratic Republic, Malaysia, the Union of Myanmar, the Republic of the Philippines, the Republic of Singapore, Thailand and the Socialist Republic of Viet Nam.

13 See ASEAN, *Enhanced ASEAN Guidelines for Strengthening Resilience and Repair of Submarine Cables,* ASEAN Telecommunications and Information Technology Ministers' Meeting, Vientiane, Lao People's Democratic Republic, 24 October 2019, https://asean.org/wp-content/uploads/2026/01/Enhanced-ASEAN-Guidelines-for-SR-and-Repair-of-Submarine.pdf (accessed 9 July 2026).

14 See ASEAN, *Enhanced ASEAN Guidelines for Strengthening Resilience and Repair of Submarine Cables,* ASEAN Digital Ministers Meeting, Viet Nam, 16 January 2026, https://asean.org/wp-content/uploads/2026/01/Enhanced-ASEAN-Guidelines-for-SR-and-Repair-of-Submarine.pdf

2.3 TOWARD REGULATORY EFFICIENCY: NATIONAL MODELS OF REGULATORY EXCELLENCE

Despite the challenges, a number of jurisdictions have successfully implemented approaches that facilitate the timely deployment and repair of cables.

Such approaches include:

- **Centralized coordination:** With traditional approaches involving operators navigating separate regulatory agencies and permitting processes, States have been seeking to streamline or coordinate their regulatory procedures. Singapore's Infocomm Media Development Authority (IMDA), for example, takes a 'one-stop shop' approach as the designated single point of contact for the industry. The IMDA facilitates engagements between industry, government and regulatory agencies with responsibilities for land, the maritime and construction sectors, and environmental matters. Similarly, Indonesia's National Team brings relevant government bodies together for a unified approval process, while Ireland's Maritime Area Regulatory Authority (MARA) serves as the principal permitting authority for the country's maritime and subsea infrastructure. This includes submarine telecom cables, offshore wind farms, and energy interconnections. All these organizations seek to reduce bureaucratic processes and provide operators with a single interface, reducing administrative friction.
- **Expediting repair permits:** A second critical reform is the simplifying of permitting processes by treating repairs separately from new deployments. Given the impact of lost digital connectivity, states have recognized that restoring damaged cables warrants a swift response. In Singapore, the Maritime and Port Authority (MPA), for example, has streamlined its repair permitting processes, expediting approval timelines from 1 week to between 3 and 5 working days. Nations such as South Africa, the Netherlands, and the United Kingdom have also implemented pre-authorization arrangements for repair vessels, shortening the time required for administrative processes when cable incidents occur. In the case of the United Kingdom, the average time to commence repairs is approximately 8 days, as opposed to the global average of 50 days.[15]
- **Holistic MSP:** The operational requirements for submarine cables should be holistically included in a State's overall MSP considerations. These requirements should also be de-conflicted from competing maritime activities. By embedding cable routes into national plans, bodies such as the EU can provide legal certainty and protect critical infrastructure from future spatial conflicts. Relatedly, Australia and New Zealand have adopted a more targeted approach through the creation of dedicated cable protection zones (CPZs). These protect existing assets and streamline planning for future deployments by restricting high-risk activities, such as anchoring and trawling, within their areas.

In summary, through effective administrative design, prioritized emergency protocols, and long-term holistic spatial planning, nations can reduce operational friction and foster a stable, predictable investment climate for the submarine cable industry.

2.4 INTERNATIONAL AND REGIONAL BEST PRACTICES

Given the transboundary nature of submarine cables, policies and permitting practices in one State can have an influence on deployment and operations in another. It is therefore vital that States look beyond domestic measures and collaborate with like-minded partners in harmonizing best practices at the regional and international levels.

15 See the ICPC website (https://www.iscpc.org) for reports on repair statistics. Those given here are based on 2024 data.

Established in 1958 and the world's leading organization promoting submarine cable protection and resilience, the ICPC has been a strong advocate of this collaboration and harmonization. Working with its members, governments, international organizations, marine industries and the scientific community, it has also developed the *ICPC Government Best Practices for Cable Protection Resilience* report. This provides a comprehensive blueprint to assist governments in developing laws, policies, and practices to foster the development and protection of submarine cables.

In addition to the ICPC, academia and specialized think tanks have also helped to inform policy approaches. The Global Digital Inclusion Partnership (GDIP) publication, *Good Practices for Subsea Cables Policy: Investing in Digital Inclusion*,[16] for example, advocates streamlined regulatory frameworks to support competition, innovation, and equitable access in submarine infrastructure. These recommendations also align with the findings in the Center for Cybersecurity Policy and Law (CCPL) white paper, *Shoring Up Subsea Security: A Comprehensive Action Plan to Promote Submarine Cable Resiliency, Security & Governance*.[17] The CCPL publication found that in order to reduce vulnerabilities and bolster network resilience, such streamlined regulatory frameworks were a key imperative.

At the regional level, efforts for collaboration between ASEAN Member States serve as a case study of intergovernmental cooperation aimed at jointly enhancing the region's regulatory practices in facilitating subsea cable protection and repairs. Notably, the region has endorsed enhancements to its *ASEAN Guidelines for Strengthening Resilience and Repair of the Submarine Cables,* originally produced in 2019 (see Box 1). Similar regional initiatives, such as the Pacific Islands Forum, CARICOM, or coordination in the North Sea, are additional examples of multilateral platforms harmonizing regulatory approaches, building institutional capacity, and fostering closer collaboration between governments and the industry.

2.5 RECOMMENDATIONS: TOWARD PREDICTABLE, EFFICIENT, AND RESILIENCE-ORIENTED REGULATION

With reference to the challenges and best practices identified, this section recommends a series of measures that States could adopt in order to streamline permitting and regulatory processes and overcome barriers to rapid repair.

The recommendations listed below are consistent with international law and focus on eliminating bottlenecks. They also align with regulatory best practices.

Recommendation 1: Streamline regulatory and permitting processes

a) **Governments are encouraged to establish transparent and predictable regulatory and permitting frameworks.** They could, for example, publish clear national guidelines on application requirements and what permits are necessary. Where feasible, application requirements should be standardized with checklists, while processing fees (if any) should be made public.

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[16] See GDIP, *Good Practices for Subsea Cables Policy: Investing in Digital Inclusion*, GDIP, January 2024, https://globaldigitalinclusion.org/wp-content/uploads/2024/01/GDIP-Good-Practices-for-Subsea-Cables-Policy-Investing-in-Digital-Inclusion.pdf.

[17] See CCPL, *Shoring Up Subsea Security: A Comprehensive Action Plan to Promote Submarine Cable Resiliency, Security and Governance,* CCPL, Washington DC, 24 September 2025, https://www.centerforcybersecuritypolicy.org/insights-and-research/shoring-up-subsea-security-a-comprehensive-action-plan-to-promote-submarine-cable-resiliency-security-governance.

b) **Governments are encouraged to streamline workflows and the permit application and approval process, while also establishing clear permitting timelines.** A differentiated approach that separates deployment applications from repairs to damaged cables could also be considered. Governments are also encouraged to minimize information requirements for repair applications. For example, in the case of application information requirements for cable repair permitting, governments could focus on essential information about the applicant, name of the cable, and estimated location of repair. Other key information includes a description of the repair work and the methodology being used, details about the repair vessel and crew list, the work schedule dates, and the communications plan and emergency reporting procedures.
c) **Review domestic regulations and requirements:** Governments, for example, are encouraged to review their cabotage restrictions, or requirements for diplomatic notification, potentially exempting cable repair operators from these obligations. The highly specialized nature of repair vessels and equipment, coupled with the urgent need to restore connectivity, makes such exemptions both practical and necessary.
d) **Implement pre-clearance mechanisms:** Where clearance is required, governments are encouraged to consider establishing pre-emptive processes. These could include prior technical vetting of designated repair vessels and immigration clearances for specialist personnel. This would allow them to obtain advanced authorization and mobilize quickly once a fault is detected, avoiding the need for repeated applications and reducing the time for administrative processing. Having such pre-clearance processes also strengthens regulatory control, as authorities can retain oversight through periodic renewal and reporting.
e) **Exempt repair equipment from customs duties:** Cable installations and repairs often require the importation of specialized components, such as spare cables, repeaters, and jointing kits, which may not be available domestically. Governments are encouraged to clarify importation requirements and simplify customs duty processes. A clear framework enables operators to move equipment efficiently across borders, particularly when faults occur, facilitating expeditious repairs.
f) **Designate an SPOC or national 'subsea champion'**: Where permitted by national laws and regulations, each government should appoint a dedicated agency or coordinator – an SPOC – to streamline the permitting process. This entity would serve as the central interface for industry and manage inter-agency consultation. It would also advocate for submarine cable interests in cross-stakeholder discussions, such as national maritime spatial planning processes. The SPOC would ensure digital connectivity is prioritized alongside other interests, such as energy, fishing, and conservation.

Recommendation 2: Create a public database of SPOCs

a) **Develop a voluntary public database of SPOC information**: To maximize the effectiveness of this initiative, a publicly accessible database that indicates the identity and means of contacting the SPOCs should be developed. Such a repository would provide the industry with a centralized, immediate and definitive point of reference, enabling the timely identification of the relevant regulatory authorities.

Recommendation 3: Harmonize regional approaches and scale best practices

a) **Leverage regional cooperation mechanisms to foster convergence and propagate best practices across jurisdictions**: Regional bodies, such as the EU, the African Union, CARICOM and ASEAN, are strategically positioned to champion and expand model guidelines. They can also mitigate the fragmentation that arises from differing regulatory approaches. As structured and high-level forums for dialogue, these bodies can build the political cohesiveness and technical consensus essential for regulatory alignment. In addition, efforts to standardize maritime documentation and implement mandatory electronic data exchanges, such as those undertaken by international organizations like the International Maritime Organization (IMO), can also support countries in streamlining port formalities, allowing countries to retain oversight on national priorities while committing to shared principles and operationalizing best practices.

CHAPTER 3: STRENGTHENING GLOBAL REPAIR ARCHITECTURE

Chapter 1 showed that delays in submarine cable repair could have far-reaching social and economic consequences, particularly for geographically remote, capacity-constrained, or single cable-dependent markets. At the same time, while cable faults may be unavoidable, prolonged outages are often exacerbated by structural weaknesses in the global repair ecosystem. These weaknesses include the uneven geographical distribution of repair assets, limited surge capacity, fragmented maintenance arrangements, and persistent gaps in the availability of specialized skills and cross-operator coordination.

In this context, strengthening the global repair architecture is a critical pillar of submarine cable resilience. This chapter examines current maintenance and repair models and identifies key operational gaps undermining repair readiness and response effectiveness. It also proposes actionable recommendations to enhance the availability and strategic positioning of repair assets, to improve coordination mechanisms, and to ensure the long-term sustainability of global repair capabilities.

3.1 GLOBAL CABLE MAINTENANCE MODELS: REGIONAL ZONES AND PRIVATE AGREEMENTS

Currently, submarine cable repair is typically organized according to two complementary models:

1) **Cooperative regional maintenance zones** in which multiple cable owners jointly fund and govern shared repair capacity.
2) **Private maintenance agreements (PMAs)** under which individual cable owners contract dedicated repair capacity from cable ship operators for their own systems.

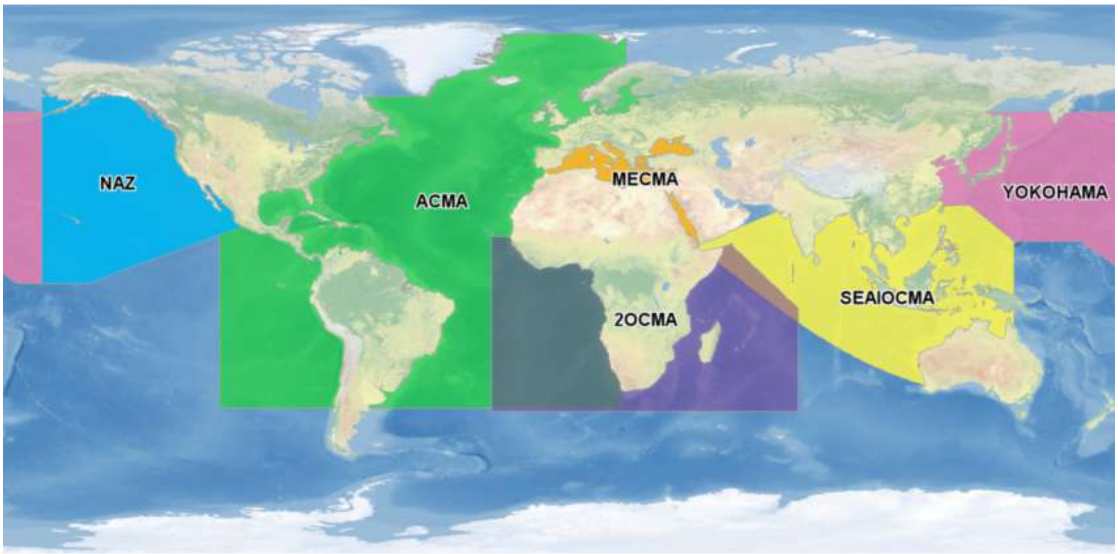
The geographical coverage of these two can also overlap, particularly in high-traffic corridors. The two sections below give further details about these models and their operation.

Cooperative regional maintenance zones

Cooperative regional maintenance zones encompass predefined geographical areas that have been established by participating cable owners (see Figure 5). These owners jointly pool standby vessels and spare depots and operate under mutually-agreed common rules. This shared-responsibility model distributes the fixed costs of vessels and depots across multiple cable systems. It also provides structured processes for fault reporting, prioritization, and repair authorization, while also facilitating mutual assistance between neighbouring zones during large-scale incidents.

Key features of this cooperative zone model include cost sharing, transparent procedures, and mobilization of repair resources in high-density cable regions. Challenges with this model persist, however. Coordination becomes complex when multiple faults occur simultaneously, while rigid geographical boundaries can limit flexibility. Coverage gaps also remain, particularly along zone edges and in remote waters not covered by existing cooperative frameworks.

Figure 5: Map of cooperative maintenance zones



Source: Global Marine Group (GMSL)

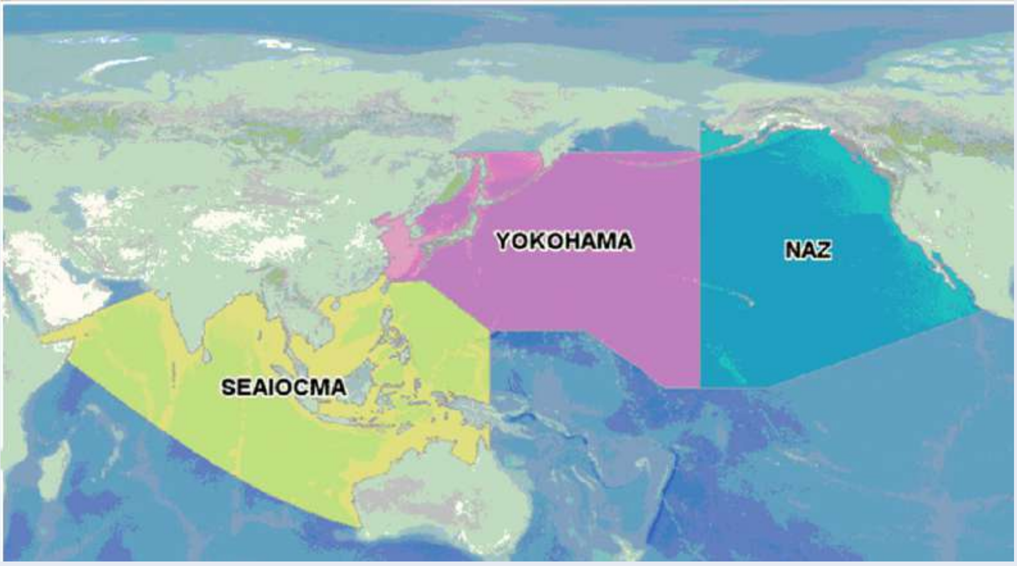
Note: ACMA = Atlantic Cable Maintenance Agreement; MECMA = Mediterranean Cable Maintenance Agreement; NAZ = North America Zone; SEAIOCMA = South East Asia and Indian Ocean Cable Maintenance Agreement; 2OCMA = Two Oceans Cable Maintenance Agreement; YOKOHAMA = Yokohama Zone (also referred to as 'YZ').

BOX 2: THE YOKOHAMA ZONE

The Yokohama Zone (YZ) is one of the oldest and most developed submarine cable maintenance regions in Asia-Pacific. Established in 1997, it was designed to provide coordinated and efficient repair support across a vast area of East Asia, while also extending eastward into the Central Pacific to around the 167th meridian (see Figure 6).

The zone operates under a well-established cooperative framework, featuring dedicated standby cable ships and advanced ROVs strategically stationed in China, Japan, and the Republic of Korea. Standby vessels are regularly rotated among key ports to ensure year-round operational readiness. The YZ has also refined its collaborative model to add pre-positioned spare parts, standardized procedures for work plan approval/fault prioritization, and seamless coordination among participants.

Figure 6: The Yokohama maintenance zone and its neighbours



Source: Global Marine Group (GMSL)

PMAs: The dominance of private cable owners and local consortia

With the growth of private and hyperscale cable systems, owners are increasingly turning to PMAs that are tailored to specific cables or routes. These agreements typically involve direct funding or long-term chartering of one or more dedicated repair vessels. Custom service levels and response times are also typically aligned with the owner's traffic demands and risk tolerance. PMAs also often include provisions allowing a vessel to undertake third-party charters during periods without active faults, improving asset utilization.

PMAs also offer streamlined decision-making, tighter control over repair prioritization, and close alignment between repair resources and the economic value of the specific cables they serve.

A growing reliance on fragmented, individually managed PMAs, however, may reduce opportunities for shared resource pooling and coordinating responses across operators, particularly during large-scale events affecting multiple, privately maintained systems.

Figure 7: Map of global PMAs

Source: SubCom

Note: APMA = Atlantic PMA; APMMSA = Asia Pacific Marine Maintenance Service Agreement; E Marine = zone in which E-Marine is the maintenance provider; SPMA = South Pacific Maintenance Agreement.

Table 3 sets out the key advantages and disadvantages of cooperative maintenance zones and PMAs, according to a range of relevant criteria.

Table 3: Comparison of maintenance zones and PMAs

Aspect	Cooperative maintenance zone	PMA
Structure	Shared governance, joint funding	Bilateral or small-group agreements
Repair speed	Moderate	High, with immediate response
Coverage	Regional zones	Specific cable systems and routes
Fleet distribution	Multi-ship fleets	Dedicated or chartered vessels
Redundancy and risk	High redundancy	Low redundancy, risk of fragmentation
Outside work	Strictly controlled to ensure vessel availability	Allowing outside work can reduce the cost, but may cause vessels not to be immediately available when needed

3.2 ASSESSMENT OF COVERAGE GAPS: UNDER-SERVED REGIONS

Despite the growing number of maintenance zones and PMAs, some regions still remain underserved, particularly if they are remote and/or less economically developed.

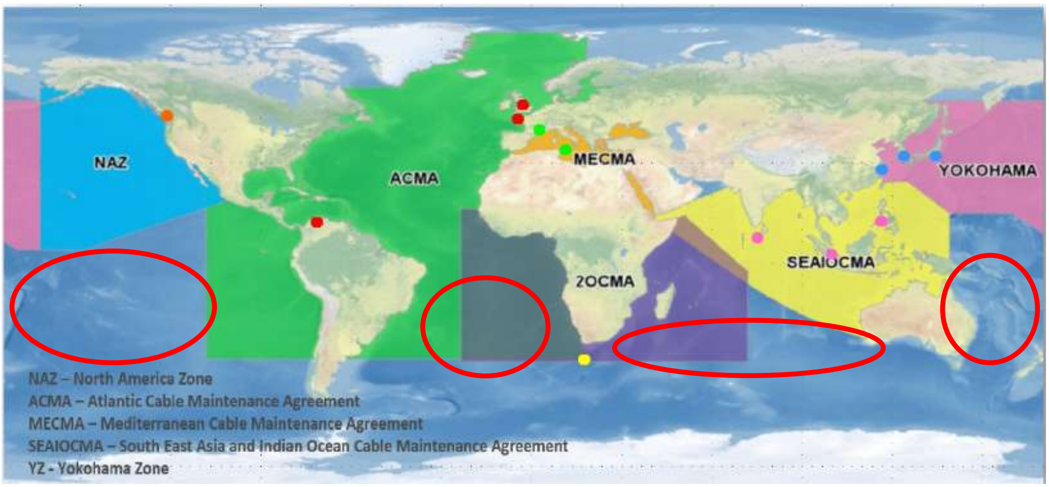
Regions with robust maintenance coverage include the European and Asia-Pacific regions. These both benefit from mature repair ecosystems and are characterized by overlapping maintenance zones and private agreements. There are also multiple vessels and well-established coordination mechanisms.

Underserved regions include Africa, which, despite growth in internet connectivity, remains critically underserved by submarine cable repair infrastructure. Many of this region's cables traverse vast stretches of unprotected waters, with only one permanently-stationed repair vessel, based in South Africa, to serve the entire region. For example, should a fault occur near Dakar, West Africa, while the vessel is repairing a cable in Mombasa, East Africa, the response time would be extremely lengthy. At over 10 000 kilometres, the immense transit distance would be a journey comparable to a transoceanic route, such as Shanghai to Los Angeles.

The remote South Atlantic and Pacific islands also suffer from minimal repair vessel presence. Due to the long mobilization distances from the nearest maintenance hubs, repair operations often require between 10 and 14 days (or more), substantially increasing service disruption risks.

This geographical and institutional imbalance shows that access to timely repair resources is not globally equitable. At the same time, during periods of high demand or concurrent faults, available vessels are often prioritized for high-traffic or commercially-critical routes. This leaves vulnerable regions at risk of significant delays and extended service outages.

Figure 8: Coverage gap heat map



Companies/zones	Base Ports
• = Orange/GMSL (ACMA)	Brest, France; Portland, UK; Curacao
• = Orange/Elettra (MECMA)	La Seyne Sur Mer, France; Catania, Italy
• = Orange (2OCMA)	Cape Town, South Africa
• = GMSL (NAZ)	Victoria, Canada
• = SBSS/KCS/KTS (YZ)	Wujing, China; Yokohama, Japan; Keoje, Republic of Korea
• = ACPL/IOCPL/GMSL (SEAIOCMA)	Singapore; Colombo, Sri Lanka; Manila, Philippines

Source: GMSL

Note: ACPL = ASEAN Cableship Pte. Ltd.; IOCPL = Indian Ocean Cable Ship Pte. Ltd.; KCS = KDDI Cableships and Subsea Engineering Inc.; KTS = KTS Cabling; SBSS = SB Submarine Systems

3.3 BARRIERS TO EFFICIENT CABLE REPAIR

Timely cable repair is hindered by a combination of logistical, technical, and human constraints. Despite decades of progress in maintenance models, the following four major factors continue to limit repair efficiency:

- repair vessel availability and geographical distribution
- fragile supply chains for cables, spares, and critical components
- technical complexity and environmental challenges
- workforce shortages and certification gaps.

The following section looks at each of these factors in more detail.

Repair vessel availability and geographical distribution

Given current demand, the global submarine cable repair fleet is insufficient. As of 2025, approximately 70 vessels worldwide possessed the technical capability to perform cable repairs. However, many of these vessels were either primarily for cable-laying and engaged in commercial installation projects, or older units no longer maintained for active service. Only around 20-25 vessels were either formally dedicated to repair operations under active maintenance agreements, or long-term chartered for these. Even within this core group, not all were kept on continuous standby, with some requiring days to mobilize. As a result, the number of vessels that could be immediately deployed in response to an emergency was substantially lower than that declared.

In addition, a significant part of the global repair fleet was built in the 1980s or 1990s. These 30-to-40-year-old ships have been periodically refitted to extend their service lives. Nevertheless, many of them were not originally designed for today's deep-water repair operations, or integrated with modern ROVs. Their outdated propulsion systems, limited dynamic positioning capabilities, and inefficient fuel consumption reduce their operational effectiveness and hinder compliance with current environmental regulations. Aging hull structures and obsolete safety systems increase the risk of mechanical failure during complex offshore operations. This compromises crew safety, undermines repair reliability, and poses a range of threats to the marine environment.

Table 4: Number of cable ships under zone maintenance arrangements

Maintenance agreement	Number of vessels
ACMA	2.5(3)
MCMA	2
2OCMA	1
SEAIOCMA	3.5(4)
YZ	2(3)
NAZ	1

Source: S.B. Submarine Systems

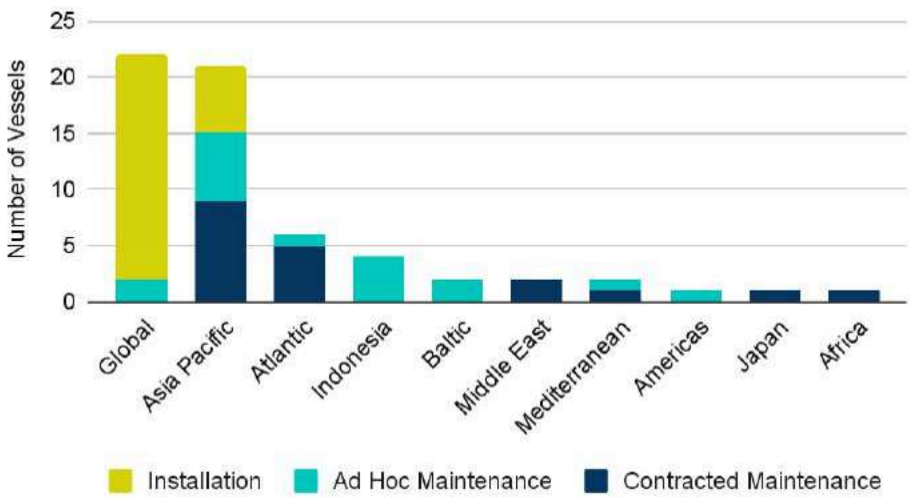
Note: Some of the vessels in ACMA, YZ, and SEAIOCMA are not contracted for the entire year, but can be brought to full year contracts if necessary. For this reason, the number is stated as a decimal, with the actual number of ships in brackets.

Table 5: Number of cable ships under PMAs

Maintenance agreement	Number of vessels
APMA	3
APMMSA	4
E-Marine	2
SPMA	1

Source: S.B. Submarine Systems

Figure 9: Vessel count by operating region and use, 2025



Source: Infra-Analytics and TeleGeography[18]

Aging vessels require more frequent dry-dock maintenance, which reduces their effective annual operational availability by between 15 per cent and 20 per cent. At the same time, the high cost of new, purpose-built cable repair ships typically ranges between USD 100 million and USD 150 million. This acts as a significant barrier to fleet renewal, particularly for private operators and smaller maintenance consortia with limited capital.

Geographical imbalance

The global fleet of submarine cable repair vessels is concentrated in high-traffic regions, leaving vast oceanic areas with minimal or no dedicated coverage. Indeed, the Asia-Pacific and North America/Europe/North Atlantic regions each host approximately 40 per cent of the world's active cable repair vessels, while the South Atlantic, Africa and Pacific Islands regions host around 13 per cent between them. The South Indian Ocean and South-east Pacific regions have no permanently stationed repair vessels and rely entirely on ad hoc mobilization from distant

[18] See Constable, M., and L. Burdette, *The Future of Submarine Cable Maintenance: Trends, Challenges, and Strategies*, Infra-Analytics and TeleGeography, 2025, https://www2.telegeography.com/future-submarine-cable-maintenance-report.

hubs. The remaining vessels, around 7 per cent of the global total, include those undergoing refit, in transit, or allocated to private agreements not tied to a specific geographical zone.

Due to this highly uneven global distribution of cable ships, transit times vary dramatically across regions, depending on the pre-positioned locations of vessels. This introduces significant uncertainty into end-to-end repair timelines. For example, a fault in the North Atlantic can often be addressed within 3-5 days due to nearby standby assets, whereas a comparable incident off West Africa may take 12-18 days, primarily because of long mobilization distances.

Some regional initiatives, such as ACMA and SEAIOCMA, have sought to mitigate these disparities by enabling shared access to repair resources. Without coordinated global planning and strategic vessel deployment, however, underserved regions will remain disproportionately vulnerable.

Supply chain fragility: Cables, spares, and components

Two major factors influence fragility in the supply chain, as outlined in the sections below.

Limited manufacturing capacity: Submarine cable repairs require replacement segments and repeaters that precisely match the original system's optical, mechanical, and structural specifications. Components are therefore highly customized and cannot be substituted by generic or off-the-shelf alternatives. This dependency on parts with such exact specifications is compounded by the extreme concentration of global manufacturing capacity: just a few specialized vendors, such as ASN, NEC, SubCom, and HMN Tech, account for more than 95 per cent of global production. Due to constrained production lines and factory backlogs, custom-fabricated repeaters or fibre sections are subject to particularly extended lead times, often lasting several months or, in some cases, over a year.

It is worth noting that industry initiatives, such as the Universal Joint (UJ) and Universal Qualified Joint (UQJ) standards, have made strides in mitigating cable interoperability issues. However, the extreme concentration of manufacturing capabilities remains a stubborn bottleneck that continues to plague the sector.

Risk of mismatch and inventory shortage: Across manufacturers, submarine cables differ significantly in sheath design, fibre count, and optical core architecture. As a result, maintaining a universal inventory of compatible spares is highly impractical. Many operators, especially in emerging markets, find that their spare inventory is either initially understocked, or fails to be replenished in time. This forces them to initiate emergency procurement when a fault occurs, which not only extends repair timelines, but also incurs unbudgeted costs, amplifying both the operational and financial impact.

Technical and environmental challenges

There are three broad categories of technical and environmental challenges, as listed below.

- **Depth and terrain:** Repairs at depths exceeding 5 000 metres demand specialized vessels and experienced crew. Complex seafloor features further complicate operations by impeding cable location and increasing the risk of failed grappling attempts. Such features include canyons, abyssal plains, and volcanic ridges.
- **Weather and seasonal constraints:** In storm-prone regions such as the North Pacific, the Bay of Bengal, and the Southern Ocean, submarine cable repair operations are tightly

constrained by limited weather windows. Typhoon and monsoon seasons can suspend work for weeks at a time, while if there is a sea state of 6 or higher, deck operations for splicing and jointing become unsafe. Vessels must often wait offshore for calmer conditions, further extending the duration of the outage.

- **Environmental regulation:** Marine Protected Areas (MPAs) and tightening environmental regulations are increasingly affecting repair logistics. In many jurisdictions, repairs that involve seabed disturbance in certain jurisdictions can occasionally require permits or prior environmental assessments. This can add days or even weeks to the authorization process and delay vessel mobilization.

Workforce shortages and certification gaps

Challenges in the realm of shortages and certification gaps can be grouped into two main areas, as detailed below.

- **Shrinking talent pool:** The cable maintenance sector faces a severe shortage of skilled marine engineers, jointers, and ROV pilots. Many experienced technicians who entered the industry during the telecom boom of the 1990s are approaching retirement, while new entrants are limited in number. Global estimates indicate that fewer than 1 000 fully qualified UJ engineers are currently in active service. This is a number far below that needed to support a rapidly expanding network that now stretches to over 1.5 million kilometres of in-service cables.
- **Lack of standardized certification:** Unlike commercial shipping, which is governed by the IMO International Convention on Standards of Training, Certification and Watchkeeping (STCW), the submarine cable repair sector lacks a globally recognized certification framework, except for that governing UJ procedures. Critical skills, such as cable recovery, grappling, and complex fault localization, remain largely unregulated and rely on company-specific training. Training requirements and competency standards are also set independently by maintenance zones or private contractors. This fragmentation results in inconsistent skill levels and operational practices, creating inefficiencies when there are personnel transfers between regions, or switches between cooperative and private fleets.

3.4 BEST PRACTICES AND INNOVATIONS IN REPAIR OPERATIONS

Despite the constraints outlined above, the industry has adopted a range of technological and organizational innovations that demonstrably enhance the efficiency and resilience of submarine cable maintenance operations. These are discussed in more detail in the section below.

Pre-positioned vessels and rapid response units

Pre-positioned vessels have emerged as an effective industry response to frequent submarine cable faults and have drastically reduced mobilization times in high-density regions. The YZ, for example, maintains two cable ships continuously on standby at Shanghai in China, Yokohama in Japan, or Keoje in the Republic of Korea. Under normal conditions, for most cable faults within the zone's core coverage area, repair vessels can typically mobilize and arrive on-site within 24 to 48 hours. This compares to a period of between 5 and 7 days for vessels that have not been pre-positioned.

Figure 10: Response times for the YZ cable ship coverage area (days)

Source: S.B. Submarine Systems

Rapid response units (RRUs) represent another effective industry practice in addressing near-shore cable faults, particularly in regions characterized by extensive continental shelves or archipelagic waters with dense submerged reefs. These units consist of small, modular teams equipped with lightweight gear and shallow-water ROVs. This enables them to operate in areas where conventional cable ships are either technically unsuitable or unable to gain access due to limited water depth and complex seabed conditions. Leveraging their compact footprint and rapid-deployment capability, RRUs can swiftly localize and remediate shallow-water cable faults, significantly reducing both the time and cost associated with traditional repair vessel mobilization.

Notably, RRU assets are typically owned not by dedicated cable maintenance entities. Instead, they are usually owned by companies specializing in cable installation and construction whose operational profiles align closely with RRU deployment scenarios. As such, RRUs are not part of the standard cable repair fleet.

Given the high fixed costs of maintaining standing RRU capacity, however, a commercially viable alternative has emerged: establishing pre-arranged agreements, or memoranda of understanding (MOUs), with RRU-capable contractors. This enables the rapid mobilization of such units on demand. This model has already demonstrated high effectiveness in regions with frequent shallow-water cable incidents. Such contractual partnerships have enabled timely, cost-efficient fault resolution without the need for permanent RRU infrastructure.

BOX 3: THE SHANTOU INCIDENT: A RAPID RESPONSE SUCCESS

On 21 February 2023, due to a container ship dragging its anchor in severe weather, four submarine cables were severed in rapid succession near the Shantou cable landing station in China. The incident occurred in waters less than 15 metres deep – too shallow for conventional cable repair ships to operate. Thus, a non-traditional approach to repair was required.

Fortunately, the service provider was able to activate its regional rapid response capability – a pre-established arrangement designed for agile deployment in constrained or atypical environments. Drawing on a pre-vetted inventory of local, shallow-water assets, the team secured a suitable barge within hours. Mobilization commenced immediately and the barge arrived on-site on 28 February. All four systems were fully restored within three weeks – a timeline that would have been significantly longer without this dedicated rapid-response mechanism.

This example underscores the strategic value of RRUs. In complex shallow-water environments where conventional cable ships cannot operate, their capacity to rapidly mobilize tailored solutions significantly shortens repair timelines and helps maintain the resilience of global connectivity.

Mutual assistance between maintenance zones, pooling of spares

Collaborative inventory systems have also emerged as an industry best practice. These enable participating maintenance zones to share cable ships, spare cable segments, and jointing materials through formalized mutual assistance agreements. By pooling resources and coordinating logistics, these arrangements reduce redundant stockpiling, while ensuring rapid access to compatible components when needed.

The key benefits of this practice include:

- reduced capital tied up in duplicate or underutilized inventory
- higher utilization rates of existing spare assets
- enhanced logistical resilience through geographically distributed depots.

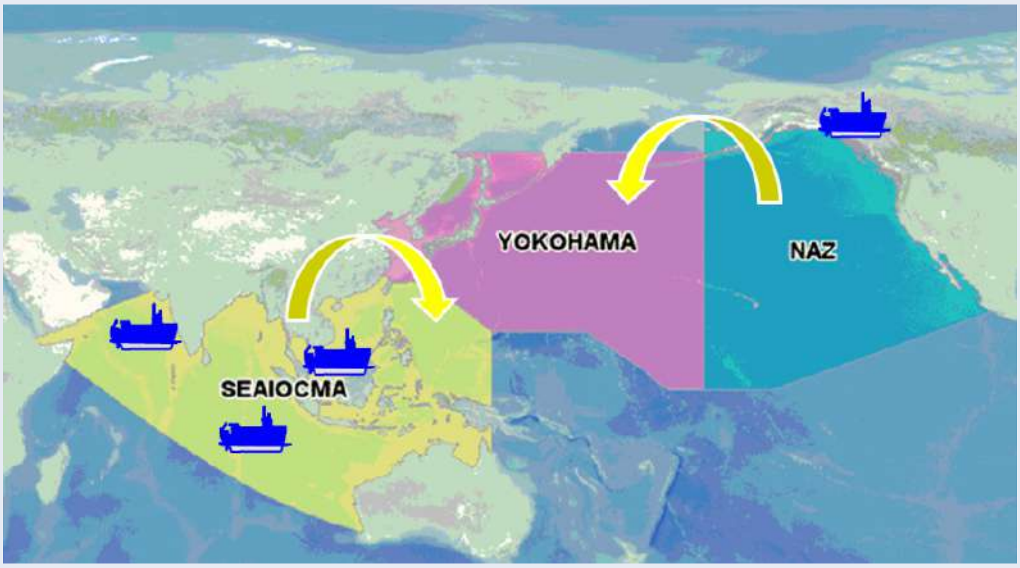
BOX 4: THE PACIFIC AND INDIAN OCEAN CABLE MUTUAL ASSISTANCE FRAMEWORK IN ACTION

The Pacific and Indian Ocean Cable Mutual Assistance (PIOCMA) framework was established to strengthen regional resilience by enabling cross-zone sharing of cable repair vessels, particularly during emergencies or periods of high demand. The maintenance agreements participating in the framework include the NAZ, SEAIOCMA, and the YZ.

Under this arrangement, if a fault occurs in one zone while its assigned vessels are fully engaged, that zone may request support from another. In 2013, for example, a submarine cable fault occurred in south-east Asia when all SEAIOCMA vessels were already committed to other repairs and unable to respond. The affected cable owner activated the PIOCMA mechanism and secured assistance from a YZ vessel, which was promptly mobilized to carry out the repair.

This inter-regional coordination significantly reduces response delays, typically cutting waiting times by between 10 and 14 days, compared to instances relying solely on local assets. The framework also demonstrates how structured cooperation enhances the reliability and resilience of global submarine cable infrastructure.

Figure 11: Mutual assistance under the PIOCMA mutual assistance arrangement



Source: S. B. Submarine Systems

Common procedures across maintenance zones

Operational harmonization has proved essential in minimizing delays in coordination during multi-operator repair scenarios. Key standardized practices include:

- **Common fault reporting formats** that enable rapid and consistent data exchange across operators.
- **Common vessel handover protocols** between different maintenance providers.
- **Uniform repair documentation and safety checklists**, aligned with recommendations from the ICPC.
- **Shared access to cable system specifications** – a step which ensures that jointing personnel possess the required qualifications for the specific cable type and manufacturer across maintenance zones.

These interoperable procedures enable seamless coordination among operators, vessels, and technical teams across maintenance zones. Common reporting formats, for example, eliminate miscommunication during fault alerts, while harmonized handover protocols prevent operational gaps when vessels change hands. At the same time, shared cable specifications ensure the right personnel are deployed with the correct tools and spares. Industry experience shows that these interoperable procedures consistently reduce delays and the need for rework, ensuring repairs succeed on the first attempt. This is critical in minimizing the duration of outages in multi-operator cable systems.

Long-term maintenance contracts

As noted above, the global submarine cable industry contains an aging fleet of cable ships. Replacing those vessels requires significant capital investment, with shipowners seeking financing for newbuilds having to address two key challenges: securing lender confidence and mitigating long-term operational risks.

In overcoming these barriers, long-term maintenance contracts can play a pivotal role. By providing predictable revenue streams, clear technical requirements, and enforceable service obligations, such contracts enhance project bankability. They also improve transparency and compliance, enabling structured risk allocation between shipowners, cable operators, and financial institutions. As a result, the financing process becomes more efficient, with investors gaining greater assurance of asset utilization and return.

BOX 5: THE YZ MAINTENANCE CONTRACT FRAMEWORK: A CASE STUDY

In 1997, the YZ introduced a 15-year maintenance contract framework that provided shipowners with financial predictability and operational stability. This long-term horizon enabled operators to secure favourable financing by demonstrating reliable revenue streams over the contract life. This facilitated major capital investments, including new cable repair vessels, advanced splicing systems, and crew training programmes. Lenders viewed these contracts as low-risk, supporting longer loan tenures and lower borrowing costs. This, in turn, strengthened regional repair capacity.

In recent renewal cycles, however, the contractual term was shortened to 5 years. Unfortunately, the reduced duration undermined investment confidence. Financial institutions have since grown reluctant to fund vessel newbuilds and upgrades. Shipowners, facing tighter credit and pressure for near-term returns, have shifted toward conservative strategies, deferring modernization and extending the service life of aging assets.

This experience underscores a key principle: sustained investment in high-value maritime infrastructure depends on contractual frameworks that align risk, return, and time. Long-term agreements are essential in maintaining a modern, resilient, and technologically capable submarine cable maintenance fleet.

Innovative tools and predictive maintenance

Increasingly, the cable repair and maintenance industry has been adopting innovative technologies that enhance repair efficiency. This has included a shift toward predictive maintenance. Key practices now include:

- The wider use of improved grapnels (including the cut and hold grapnel), digital X-ray machines and, where feasible, high-productivity splicing techniques for high fibre count cables.
- The integration of geographical information systems (GIS), vessel tracking and weather intelligence to optimize vessel routing and scheduling.
- The use of incident data and performance metrics to proactively identify high-risk segments and strategically position spare depots or pre-staged resources.

Joint industry drills and emergency exercises

Regular joint drills involving cable operators, national authorities, and marine contractors have become a cornerstone of preparedness for large-scale submarine cable disruptions, such as multiple simultaneous faults triggered by seismic events. Under realistic stress conditions, these exercises test resource mobilization, interoperability across communication protocols, and cross-zone coordination. Annual exercises sponsored by the ICPC have improved response times, clarified roles during crises, and strengthened regulatory alignment across jurisdictions.

3.5 RECOMMENDATIONS: TOWARDS A FAST-RESPONDING AND RESILIENCE-ORIENTED GLOBAL REPAIR ARCHITECTURE

A robust and efficient global repair system requires coordinated action across governance, financing, and operations. The recommendations below draw on the best practices outlined in the preceding section and are intended to help stakeholders and implementing entities strengthen system-wide preparedness, accelerate incident response, and enhance the repair capacity of the global submarine cable ecosystem. They also follow on from recommendations 1, 2, and 3 in Chapter 2, above.

Recommendation 4: Encourage the creation or expansion of incentives to expand repair assets

Governments and industry stakeholders are encouraged to consider incentives aimed at improving the availability and pre-positioning of repair assets, including repair vessels and spare parts. This should be achieved by enabling broader participation by both companies and countries. Such an incentive scheme might contribute to improving repair readiness in high-risk and remote areas and to reducing mobilization times for emergency response. Meanwhile, where appropriate, such efforts could be supported by the removal of relevant regulatory barriers, as referenced in the recommendation in Chapter 2.

Recommendation 5: Establish plans for shallow-water RRUs

Industry stakeholders, particularly those that may be involved in addressing shallow-water submarine cable faults, are encouraged to consider establishing plans for mobilizing shallow-water RRUs. An initial step could involve conducting preliminary assessments to identify suitable RRU resources within relevant regions. Where appropriate, stakeholders may enter into cooperative agreements or framework arrangements with RRU-capable contractors. In these, responsibilities, repair scopes, and cost allocations for commissioned repairs must be clearly defined.

RRUs should be regarded as a supplementary capability to conventional repair vessels. They should be used only when conventional repair vessels are unavailable, unsuitable, or require extensive technical modifications that would delay responses to near-shore incidents. The cost-effectiveness of the use of RRUs should also be assessed, taking into account the specific operational conditions of each region.

Recommendation 6: Promote mutual assistance and shared infrastructure models

Cable maintenance companies and cable owners are encouraged to strengthen multistakeholder cooperation among maintenance zones and private agreements. This can be achieved through:

- **Regional pools of cable spares and shared repair vessels operated under commercial agreements,** especially in Africa, the SIDS and parts of Latin America, where repair resources are limited.
- **Jointly funded or multi-contracted vessels** based at critical hubs and supporting regions lacking sufficient repair resources.
- **Cross-zone and cross-arrangement mutual assistance mechanisms** to enhance the overall effectiveness of cable repairs.

Recommendation 7: Establish a global repair asset optimization framework

Industry associations could conduct relevant research to map global vessel and depot coverage gaps using operational data. This would identify repair resource shortfalls and inform investment decisions. It would:

- **Identify underserved regions and prioritize strategic investment incentives**, such as tax credits, exemptions and incentives, co-funded vessels, port bases and cable depots.
- **Encourage long-term maintenance contracts** to ensure the necessary investment in repair capability.
- **Encourage public–private partnerships (PPPs)** to establish maintenance hubs in underserved regions.

In addition to the above recommendations based on best practices, the industry also acknowledges that a resilient submarine cable repair ecosystem depends on other key enablers. These include the systematic capture of operational experience, along with sustained investment in workforce capability.

Recommendation 8: Encourage collaboration between maintenance agreements on industry best practices

Collaboration on industry best practices should be encouraged between maintenance agreements, including those reflected in the relevant ICPC Recommendations and other appropriate mechanisms. To support a more effective and consistent approach to submarine cable repair and maintenance, this collaboration should take place in areas such as safety, proximity, coordination and operational response.

Recommendation 9: Encourage training and knowledge platforms

The industry should be encouraged to establish submarine maintenance training opportunities and programmes in key maritime regions. This should be done through partnerships among telecom companies, universities, and maritime institutes. Programmes may cover:

- cable jointing
- deck operation, including deep-sea operations
- ROV operation and maintenance
- marine health, safety, environment (HSE) and risk assessment
- project management.

Such programmes can complement existing digital repositories of best practices.

CHAPTER 4: GOVERNMENT AND INDUSTRY COLLABORATION AND COOPERATION IN CABLE REPAIR AND DEPLOYMENT

Submarine cable resilience is influenced not only by technical design and maintenance arrangements, but also by the effectiveness of coordination between public authorities and the industry. Across jurisdictions, deployment and repair timelines are affected by permitting processes, maritime safety requirements, border procedures and security coordination, all of which sit at the interface between government and private operators.

This chapter addresses how public–private cooperation mechanisms support preparedness and the efficient use of global maintenance and repair capacity. The focus is on practical coordination arrangements observed across different regions, rather than on regulatory models or technical solutions, which are addressed elsewhere in this report.

4.1 PUBLIC–PRIVATE COOPERATION AND REPAIR READINESS

Repair readiness is a system-level outcome arising from the interaction of multiple stakeholders with distinct responsibilities. Cable owners, system suppliers, and maintenance providers manage vessels, spares and operational execution, while public authorities are responsible for authorizations, maritime safety, border controls, security coordination, and spatial planning.

In practice, restoration outcomes depend on whether the 'system around the system' is ready. For this, there must be clear decision paths, current contacts, pre-agreed procedures, and a shared understanding of the minimum conditions for safe and compliant repair operations. Where these interfaces rely primarily on ad hoc coordination, uncertainty and delay are more likely during incidents. This is particularly the case when there is a need for parallel action by multiple authorities, such as maritime administrations, ports and vessel traffic services (VTS),[19] customs and immigration, environmental bodies, and security actors.

Jurisdictions that maintain standing public–private cooperation arrangements tend to demonstrate clearer role allocation, more predictable decision-making and faster mobilization. Such arrangements provide a stable basis for routine coordination in areas such as planned surveys, maintenance activities, and landing works. They also provide such a basis for emergency responses, such as fault notification, mobilization, on-scene deconfliction and restoration. They also enable periodic validation of assumptions through exercises and after-action reviews, supporting continuous improvement without requiring a crisis to reveal procedural gaps.

From an implementation perspective, cooperation commonly works best when responsibilities are made explicit via a light, 'who leads/who supports/who must be consulted/who should be informed' approach. It also works best when coordination is supported by practical artefacts, such as 24/7 contact lists, standard notification templates, agreed evidence packs, and time-bound decision points. These elements increase predictability for all parties, including repair contractors and insurers, and help reduce non-technical delays that can otherwise dominate overall restoration time.

[19] For more information on VTS, see the IMO web page, "Vessel Traffic Services", https://www.imo.org/en/ourwork/safety/pages/vesseltrafficservices.aspx (accessed 29 May 2026).

4.2 COOPERATION MECHANISMS

Two main varieties of cooperation mechanisms – those aimed at risk reduction, preparedness and predictive approaches, and those targeting maintenance and repair capacity – are now addressed below.

1) Cooperation mechanisms for risk reduction, preparedness and predictive approaches

Improved risk awareness and preparedness typically requires sustained interaction between authorities and operators, since key risk drivers (maritime activity patterns, environmental constraints, operational experience and incident history) are distributed across multiple stakeholders. Public–private cooperation provides the institutional context within which risk insights can be shared,

- **Shared risk awareness and information exchange**

Public authorities and industry stakeholders hold complementary information relevant to cable protection and resilience. This information includes maritime activity data, environmental constraints and operational experience. Structured cooperation mechanisms enable this information to be considered jointly. This supports:

- the identification of higher-risk areas and activities
- the prioritization of protection and monitoring measures
- the integration of cable considerations into planning and protection processes.

These arrangements support preventive action and provide a foundation for risk-informed and predictive approaches.

- **Preparedness through standing coordination arrangements**

Preparedness is strengthened when roles, decision pathways and coordination routines are established before an incident occurs. Standing coordination arrangements provide a mechanism to keep contact chains current, align expectations across agencies, and reduce ambiguity during time-critical repair operations. Common features observed across jurisdictions include designated points of contact, agreed notification procedures and periodic joint exercises. These mechanisms support consistency in response and, over time, enable lessons learned to be incorporated into updated procedures and practices.

2) Cooperation mechanisms for global maintenance and repair capacity

Given that repair vessels, specialized crews and certain categories of spares are finite and regionally distributed, restoration outcomes may depend on the ability to mobilize assets across jurisdictions and to reduce avoidable administrative friction. Public–private cooperation contributes by enabling a shared understanding of constraints. It also contributes by supporting practical facilitation measures that improve mobilization.

- **Coordination on repair readiness and capacity**

High-level coordination can help reconcile public resilience priorities with privately-managed maintenance arrangements. Governments have an interest in understanding repair readiness for routes that are critical to national or regional connectivity, while industry manages repair assets under commercial arrangements. Public–private cooperation can support high-level visibility of repair readiness and of its constraints. This can, in turn, facilitate dialogue on potential gaps and dependencies without requiring the disclosure of information that is commercially or security sensitive.

- **Enabling regional and cross-border arrangements**

The efficient use of global repair assets depends on interoperability across regions. Public authorities contribute by facilitating cross-border movement of vessels, crews and equipment, supporting compatible procedures where feasible, and avoiding regulatory fragmentation that could limit regional maintenance arrangements. These measures support flexible deployment and reduce response times when incidents occur.

4.3 THE EVOLVING LANDSCAPE OF PUBLIC-PRIVATE COOPERATION

Cooperation mechanisms vary by jurisdiction, reflecting different legal systems, maritime geographies and institutional mandates. Nevertheless, several models illustrate how standing structures can provide continuity, trusted interfaces and repeatable procedures for both protection and repair. Some examples of this include:

- **Europe: The European Subsea Cables Association (ESCA)**

  The European Subsea Cables Association is an association of telecommunications, power, and offshore renewable cable owners, in addition to vessel operators, supply chain entities and government departments. ESCA provides a platform for informal engagement and collaboration on subsea cable policy, as well as the exchange of technical information. It also provides a voice for the industry in the European region.

- **Denmark: The Danish Cable Protection Committee (DKCPC)**

  This is an association of gas, telecommunications and electricity companies that own submarine cables and pipelines in Danish waters. Its purpose is to strengthen the protection of pipelines and subsea cables in order to safeguard security of supply and the reliable provision of electricity and telecommunications services. Operating as a standing, public-private platform with the competent state administrations, the DKCPC co-ordinates MSP, shared risk monitoring and enforcement support. The organization also illustrates how a high-traffic, maritime state can align public and private channels to reduce day-to-day interference risks and speed up permitting.

- **Kingdom of the Netherlands: The Dutch Subsea Cable Coalition**

  This is a cooperation between public and private entities that acts as the central point of contact for subsea cable landings in the Kingdom of the Netherlands. It brings together infrastructure operators, data centres, internet exchanges, knowledge institutes and multiple layers of government to stimulate new landings and maintain and strengthen the country's digital-hub position. The Coalition guides landing parties through the Dutch administrative ecosystem, connecting them to the right authorities and partners, streamlining permitting and spatial-planning interfaces, and sharing local knowledge. It also actively explores opportunities to link to European and intercontinental routes. This 'single front door' model helps shorten timelines and de-risk landings.

- **Portugal: The Observatory of Digital Ecosystems and Infrastructure (OEID)**

  The OEID is a non-profit, neutral forum that produces and shares specialist knowledge on digital ecosystems and infrastructure in Portugal and abroad. It works with government, academia and operators on the topics of security, resilience and prevention policy for critical digital assets – including international submarine cables and landing facilities.

The OEID is not a regulator; it acts as a knowledge broker and convening platform. In practice, the organization provides an interface for dialogue, evidence and best-practice. It convenes stakeholders via conferences, technical sessions and institutional meetings to align public aims and private investment with resilience goals, linking landing entities and adjacent sectors, such as ports, defence, research, and the maritime industry. For submarine cables, the OEID complements the competent authorities and industry groups by publishing analyses and hosting events on operational and policy options. These range from repair readiness to integrating cable needs in maritime spatial planning. Topics covered include, for example, how to increase the resilience of submarine cables in Portuguese waters and Portugal's place in the global submarine cable network.

- **Brazil: The Brazilian Submarine Cable Protection Committee (CBPC)**

  This is a multi-stakeholder forum involving government bodies, the sector regulator, the navy and the industry. It is focused on protection and coordinating responses at a major landing hub.

4.4 COMMON ENABLERS ACROSS JURISDICTIONS

Across cooperation arrangements, a small set of enabling elements recurs. This set appears to contribute to predictability and speed during both planned activities and emergency repairs. These enablers help reduce ambiguity over roles and interfaces and support continuous improvement through routine review. Common elements among them include:

- a designated national SPOC for submarine cables
- clarity on roles and decision-making responsibilities
- pre-agreed procedures for emergency repair facilitation
- routine use of performance indicators, such as time-to-permit, time-to-mobilize and mean time to repair (MTTR).

Together, these elements support predictability and continuous improvement.

4.5 RECOMMENDATIONS: PUBLIC-PRIVATE COOPERATION IN ENHANCING DEPLOYMENT AND REPAIR EFFICIENCY

This chapter's analysis shows that public–private cooperation is a practical enabler of submarine cable resilience. Effective cooperation arrangements reduce ambiguity between public authorities and private operators, improve preparedness before incidents occur and support faster, more predictable deployment and repair processes. The examples reviewed above reveal that common success factors include: shared awareness of risks and operational constraints; established coordination procedures; clear operational interfaces; verified contact chains; and operational tools that can be activated immediately.

The following recommendations are based on these findings. They aim to make coordination more predictable and reduce non-technical delays. They also aim to strengthen the readiness of governments, cable owners and operators to address challenges in deploying and repairing cables in both routine and contingency situations. They also follow in numerical order from the recommendations in Chapter 2 and Chapter 3.

Recommendation 10: Encourage voluntary data sharing

Governments, industry, and regional organisations should be encouraged to consider voluntary arrangements for sharing relevant best practices and lessons learned. They should also be encouraged to share non-sensitive, incident-related information that could enhance submarine cable preparedness, protection, deployment and repair, where appropriate. Wherever possible, these arrangements should be based on trusted, existing mechanisms and cooperation platforms rather than involving the creation of duplicate structures.

Such arrangements must also be proportionate, respecting commercial confidentiality, security-sensitive information and applicable legal frameworks. The aim should be to improve the shared awareness of recurring operational bottlenecks, higher-risk scenarios, practical mitigation measures, and coordination practices that can reduce non-technical delays and support more effective restoration.

Relevant international and regional organisations, acting within their respective mandates, can support this objective by raising awareness and disseminating good practices. In this regard, the IMO could raise awareness among maritime administrations of practical lessons and good practices relevant to submarine cable incident coordination, repair facilitation, and prevention-oriented cooperation with industry. Similarly, the International Hydrographic Organization (IHO) could support the dissemination of good practices relevant to hydrographic data coordination, nautical charting and cooperation with national hydrographic offices, insofar as these are relevant to accurately and promptly depicting submarine cable networks.

Recommendation 11: Encourage national public-private cooperation mechanisms

The establishment, or strengthening, of national public-private cooperation mechanisms between the relevant authorities and cable owners and operators should be encouraged. This should be done in order to facilitate the predictable coordination of submarine cable deployment, protection, and repair. These mechanisms could be platforms, committees or working groups, for example, and should be suited to national legal and institutional contexts. These mechanisms should also provide a stable interface for routine coordination and emergency response.

Where feasible and appropriate, such mechanisms should also maintain a clear operational entry point, or 'single front door', for coordination. This should be supported by validated 24/7 contact lists and escalation pathways across the relevant authorities and private actors. Such mechanisms should also facilitate periodic multi-stakeholder exercises and routine reviews – as well as post-incident learning – to ensure that assumptions, procedures and institutional interfaces remain current and usable in practice.

Additionally, these mechanisms should maintain a set of practical coordination tools to support timely, predictable, and repeatable action. These tools could include notification templates, agreed decision pathways, and proportionate evidence packs. The overall objective should be to clarify roles and responsibilities, reduce procedural uncertainty and strengthen preparedness before incidents occur. The objective should also be to improve interoperability with regional and cross-border arrangements when vessels, crews, spares or authorisations must be mobilised across jurisdictions.

WORKING GROUP REPORT 2: RISK IDENTIFICATION, MONITORING AND MITIGATION

RECOMMENDATIONS[20]

WORKING GROUP 2 RECOMMENDATIONS
RISK IDENTIFICATION, MONITORING & MITIGATION

	National, Regional* and Global Cooperation, Coordination and Collaboration
1	Encourage governments to develop National level strategies based on data evidencing the risks: encourage relevant national authorities to collaborate with cable landing licensees to enhance visibility and oversight of submarine cable faults and vulnerabilities within and beyond their waters, taking into account considerations for storage, sharing, and security of such data.
2	Knowledge sharing between industry and government: Foster greater cooperation and improvements to knowledge sharing between industry and national governments, to ensure national policy frameworks include appropriate measures to help enhance resilience. To be coordinated via the International Cable Protection Committee (''ICPC'') and/or regional Cable Protection Committees (''CPC'') or other recognized industry organizations, and further supported by consultative bodies with submarine cables expertise to inform relevant governmental bodies on technical aspects of cables industry best practice (Ministries, National Regulatory Authorities, Marine & Environmental regulators, Customs, etc.
3	Encourage the development of a standard reporting mechanism for governments and ICPC/regional CPCs or recognized industry organizations to share, on a voluntary basis, anonymised information they collect on submarine cable delays, marine faults and other outages on a disassociated basis from cable systems with other governments and/or industry stakeholders.
	Cable Protection Legislation and Enforcement
4	Jurisdiction and Authority: Encourage national governments to establish clear legal and operational frameworks that are consistent with international law for the management of submarine cables in their waters, including critical national infrastructure designation where appropriate.
5	Treaty Obligations: Urge states to implement United Nations Convention on Law of the Sea (''UNCLOS'') article 113 (to make the damaging of cables a punishable offence) and International Hydrographic Office (IHO) resolution 4/1967 (regarding certain activities within 0.25-mile on either side of submarine cables).
6	Enforcement legislation: Encourage governments to engage law enforcement agencies to assist with cable damage investigations (where the cause may be a third party), consistent with national laws and national sovereignty. Encourage real-time data sharing between industry and government agencies on cable fault localisation and identification of suspect vessels aided by enhanced enforcement of Automatic Identification System (AIS) regulations and the use of other applicable technologies. In developing legislation, clarify liability standards (intentionality, negligence) and penalty amounts.
	Co-existence with other Maritime Sectors

[20] The wording of these recommendations is as it was approved in the original document, unedited.

(continued)

7	Include navigating in proximity to submarine cables within the standard syllabus for the Basic Safety Training mandated by the International Maritime Organisation (IMO) under their International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW).
8	Require adequate stowage and securing of anchors on vessels to be inspected under the Flag State and regular Port State Control Inspection to avoid anchor dragging against submarine cables.
9	Recognize the spatial requirements of existing and future submarine cables, including their avoidance of manmade and natural hazards, chokepoints, and coexistence with regulated uses of (or protective measures for) the seabed and marine environment, consistent with the jurisdictional provisions of UNCLOS and customary international law.
10	Consider expanding the remit of nautical charting agencies to require them to regularly update the plotting of cables based on latest information from industry. Promote the maintenance of up-to-date cable system position records by cable owners, and encourage clear data flows where relevant from cable installers, owners and recovery companies to government and charting agencies to ensure accuracy, consistency and accountability.
	Strengthening Security & Resilience
11	Audits and Stress Tests: Encourage relevant entities to conduct routine stress tests to verify submarine cable system robustness, assess network risks from choke points and/or route congestion/clustered landings, and disaster response. Regularly audit cable resilience and maintenance provisions to ensure adequate spares, repair agreements, and test the robustness of cable station and digital access security.
12	Decommissioning and redundancy: Promote information sharing and/or notification regarding submarine cable decommissioning to address any resilience gaps, particularly for Small Island Developing States (SIDS) reliant upon few international links.
13	Enhance and expand industry guidance on hardening the security and surveillance of cable stations, fronthaul cables and outside plant and digital access portals (command and control systems).
14	Evaluate the benefit of higher upfront Investment to reduce the risk of future outages. Industry is encouraged to share detailed recommendations on survey, route planning, engineering and installation (including burial) to enhance cable protection.

*Any reference to "national" or "government" is understood to extend to regional economic integration organizations (REIOs) within their respective area of competence.

EXECUTIVE SUMMARY

Submarine telecommunications cables form the critical backbone of the global digital economy, carrying over 99 per cent of intercontinental data traffic. Despite their strategic importance, however, these networks remain vulnerable to a range of mainly physical risks, experiencing approximately 150-200 faults annually. Over 80 per cent of those incidents are attributable to human maritime activities – primarily commercial fishing and dragged ship anchors. In addition, natural hazards and structural vulnerabilities, such as route concentration in global chokepoints, further compound risks.

This report, produced by the International Advisory Body (IAB) on Submarine Cable Resilience, Working Group 2: Risk Identification, Monitoring and Mitigation, provides a comprehensive analysis of these risks. It also proposes 14 actionable recommendations to safeguard this critical infrastructure. The recommendations are structured around four strategic pillars:

1. National,[21] regional, and global cooperation

Resilience begins with visibility. This report urges governments[1] to develop data-driven national strategies (Recommendation 1) by collaborating with cable landing licensees to monitor risks and deploy active mitigation measures – such as guard vessels – in high-risk zones. It further advocates enhanced knowledge sharing between industry and government (Recommendation 2). To enable evidence-based policymaking and resource allocation, the report also recommends the establishment of a standardized, anonymized reporting mechanism for cable faults and outages (Recommendation 3).

2. Cable protection legislation and enforcement

Robust legal frameworks are essential for deterrence and accountability. This report calls on national governments to establish clear jurisdictional authority over submarine cables, including designating them as critical national infrastructure (Recommendation 4). It emphasizes the need to implement treaty obligations under the United Nations Convention on the Law of the Sea (UNCLOS) to make cable damage a punishable offence (Recommendation 5). The report also encourages the enactment of enforcement legislation that leverages real-time vessel tracking data (the automatic identification system [AIS]) to assist law enforcement in fault investigations (Recommendation 6).

3. Co-existence with other maritime sectors

As the seabed becomes increasingly crowded with competing economic activities, proactive spatial planning is vital. The recommendations of this report highlight the need to integrate cable awareness into mandatory seafarer training (Recommendation 7) and enforce strict anchor stowage inspections (Recommendation 8). Furthermore, governments must recognize the spatial requirements of cables in order to avoid hazards (Recommendation 9) and mandate the regular updating of nautical charts to reflect accurate cable positions, ensuring mariners have the information needed to navigate safely (Recommendation 10).

4. Strengthening security and resilience

To address structural vulnerabilities, this report recommends routine audits and stress tests of cable systems. These should assess disaster response capabilities and network risks from route congestion (Recommendation 11). This report also highlights the importance of managing resilience gaps during cable decommissioning (Recommendation 12) and of hardening the physical and digital security of cable landing stations (Recommendation 13). It also highlights the importance of evaluating the long-term benefits of higher upfront investments in route engineering and burial techniques in order to reduce future outages (Recommendation 14).

Ultimately, securing the global digital backbone requires a transition from reactive, siloed approaches to proactive, collaborative efforts. By implementing these recommendations, governments and private operators can work in tandem to mitigate risks, co-exist with other ocean industries, and ensure the uninterrupted flow of global communications.

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[21] Any reference to "national" or "government" is understood to extend to Regional Economic Integration Organizations (REIOs) within their respective area of competence. Any reference to "governments" or "states" is otherwise intended to refer to individual governments or states.

RECOMMENDATION 1: DEVELOP NATIONAL LEVEL STRATEGIES BASED ON DATA EVIDENCING THE RISKS

Encourage governments to develop National level strategies based on data evidencing the risks: encourage relevant national authorities to collaborate with cable landing licensees to enhance visibility and oversight of submarine cable faults and vulnerabilities within and beyond their waters, taking into account considerations for storage, sharing, and security of such data.

1.1 INTRODUCTION

Globally, submarine cables experience approximately 150-200 faults each year, with over 80 per cent of these incidents attributed to human activities, such as commercial fishing and dragged ship anchors.[22] Recommendation 1 addresses the foundational need for evidence-based policy-making at the State level, recognising that resilience cannot be achieved without first making the risks facing cable infrastructure visible.

This chapter provides an in-depth analysis of Recommendation 1. It explores the primary risks to submarine cables, the mechanisms for monitoring those risks, and the strategic value of developing data-driven national resilience frameworks – including the deployment of active, physical mitigations such as guard vessels.

1.2 IDENTIFYING THE RISKS: THE FOUNDATION OF DATA-DRIVEN STRATEGIES

To develop effective national strategies, governments must first understand the specific threat vectors operating within their maritime jurisdictions.

The risks to submarine cables can be broadly categorised into: human maritime activities; natural and environmental hazards; and structural vulnerabilities.

Human maritime activities: Fishing and anchoring

Human maritime activity remains the leading cause of submarine cable faults, accounting for between 40 per cent and 70 per cent of all known incidents, globally. The risk is highest in continental shelf areas, major fishing grounds, and coastal zones with intense artisanal fisheries.

Fishing activities: Fishing is considered the primary cause of cable damage worldwide, with the highest frequency of these events occurring in Asia. Trawling is the method that makes the most impact, though the specific gear used heavily influences the likelihood of damage. The introduction of innovative, Sumwing trawls in European waters, for example, has inadvertently increased cable damage, as while the hydroplane devices used by this system do not sever cables directly, they damage cable insulation. This allows seawater to penetrate the metallic

[22] See the International Cable Protection Committee (ICPC) report, *Damage to Submarine Cables from Dragged Anchors*, ICPC, Portsmouth, 2025, https://iscpc.org/publications/icpc-viewpoints/damage-to-submarine-cables-from-dragged-anchors/

core and cause short circuits. In the East China Sea, stow net fishing – which uses massive anchors that penetrate soft sediments up to three metres – is responsible for approximately 15 per cent of annual global cable faults. Furthermore, the proliferation of fish aggregating devices (FADs) in the Pacific has introduced new risks, as their heavy, concrete sinkers can impact cables during deployment or dragging.

Anchoring incidents: For many years, distinguishing between fishing and anchoring faults was difficult. However, the widespread adoption of vessel tracking technologies has revealed that many faults previously attributed to fishing were actually caused by anchors.[23] Anchor damage occurs when an anchor is dropped directly onto a cable or, more frequently, when it drags due to extreme weather, inadequate chain scope, or poor seabed conditions. The consequences can be catastrophic. In 2008, for instance, a ship off the coast of Sicily dragged its anchor for 300 kilometres, damaging six submarine cables. Similarly, in 2023, a container ship navigating the China Sea dragged its anchor during severe weather, severing four cables. In United States dollar (USD) terms, the incident caused an estimated USD 1.1 million in initial economic losses.

Natural and environmental hazards

Natural hazards, while less frequent than human-induced faults, can cause devastating and widespread disruptions.

Seismic activity and submarine landslides: Seafloor shaking from earthquakes imposes severe tensile and bending stresses on cables. However, cables are rarely broken by the fault displacement itself; rather, they are severed by massive submarine landslides or turbidity currents triggered by the seismic event. An historic example is the 1929 Grand Banks earthquake, which triggered a turbidity current that severed 11 of the 13 transatlantic telegraph cables. More recently, the 2006 Pingtung earthquake south of Asia caused 13 cable faults within hours. In addition, the 2022 Hunga Tonga-Hunga Ha´apai volcanic eruption triggered a subsea landslide that severed both domestic and international cables, entirely isolating Tonga from the global network.[24]

Climatological impacts: Climate-related hazards primarily affect shallow-water regions. Typhoons and severe storm systems generate high-energy waves and turbulent nearshore currents capable of eroding seabed sediments and exposing previously buried cables. Once exposed, cables face increased risks of mechanical fatigue and human-induced damage. Furthermore, rising sea levels and ocean warming are reshaping coastal energy regimes and shifting the spatial distribution of fishing activities. This is altering cable risk zones in ways that historical data cannot reliably predict.

1.2.3 Structural and operational vulnerabilities

Beyond physical risks, the resilience of the global network is constrained by structural and technical vulnerabilities.

Route concentration: A prominent structural vulnerability is the high spatial concentration of international cable systems in global chokepoints, such as the Luzon Strait, the Strait of Malacca,

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[23] See footnote 2.

[24] See Clare, M.A., *et al.*, "Volcanic eruptions and the global subsea telecommunications network", *Bulletin of Volcanology,* 87, 51, Springer, 2025, https://doi.org/10.1007/s00445-025-01832-1 (accessed 15 June 2026).

and the Red Sea corridor. Driven by economic and bathymetric constraints, these dense clusters amplify systemic risk; a single natural hazard or geopolitical disruption in these corridors can cause multiple systems to fail simultaneously.

Lack of redundancy: The absence of redundancy mechanisms across submarine segments, terrestrial backhaul routes, and cable landing stations (CLSs) creates localized single points of failure. If a region relies on a single major international cable, any disruption can result in a complete loss of connectivity.

1.3 MONITORING AND VISIBILITY: THE ROLE OF DATA

Recommendation 1 emphasizes the need for governments to "enhance visibility and oversight of submarine cable faults and vulnerabilities". Effective monitoring is a prerequisite for generating the data required to build national strategies.

Tracking physical risks

The integration of advanced tracking systems has revolutionized the monitoring of vessel traffic near cables. These systems allow operators to track ship movements in real-time, identify vessels responsible for damage, and, in some cases, forewarn vessels before damage occurs. However, global tracking data is not yet comprehensively integrated into all national cable monitoring platforms, and coastal enforcement capabilities vary significantly.

Additionally, fibre sensing techniques, such as distributed acoustic sensing (DAS), are increasingly used to identify seabed sounds linked to potential risks. While correlating these sounds with specific vessels remains challenging in the open ocean, fibre sensing on terrestrial fronthaul cables between the beach manhole (BMH) and the CLS has proved highly effective in identifying unauthorized construction work and preventing damage.

Data aggregation and oversight

To build comprehensive risk datasets, governments may wish to consider implementing robust oversight mechanisms. Currently, data collection frameworks vary widely, ranging from mandatory national reporting systems to voluntary industry aggregation efforts that track fault trends and repair commencement times (see Recommendation 3).

By collaborating with cable landing licensees, national authorities can consolidate these disparate data streams into a unified national threat picture. This collaboration ensures that governments have the empirical evidence necessary to assess vulnerabilities within and beyond their waters, while also carefully managing the storage, sharing, and security of sensitive commercial data.

1.4 DEVELOPING DATA-DRIVEN NATIONAL STRATEGIES

With a clear understanding of the risks and robust data collection mechanisms in place, governments can develop targeted, evidence-based national strategies to protect their submarine cable infrastructure.

Implementing comprehensive government protection strategies

Beyond active physical mitigation, governments can adopt a suite of regulatory and administrative strategies to safeguard submarine cables, drawing on international best practices and regional frameworks.

Establishing CPZs: Governments can designate specific geographical areas as CPZs. In these, high-risk activities, such as anchoring and bottom-trawling, are strictly prohibited. The Australian Communications and Media Authority (ACMA), for example, has declared protection zones that extend up to 200 nautical miles offshore. Within these, certain state laws are superseded to ensure uniform protection. Similarly, New Zealand has established 10 protection zones under its Submarine Cables and Pipelines Protection Act, backed by significant fines for both commercial and non-commercial vessels that violate the anchoring bans.[25]

Under international law, these measures are only enforceable with respect to vessels flying the national flag beyond territorial waters (the 12 nautical mile limit). CPZs are therefore not appropriate in all geographies, as they can encourage the clustering of cables and create single points of failure.

Mandating burial depths and separation distances: In some circumstances, national authorities can enforce strict engineering standards for cable installation within their jurisdictions. Within the Singapore Port Limits, the Maritime and Port Authority (MPA) of Singapore requires licensees to bury their submarine cables to a depth that can withstand an anchor drop from a very large crude carrier (VLCC). This may translate into a required depth of between 4 and 12 metres, depending on the seabed conditions.[26] Beyond the Singapore Port Limits, the Infocomm Media Development Authority (IMDA) of Singapore strongly encourages burial of cables to similarly withstand an anchor drop from a VLCC, especially in areas where higher levels of incidents are known to occur.

Applying depth of burial requirements must be considered cautiously, however, in discussion with technical experts from the relevant sector. Whilst this is a measure taken in some jurisdictions, for technical reasons it may not be appropriate in certain seabed conditions, or in congested areas.

Furthermore, governments can adopt the ICPC recommendations on spatial separation. These advise a minimum separation distance of 300 metres in shallow waters and twice the water depth in deeper waters.[27]

Enhancing navigational awareness: To prevent accidental damage, governments may wish to ensure that mariners are fully aware of cable locations. The Maritime and Coastguard Agency (MCA) of the United Kingdom (UK) issues guidance requiring masters to consult updated Admiralty charts, which clearly demarcate areas where anchoring and fishing are prohibited

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25 See Carter, N. T., *et al.*, *Protection of Undersea Telecommunication Cables: Issues for Congress,* Report R47648, 7 August 2023, Congressional Research Service, Washington DC, https://www.congress.gov/crs-product/R47648 (accessed 16 June 2026).

26 See Info-communications Media Development Authority (IMDA), *Guidelines on the Management of Submarine Cable Damage Incidents in Singapore Port Limits and the Traffic Separation Scheme Zone*, IMDA, Singapore, 2019, https://www.imda.gov.sg/-/media/imda/files/regulation-licensing-and-consultations/codes-of-practice-and-guidelines/2019-04-01-guidelines-on-the-management-of-submarine-cable-incidents.pdf (accessed 16 June 2026).

27 See ICPC Recommendation 2, ICPC, Portsmouth, 2022, https://www.iscpc.org/publications/recommendations/ (accessed 28 June 2026).

due to cables.[28] The ICPC further recommends that governments promote the distribution of cable awareness charts to fishing communities directly and require the use of vessel monitoring systems (VMS) on all vessels – regardless of size – to track compliance.[29]

Active mitigation

While data-driven planning provides foundational protection, some high-risk areas require active, physical mitigation. In locations where cable damage has occurred repeatedly and other mitigations (such as burial or exclusion zones) have failed, the deployment of guard boats or patrol vessels can be a highly effective solution – albeit one that is also costly and short term. Working Group 2 noted that where additional protective measures – such as guard vessel deployment – are considered necessary to safeguard submarine cable infrastructure, such measures generally fall within the core responsibilities and competence of the coastal State authorities concerned with maritime safety, security and the protection of critical infrastructure. In certain situations, however, interim or supplementary measures may be undertaken by infrastructure operators or other stakeholders. This is particularly the case when immediate risk mitigation actions are required due to operational timelines, or evolving threat conditions.

Guard vessels act as sentinels over subsea telecommunications cables, actively monitoring maritime traffic and warning nearby vessels to keep a safe distance before damage occurs. These vessels are particularly valuable in congested straits, or during high-risk periods – such as awaiting post-lay burial during the construction phase. By integrating with AIS data and radar, guard vessels can identify ships that are anchoring or trawling too close to the cable route and intervene directly via VHF radio or physical interception.[30]

1.5 FOSTERING PUBLIC-PRIVATE COLLABORATION

Recommendation 1 explicitly calls for collaboration between national authorities and cable landing licensees. Because the vast majority of submarine cables are privately owned and operated, governments cannot achieve resilience in isolation.

National strategies should establish formal mechanisms for continuous dialogue, such as the creation of domestic submarine cable coordination units. These platforms facilitate the secure exchange of threat intelligence and ensure that considerations for the "storage, sharing, and security of such data" are strictly managed to protect commercial sensitivities. This allows governments to maintain oversight without compromising operational security.

1.6 FINAL REMARKS

International Advisory Body (IAB) Working Group 2 Recommendation 1 highlights a fundamental truth about modern infrastructure protection: resilience cannot be achieved without visibility. By encouraging governments to develop national strategies based on empirical data, the IAB

[28] See MCA, *MGN 661 (M+F) Navigation: Safe and responsible anchoring and fishing practices*, GOV.UK, London 2021, https://www.gov.uk/government/publications/mgn-661-mf-navigation-safe-and-responsible-anchoring-and-fishing-practices/mgn-661-mf-navigation-safe-and-responsible-anchoring-and-fishing-practices (accessed 16 June 2026).

[29] See footnote 7.

[30] See Ground Control, "The Role of RockFLEET in Securing Undersea Cables", *Ground Control*, 12 March 2025, https://www.groundcontrol.com/blog/the-role-of-rockfleet-in-securing-undersea-cables/ (accessed 16 June 2026).

report provides a roadmap for mitigating the complex array of risks facing submarine cables. Through the integration of tracking technologies, the implementation of robust oversight frameworks, and the deployment of active mitigations in high-risk zones, states can transition from a reactive posture to a proactive, collaborative approach. Ultimately, securing the global digital backbone requires governments and private operators to work in tandem, guided by a shared, data-evidenced understanding of the risks both within and beyond their waters.

RECOMMENDATION 2: KNOWLEDGE SHARING BETWEEN INDUSTRY AND GOVERNMENT

Knowledge sharing between industry and government: Foster greater cooperation and improvements to knowledge sharing between industry and national governments, to ensure national policy frameworks include appropriate measures to help enhance resilience. To be coordinated via the International Cable Protection Committee (''ICPC'') and/or regional Cable Protection Committees (''CPC'') or other recognized industry organizations, and further supported by consultative bodies with submarine cables expertise to inform relevant governmental bodies on technical aspects of cables industry best practice (Ministries, National Regulatory Authorities, Marine & Environmental regulators, Customs, etc.

2.1 FOSTER INTERNATIONAL/INDUSTRY COOPERATION AND INFORMATION SHARING

The European Union (EU) policy, legislative, and funding framework

The EU has a comprehensive policy, legislative, and funding framework on critical infrastructure in general and submarine (data) cables in particular. Key legislation covering different types of critical infrastructure horizontally includes EU Directives on the physical security and cybersecurity of critical infrastructures (see 'NIS2' Directive (EU) 2022/2555 and 'CER' Directive (EU) 2022/2557).[31]

On submarine data cables specifically, in 2024, the European Commission (EC) adopted Commission Recommendation (EU) 2024/779 on Secure and Resilient Submarine Cable Infrastructure.[32] This established an expert group for policy coordination with EU Member State authorities and the EU Agency for Cybersecurity (ENISA). The Recommendation was followed in 2025 by the comprehensive EU Action Plan on Cable Security (JOIN(2025) 9 final),[33] which

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31 For cybersecurity, see EUR-Lex, "Directive (EU) 2022/2555 of the European Parliament and of the Council", EUR-Lex, Brussels, https://eur-lex.europa.eu/eli/dir/2022/2555/oj/eng (accessed 28 June 2026), and for critical entity resilience, EUR-Lex, "Directive (EU) 2022/2557 of the European Parliament and of the Council", EUR-Lex, Brussels, https://eur-lex.europa.eu/eli/dir/2022/2557/oj/eng (accessed 28 June 2026).

32 See EUR-Lex, "Commission Recommendation (EU) 2024/779 of 26 February 2024 on Secure and Resilient Submarine Cable Infrastructures," EUR-Lex, Brussels, https://eur-lex.europa.eu/eli/reco/2024/779/oj/eng (accessed 28 June 2026).

33 See EUR-Lex, "Joint Communication to the European Parliament and the Council EU Action Plan on Cable Security," EUR-Lex, Brussels, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025JC0009 (accessed 28 June 2026).

encompasses the whole resilience cycle: prevention, detection, response and recovery, and deterrence.

As a major deliverable under the 2025 Action Plan and the 2024 Recommendation, in October 2025, the EC published the Submarine Cable Infrastructures Expert Group report on EU-wide mapping, coordinated risk assessment and stress-test guidance.[34] This report was prepared and agreed with EU Member States. It delivered: 1) a mapping of existing and planned submarine data cable infrastructures connecting EU territories to each other and to other parts of the world; 2) a coordinated risk assessment identifying seven main risk scenarios that build on different risks, vulnerabilities and dependencies; and 3) guidance to stress-test these risk scenarios. The report also provided a comprehensive policy and market overview of EU submarine data cable infrastructures.

In February 2026, the EC published a follow-up report by its Expert Group, delivering the Cable Security Toolbox – a series of mitigating measures put forward in response to the results of the EU risk assessment. The Expert Group also delivered a priority areas list for Cable Projects of European Interest (CPEIs) to be prioritised for future public support.

The Cable Security Toolbox also places strong emphasis on enhanced coordination across industry, Member States, and international partners. It calls for strengthened public–private cooperation in both prevention and response to critical incidents, as well as improved information sharing and exchange of best practices among Member States. The toolbox stresses that effective implementation requires coordinated efforts between Member State authorities, the EC, operators, and a range of international and industry organisations. In particular, it points to the role of partners in facilitating coordination, promoting best practices, and strengthening the security and resilience of submarine cable infrastructures.

As regards funding, the EU has various programmes in place. For example, in euro (EUR) terms, it has committed investments worth over EUR 600 million under the Connecting Europe Facility Regulation (EU) 2021/1153 (CEF Digital)[35] in connectivity backbones (mostly submarine data cables) within the EU and with third countries. A further EUR 347 million is planned to be invested under this framework in 2026 and 2027.

ASEAN Working Group on Submarine Cables and Enhanced Guidelines for Strengthening Resilience and Repair of Submarine Cables

The Association of Southeast Asian Nations (ASEAN) serves as a model for how regional blocs can transition from high-level policy intent to active, operationalized cooperation in submarine cable resilience. In 2019, ASEAN Member States[36] collaborated to establish the ASEAN Guidelines for Strengthening Resilience and Repair of the Submarine Cables (also known as the "2019 Guidelines"). These provide foundational best practices for the region in terms of expediting the repair of submarine cables.

[34] See EC, *Report on security and resilience of EU submarine cable infrastructures,* EC, Brussels, 23 October 2025, https://digital-strategy.ec.europa.eu/en/library/report-security-and-resilience-eu-submarine-cable-infrastructures

[35] See EUR-Lex, "Regulation (EU) 2021/1153 of the European Parliament and the Council," EUR-Lex, Brussels, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R1153 (accessed 28 June 2026).

[36] The ASEAN Member States are: Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Viet Nam.

Recognizing that infrastructure resilience is a shared responsibility, ASEAN deepened this cooperation in 2024 by formalizing the Working Group on Submarine Cables – a body that allowed ASEAN member states to exchange experiences and conduct joint capacity-building initiatives. Collaborative efforts by ASEAN also led to the region successfully enhancing the 2019 Guidelines. Formally endorsed at the 6th ASEAN Digital Ministers Meeting (ADGMIN) in January 2026, the updated framework – the Enhanced Guidelines for Strengthening Resilience and Repair of Submarine Cables – incorporated best practices in the protection of submarine cables and reduced regulatory requirements for timely submarine cable repairs.

The ACMA

The ACMA is a non-profit, cooperative submarine cable network maintenance agreement with over 60 member signatories. In terms of its character, the ACMA is more of a commercially driven grouping than a formal, international cooperation between countries. Its members mostly consist of companies responsible for operating and maintaining undersea communication and power cables in the Atlantic, North Sea, and south-east Pacific, as well as operators of oil and gas platforms.

The organization's approach to submarine cable repair and maintenance also reflects its commercial orientation. The three major technical elements in cable maintenance – vessels, remotely operated vehicles (ROVs), and technical experts – are all provided for by specialized third-party service providers under independent contracts. These are supplemented by key performance indicator (KPI) management in areas such as cable ship deployment, spare parts loading, and operating time.

The ACMA therefore represents an innovative cooperative model. Under this, appropriate commercial incentives and performance evaluations encourage participants in cable operations and maintenance to prioritize efficiency and technical expertise in their business activities.

The Yokohama Maintenance Zone: Asia-Pacific Submarine Cable Repair Joint Mechanism

The Yokohama Maintenance Zone, jointly managed by China, Japan, and the Republic of Korea, has long been one of the main cable maintenance areas in the Asia-Pacific region. In 1997, the area underwent reform and development with the signing of the Yokohama Regional Pacific Submarine Cable System Maintenance Agreement and the maintaining of two standby ships in the region. In 2001, the Yokohama Regional ROV Agreement was added.

The above agreements cover the majority of submarine cable maintenance in the zone and provide the necessary security assurances for these important cables. Maintenance in the Yokohama area is currently provided by three cable ship operators: KCS, LSMS, and SBSS, all of which operate high-performance cable maintenance ships in Asia-Pacific. These vessels are deployed at berths near cable warehouses located in: Wujing, China; Yokohama, Japan; and Geoje, Republic of Korea. This geographical distribution is well-planned and reasonably spaced, allowing rapid response to any cable incident within the maintenance zone.

RECOMMENDATION 3: ENCOURAGE A STANDARD REPORTING MECHANISM FOR GOVERNMENT AND INDUSTRY

Encourage the development of a standard reporting mechanism for governments and ICPC/regional CPCs or recognized industry organizations to share, on a voluntary basis, anonymised information they collect on submarine cable delays, marine faults and other outages on a disassociated basis from cable systems with other governments and/or industry stakeholders.

3.1 INTRODUCTION

Recommendation 3 addresses a critical gap in the current global resilience architecture: the lack of a unified mechanism for sharing data on cable faults and outages.

This chapter provides an in-depth analysis of that Recommendation, exploring the rationale behind standardising incident reporting, the challenges of implementation, and the potential benefits of an anonymized, voluntary data-sharing framework.

3.2 THE CURRENT LANDSCAPE OF INCIDENT REPORTING

The current global framework for reporting submarine cable faults is highly fragmented, characterised by a patchwork of national regulations and voluntary industry initiatives. This fragmentation limits the ability of stakeholders to conduct comprehensive risk assessments and identify systemic vulnerabilities.

National and regional regulatory frameworks

At the national level, some jurisdictions have implemented mandatory reporting requirements for submarine cable outages. In the United States, the Federal Communications Commission (FCC) adopted rules in 2016 – which became fully effective in January 2024 – requiring submarine cable licensees to report significant outages through the Network Outage Reporting System (NORS).[37] Under these rules, licensees must file a notification, an interim report, and a final report for outages that meet specific scope and duration thresholds.

Similarly, the EU has strengthened its reporting requirements through the Directive on Measures for a Level of Cybersecurity across the Union (NIS2 Directive), which took effect in October 2024.[38] The NIS2 Directive mandates that essential and important entities, including digital infrastructure providers, report significant incidents to national authorities. These, in turn, provide summary reports to ENISA (see 2.1.1 for details on the EU framework).

[37] See FCC, "Improving Outage Reporting for Submarine Cables and Enhanced Submarine Cable Outage Data", *Federal Register*, 89 FR 1465, 10 January 2024, https://www.federalregister.gov/documents/2024/01/10/2024-00341/improving-outage-reporting-for-submarine-cables-and-enhanced-submarine-cable-outage-data (accessed 16 June 2026).

[38] See ENISA, *Undersea cables – what is at stake?* ENISA, Athens, 31 August 2023, https://www.enisa.europa.eu/publications/undersea-cables (accessed 16 June 2026).

Industry-led data collection

Industry organizations have historically led data collection efforts on cable faults. The ICPC, founded in 1958, maintains a comprehensive database of cable faults and repairs, publishing annual statistics that inform industry best practices.[39] This data is primarily aggregated for high-level statistical analysis, however, rather than real-time operational coordination.

The limitations of the current landscape were highlighted in a September 2025 report by the Joint Committee on the National Security Strategy of the UK Parliament. The committee noted that commercial sensitivities often make operators reluctant to disclose vulnerabilities to rivals. To address this, certain industry stakeholders advocated for the creation of a dedicated information-sharing and analysis centre (ISAC) to enable subsea cable operators to share real-time data and threat intelligence confidentially, although with the UK Government only.[40]

3.3 THE OBJECTIVES OF RECOMMENDATION 3

Recommendation 3 proposes a pragmatic solution to the fragmentation of incident reporting. It does this by advocating for a standardized, voluntary, and anonymized mechanism. This recommendation is built upon several key principles which are designed to balance the need for actionable intelligence with the commercial and security concerns of operators and states. The recommendation does not suggest that information with any commercial or security sensitivity should be shared across borders; this is a matter to be determined by Member States. It is probable that some governments may see benefits in sharing information with closely allied neighbours, whereas others may be less open to the sharing of any information which could reveal vulnerabilities.

Standardisation and voluntary participation

The call for an industry-developed standard reporting mechanism addresses the current lack of uniformity in how faults, delays, and outages are defined and recorded across different jurisdictions. A standardized taxonomy would enable accurate cross-border aggregation and comparative analysis. The recommendation explicitly notes, however, that participation should be on a "voluntary basis".[41] This non-binding approach respects national sovereignty and acknowledges that mandatory international reporting regimes are politically difficult to negotiate and enforce.

Anonymization and disassociation

The most critical element of Recommendation 3 is the stipulation that shared information must be "anonymized" and provided on a "disassociated basis from cable systems".

Table 6 below gives further details of the concepts involved in anonymization and disassociation.

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39 See footnote 2.

40 See Joint Committee on the National Security Strategy, *Subsea telecommunications cables: resilience and crisis preparedness,* UK Parliament, London, https://publications.parliament.uk/pa/jt5901/jtselect/jtnatsec/723/report.html

41 See International Telecommunication Union (ITU), "Launch of international advisory body to support resilience of submarine telecom cables", ITU, Geneva, 29 November 2024, https://www.itu.int/en/mediacentre/Pages/PR-2024-11-29-advisory-body-submarine-cable-resilience.aspx (accessed 16 June 2026).

Table 6: Anonymization and disassociation

Concept	Definition in the context of submarine cables	Purpose
Anonymization	The removal of identifying details regarding the specific operator, owner, or precise geographical coordinates of the fault.	Protects commercial confidentiality and prevents reputational damage to specific operators.
Disassociation	The decoupling of fault data from the specific named cable system (for example, reporting a fault in the "North Atlantic", rather than on "Cable System X").	Mitigates national security risks by preventing adversaries from mapping the exact vulnerabilities of specific, critical infrastructure assets.

By ensuring that data cannot be traced back to a specific company or cable, the mechanism aims to overcome the primary barrier to information sharing: the fear of commercial disadvantage or security exposure. This approach mirrors successful models in other sectors, such as the aviation industry's accident/incident data reporting (ADREP) system, managed by the International Civil Aviation Organization (ICAO), and the ISAC models used in the cybersecurity and financial sectors.[42]

The role of coordinating bodies

Recommendation 3 identifies "governments and ICPC/regional CPCs or recognised industry organisations" as the primary nodes for data collection and sharing.[43] This multi-stakeholder approach leverages the existing trust and technical expertise of bodies like the ICPC, while also encouraging the regional CPCs to handle localised data sharing. By positioning these organisations as trusted intermediaries, the mechanism can facilitate the sanitisation and aggregation of data before it is shared more broadly.

3.4 THE EMPIRICAL CASE FOR STANDARDIZED REPORTING: GLOBAL REPAIR TRENDS

The strategic necessity of Recommendation 3 is underscored by recent empirical data on global cable faults and repair efficiencies. The ICPC Global Submarine Cable Repair Analysis (2007-2024), presented at the ICPC Plenary in 2025, analysed 3 053 valid repair records across 140 countries. The findings highlight significant regional disparities and operational bottlenecks that a standardized reporting mechanism could help address.

Regional disparities and high-risk zones

The ICPC analysis reveals that the Asia-Pacific region dominates global repair activity, accounting for over 40 per cent of all global repairs.[44] This concentration is driven by high cable density, intense maritime traffic, and extensive fishing activity.

These statistics align with findings from the Australian Strategic Policy Institute (ASPI). This notes that locations in the South China Sea frequently require cable repair, diminishing the

[42] See footnote 15.
[43] See footnote 16.
[44] See ICPC, "Global Submarine Cable Repair Analysis (2007–2024)", ICPC, Portsmouth, ICPC Plenary 2025.

appeal of traditional hubs like Hong Kong. Conversely, regions like Australia experience infrequent repairs due to fewer cables, wide distances between landmasses, and a relatively short continental shelf.[45] A standardized reporting mechanism would provide real-time visibility in these shifting regional risk profiles. It would enable operators to route new cables through more resilient corridors, while also enabling governments to step up cable protection efforts to ensure they do not become bypassed.

The "repair gap" and mobilisation delays

A critical metric highlighted by the ICPC report is the "commencement time" – the duration between a fault occurring and a repair vessel mobilising. While the global median commencement time is 8.0 days, the global average is significantly higher, at 22.7 days – a figure skewed by extreme outliers.[46] Indeed, operational efficiency varies drastically by jurisdiction. The fastest responders, such as South Africa (1.95 days) and the United Kingdom (3.66 days), benefit from proximity to cable depots and streamlined permitting processes.[47]

The ASPI report further contextualises this issue, warning of a "lack of an assured cable repair capability" in regions like the South Pacific, where a single vessel services a vast area stretching from Australia to Hawaii. The limited global availability of specialised cable vessels, compounded by the lucrative demand for cable laying over maintenance, exacerbates this vulnerability.[48] By standardising the reporting of submarine cable delays, as advocated in Recommendation 3, the international community can empirically identify regulatory bottlenecks and advocate for the streamlined permitting reforms recommended by the ICPC.[49]

3.5 CHALLENGES TO IMPLEMENTATION

While the conceptual framework of Recommendation 3 is sound, transposing these data-sharing principles into actual practice presents significant challenges. As noted in a 2025 report by the United Nations Institute for Disarmament Research (UNIDIR), implementing data-sharing arrangements for critical infrastructure can easily become entangled in a web of competing interests.[50]

Major challenges include:

1) Defining thresholds: Establishing universally accepted definitions of what constitutes a reportable delay, marine fault, or outage is complex. A minor shunt fault that degrades performance, but does not sever connectivity may be classified differently by different operators.

2) Geopolitical sensitivities: In an era of heightened geopolitical tension, states may be reluctant to share even anonymized data if it highlights vulnerabilities in regions critical to their national security. Analysts have noted that while the IAB recommendations focus heavily on accidental damage (fishing and anchoring), they largely avoid explicit discussion of wilful

45 See Kang, J., and J. Jacob, *Connecting the Indo-Pacific: The future of subsea cables and opportunities for Australia*, ASPI, Canberra, https://aspi.s3.ap-southeast-2.amazonaws.com/wp-content/uploads/2024/10/28023544/Connecting-the-Indo-Pacific.pdf

46 See footnote 19.

47 See footnote 19.

48 See footnote 20.

49 See footnote 19.

50 See Kavanagh, C., J. Franken, and W. He, *Achieving Depth: Subsea Telecommunications Cables as Critical Infrastructure*, UNIDIR, Geneva,https://unidir.org/wp-content/uploads/2025/04/UNIDIR_Achieving_Depth_Subsea_Telecommunications_Cables_Critical_Infrastructure.pdf

misconduct. The ASPI report also highlights the emerging division of the global submarine cable network into distinct, United States (US) and Chinese ecosystems, which complicates international cooperation on repair and data sharing.[51]

3) Data utility versus anonymity: There is an inherent tension between the degree of anonymisation and the operational utility of the data. If data is too heavily sanitised – for example, if all geographical context has been stripped out – it loses its value in identifying regional risk hotspots or chokepoints.

3.6 THE STRATEGIC VALUE OF STANDARDIZED REPORTING

Despite these challenges, the successful implementation of Recommendation 3 would yield substantial benefits for global digital resilience.

Firstly, it would enable evidence-based policy-making. Working Group 2's first recommendation calls for governments to develop national strategies "based on data evidencing the risks".[52] A standardized reporting mechanism is the prerequisite for generating this data. As the ICPC report recommends, data-driven resource allocation – such as positioning more repair vessels and spare cable depots in the high-volume Asia-Pacific region – is essential in closing the global "repair gap".[53]

Secondly, aggregated data can drive improvements in maritime spatial planning. With fishing activity and anchoring accounting for 40 per cent and 25 per cent of global faults respectively, governments can use shared data to implement targeted protective measures.[54] This includes establishing exclusion zones, updating nautical charts, and enhancing coordination with fishing industries, as recommended here and in the ICPC Government Best Practices.[55]

Finally, a voluntary reporting mechanism fosters a culture of trust and collaboration between the public and private sectors. As submarine cables are increasingly designated critical national infrastructure, bridging the information gap between private operators (who own the cables) and governments (who are responsible for national security) is essential in maintaining the resilience of the global digital lifeline.

3.7 FINAL REMARKS

Recommendation 3 represents a vital step toward maturing the global governance of submarine cable infrastructure. By advocating for a voluntary, anonymized, and disassociated reporting mechanism, the proposed framework respects commercial and security sensitivities while addressing the urgent need for actionable source information. As empirical evidence from the ICPC demonstrates, understanding regional fault trends and repair bottlenecks is critical for mitigating vulnerabilities.

As the global economy becomes ever more reliant on subsea connectivity, the transition from fragmented, siloed incident reporting to a collaborative, standardized model will be crucial for anticipating and mitigating the risks to the world's digital backbone.

[51] See footnote 20.
[52] See footnote 16.
[53] See footnote 19.
[54] See footnote 19.
[55] See Bressie, K., *Government Best Practices for Cable Protection Resilience*, ICPC, Portsmouth, https://www.iscpc.org/publications/icpc-best-practices/ (accessed 16 June 2026).

RECOMMENDATION 4: ESTABLISH CLEAR LEGAL AND OPERATIONAL FRAMEWORKS

Jurisdiction and Authority: Encourage national governments to establish clear legal and operational frameworks that are consistent with international law for the management of submarine cables in their waters, including critical national infrastructure designation where appropriate.

4.1 LEGAL INSTRUMENTS

Laws and regulations are the cornerstones and ultimate basis of all submarine cable protection measures. Relevant laws in various countries provide institutional safeguards for the safety of optical cables by clarifying responsibilities for protection, prohibiting destructive actions, regulating emergency repairs, and optimizing early warnings. These measures help prevent damage caused by humans, ensure the smooth operation of international communication and financial transactions, and safeguard international information and economic security.

The following sections outline some of the key laws and regulations currently in place.

Singapore: Telecommunications Act 1999[56]

As a statutory board under the Singapore Ministry of Digital Development and Information, the IMDA is responsible for the development, promotion, and regulation of the info-communications industry. This includes both the telecom and information technology (IT) sectors.

Key regulatory frameworks governing telecommunications in Singapore include the Telecommunications Act 1999, which includes the protection of submarine cables, among other matters. Section 68 of the Act, for example, makes it an offence for any person to wilfully remove, destroy or damage any installation or plant used for telecommunications.

The Act also authorizes the IMDA to require any public telecommunications licensee to conduct approved training courses – including refresher courses – and to provide examinations for cable detection workers.

The United Kingdom: Communications Act 2003 and Marine and Coastal Access Act 2009

- **Communications Act 2003**[57]

Section 105A of the Communications Act 2003 requires public telecoms operators to:

- identify the risks of security compromises occurring
- reduce the risks of security compromises occurring

[56] See Singapore Statutes Online, ***Telecommunications Act 1999***, Government of Singapore, Singapore, 1999, https://sso.agc.gov.sg/Act/TA1999 (accessed 16 June 2026).

[57] See legislation.gov.uk, ***Communications Act 2003***, UK Government, London, 2003, https://www.legislation.gov.uk/ukpga/2003/21/contents (accessed 16 June 2026).

- prepare for the occurrence of security compromises.

This overarching duty applies also in relation to submarine optical cables, to the extent that they are part of a UK public electronic communications network or support its provision. UK public telecoms operators are also required, under section 105K, to notify the sector regulator, the Office of Communications (OFCOM), of the occurrence of security compromises with a significant effect on the operation of a public electronic communications network or service.

- Marine and Coastal Access Act 2009[58]

The Marine and Coastal Access Act 2009 (MCAA) is a key piece of UK legislation for the integrated management of oceans and coasts. It aims to protect the marine environment through systematic planning, promote sustainable use, and ensure public access to the coastline. It provides further detailed regulations regarding the laying, maintenance, and removal of submarine cables.

For example, Section 66 stipulates that new installation or removal of submarine cables requires a license from the Marine Management Organisation (MMO), while Section 81 provides detailed rules on whether various activities related to submarine cables within UK waters require MMO approval. Such activities include cable laying, maintenance, clearance of debris, and rock protection, which are all assessed under differing circumstances – for example, inshore/offshore, exempt/not exempt.[59] Licensing rules in Scottish inshore waters are covered by the Marine (Scotland) Act 2010.

China: Departmental Regulation for the Installation and Operation of Submarine Cables

- **Installation: Implementation Measures for the Regulations on the Management of Submarine Cable Laying**[60]

The core of this implementation measure clarifies that the State Oceanic Administration has authority over the approval of domestic and international submarine cable projects. Ultimately enhancing cable resilience, the measure also strengthens the responsibilities of all parties involved in the installation of submarine cables through a mutual impact assessment mechanism.

The new regulations impose strict requirements on new cable construction. Route survey data must clearly indicate “other marine development activities and submarine facilities”, while environmental impact assessment reports must include a comprehensive analysis and response plan for the impact of both construction and operational periods on marine resources, the ecological environment, and surrounding development activities. In essence, the regulations mandate cable owners to proactively assess and coordinate potential conflicts between new cables and other marine activities before installation begins.

58 See legislation.gov.uk, Marine and Coastal Access Act 2009, UK Government, London, 2009, https://www.legislation.gov.uk/ukpga/2009/23/contents (accessed 16 Jine 2026).

59 See footnote 33 and gov.uk, “Collaborating to support marine license applications from the subsea cable sector”, *Desk note 2021*, MMO and European Subsea Cables Association (ESCA), London, 22 January 2018, https://www.gov.uk/government/news/collaborating-to-support-marine-licence-applications-from-the-subsea-cable-sector (accessed 16 June 2026).

60 See State Oceanic Administration of China, ***Implementation Measures for the Regulations on the Management of Submarine Cable Laying***, State Oceanic Administration of China, Beijing, 1992, https://www.gov.cn/zhengce/1992-08/26/content_5711422.htm (accessed 16 June 2026).

In addition, the measures simultaneously clarify the obligation of other marine developers to avoid interference; they must legally steer clear of existing cables and pipelines in order to prevent disruption of their safe, ongoing operation.

- **Operation: Regulations for the Protection of Submarine Cables and Pipelines**[61]

This regulation clearly defines the boundaries of submarine CPZs. At the same time, it mandates a prohibition on anchoring, trawling, drilling, and other marine development activities that may cause damage to submarine cables within the following zones:

- in wide coastal waters, 500 meters on each side of the submarine cable route
- in narrow waters, such as bays, 100 meters on each side of the submarine cable route
- in port areas, 50 meters on each side of the submarine cable route.

In addition, the regulation also stipulates that submarine cable owners should promptly register with the marine administrative authorities after the completion of their work. This means information about the cable's route, its identifiers (owners are encouraged to set identifiers), and the latitude and longitude of the start and end points are publicly announced, thereby enhancing protection by raising public awareness of the existence of the cables.

Japan: Telecommunications Business Act[62]

A key characteristic of this legislation is that it clearly defines and sets out the rules around submarine cable protection areas, rather than incorporating them under other guidelines or regulations. For example, Article 141 of the Act stipulates that after a telecommunications operator submits an application, if necessary, the Minister of Internal Affairs and Communications may designate an area within 1 000 metres of a submarine cable as a submarine cable protection zone. Subsequently, the operator who submitted the application must install terrestrial markers, while the Ministry of Internal Affairs and Communications is responsible for public notification.

Within a designated protection zone, it is prohibited for anyone to anchor or stop a vessel, use trawl nets or other fishing methods specified in government orders, engage in sand or mud extraction, or moor a vessel or raft to the markers stipulated in the previous provision. At the same time, the establishment of fisheries rights in the relevant waters and the construction of submarine cable protection areas must also take into account the protection of submarine cables.

In addition, Article 143 of the Act regulates vessel navigation, stipulating that areas within 1 000 metres of vessels engaged in submarine cable laying and maintenance operations are also considered restricted zones. In addition, areas within 400 meters of designated warning buoys are also considered restricted.

4.2 CROSS-DEPARTMENTAL COLLABORATION

Cross-departmental collaboration is both an opportunity and a risk. The "opportunity" refers to having more responsible departments participate in the work of enhancing submarine cable

[61] See State Oceanic Administration of China, ***Regulations for the Protection of Submarine Cable and Pipelines***, State Oceanic Administration of China, Beijing, 2004, https://www.gov.cn/gongbao/content/2004/content_62949.htm (accessed 16 June 2026).

[62] See Japanese Law Translation, ***Telecommunications Business Act***, Government of Japan, Tokyo, 1984, latest version 2020, https://www.japaneselawtranslation.go.jp/en/laws/view/3648 (accessed 16 June 2026).

resilience, while the "risk" refers to the inability to immediately identify the most effective contact department when a submarine cable is damaged, thereby slowing repair speed.

The following countries generally adopt an approach in which the telecommunications authority (usually under its ministry of communications) is responsible for receiving accident reports – in other words, is the single point of contact. Meanwhile, the maritime authority assists in the preparation of detailed rules and approving authorizations.

4.2.1 Singapore: IMDA and MPA

In Singapore, the IMDA has been designated as the single-point of contact for submarine telecommunication cables, facilitating coordination across the government with other agencies, such as the MPA.

- **The MPA stipulation:** Through the issuing of Notice to Mariners, the MPA requires that vessels entering are to anchor in the designated anchorages and that every care should be taken to avoid anchoring in the vicinity of submarine cables or pipelines. An example of such a notice is TT363 in Notices to Mariners No. 3 of 2026.[63] Approval from and compliance with the requirements of the MPA Committee for Marine Projects is also required for foreshore and marine development projects, such as construction and installation of infrastructure, as well as dredging and dumping works.
- **The IMDA stipulation:** In 2019, the IMDA also issued its *Guidelines on the Management of Submarine Cable Damage Incidents in Singapore Port Limits and the Traffic Separation Scheme*.[64] In this, the IMDA provides the following main guidance:
  - **Burial requirement:** Within the Singapore Port Limits, submarine telecommunication cables are required to be buried to a depth that can withstand an anchor drop from a VLCC. Beyond the Singapore Port Limits, the IMDA also strongly encourages burial of cables to a depth that can similarly withstand an anchor drop from a VLCC, especially in areas where higher levels of incidents are known to occur.
  - **Accident response:** When a submarine cable damage incident occurs, apart from notifying the IMDA, operators should also seek the MPA's assistance in obtaining information about vessels in the vicinity of the cable incident in order to identify the potential vessel that might have damaged the cable/s.
  - **Recovery:** To facilitate repair work, operators should first submit an application with an operations overview to the MPA for approval. Following this, the operator can also submit its standard operating procedures. These should include the communications plan and reporting procedures, the work schedule and operational details – including how the safety of navigation will be ensured and any additional contingency plans.

In another of its guidance documents, *Guidelines on Deployment of Submarine Cables into Singapore,*[65] the series of approval documents that need to be submitted before the construction of submarine cables is clearly specified, with each document corresponding to a specific reviewing department. For example, the approval of the submarine cable route is handled by the MPA.

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63 See MPA, "No. 03 of 2026 - MAR - Notices to Mariners No. 14 to 20", MPA, Singapore, 2026, https://www.mpa.gov.sg/api/media/fa135ddc-56b1-46d7-8ff2-45ec46cffbd0/notmarimar26.pdf

64 See IMDA, Guidelines on the Management of Submarine Cable Damage Incidents in Singapore Port Limits and the Traffic Separation Scheme Zone, IMDA, Singapore, 2019, https://www.imda.gov.sg/-/media/imda/files/regulation-licensing-and-consultations/codes-of-practice-and-guidelines/2019-04-01-guidelines-on-the-management-of-submarine-cable-incidents.pdf (accessed 16 June 2026).

65 See IMDA, *Guidelines on Deployment of Submarine Cables to Singapore*, IMDA, Singapore, https://www.imda.gov.sg/assets/7f12fa78-3944-4ec9-86b2-bd2f74329d15.pdf

4.2.2 Norway: Nkom and the National Coastal Administration (NCA)

Norway achieves full-process management of submarine cable protection through coordination among specialized government agencies. The Norwegian Communications Authority (Nkom) approves operators' applications for new submarine cables, while the NCA is responsible for coordinating construction applications for new cables within Norwegian territorial waters. Applicants must also obtain route approval from the port and channel authorities and submit the submarine cable route information to the Norwegian Mapping Authority so that it can update comprehensive electronic nautical charts.[66]

4.2.3 The United Kingdom

The Department for Science, Innovation and Technology (DSIT) is the lead UK government department responsible for digital infrastructure, including the resilience of the country's subsea, fibre-optic cable infrastructure. DSIT works closely with cable operators and the Joint Maritime Security Centre (JMSC) to monitor incidents impacting subsea cables in UK waters.

Ofcom is responsible for considering applications from operators for a direction, applying powers under the Electronic Communications Code set out at in Schedule 3A of the Communications Act 2003 (also referred to as "the Code"). Ofcom also has an enforcement role over compliance by Code operators with conditions and restrictions that apply under The Electronic Communications Code (Conditions and Restrictions) Regulations 2003 (also referred to as "the Regulations").

The Code confers rights on providers of electronic communications networks and on providers of systems of infrastructure to install and maintain apparatus on, under and over land. This results in considerably simplified planning procedures. The Code also confers tidal water rights, but does not otherwise extend to the laying of submarine telecommunications cables and networks. Ofcom's role under the Code in this respect is therefore limited.

The Crown Estate and Crown Estate Scotland manage the seabed and issue leases for the laying, maintenance and operation of cables and pipelines on the seabed around England, Scotland, Wales, and Northern Ireland out to 12 nautical miles. The MMO is authorized under the Marine and Coastal Access Act (MCAA)[67] to issue marine licenses for a variety of infrastructure (including cables and pipelines) accessing the coast of England. Moreover, the MMO collaborates with relevant UK and European industry associations to draft various guidance documents, serving as important references for submarine cable construction and maintenance.

As an example, Subsea Cables Desk note 2021,[68] co-written and updated by the MMO and the ESCA, provides guidance for submarine cable project approvals. Similarly, in Scotland, responsibilities are handled by the Marine Directorate of the Scottish Government; in Wales, by Natural Resources Wales; and in Northern Ireland (NI), by both the MMO and the Department of Environment NI Environment Agency.

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[66] See Ministry of Climate and Environment, *Meld. St. 21 (2023-2024) Report to the Storting (white paper)*, Government.no, Oslo, https://www.regjeringen.no/en/documents/meld.-st.-21-20232024/id3032474/ (accessed 16 June 2026).

[67] See legislation.gov.uk, *Marine and Coastal Access Act 2009*, UK Government, London, 2009, https://www.legislation.gov.uk/ukpga/2009/23/contents (accessed 16 June 2026).

[68] See footnote 34.

4.2.4 The United States: The FCC and the National Oceanic and Atmospheric Administration (NOAA)

As the authority in the US telecommunications field, the FCC has approval power over the landing of submarine cables in the United States and the direct or indirect access of submarine cable networks to the country. In addition, the FCC regulates the landing and operation of submarine cables laid in US coastal waters. In the event of damage, such as a cable break, the FCC is the lead authority, requiring submarine cable operators to report to them any unplanned cable breaks.

As the authority for ocean resource management in the United States, NOAA has the power to approve the use of marine areas for submarine cable projects and construction. Its approval mechanism is also coordinated with the FCC, which focuses on the approval of the cable owner. This means that construction can only proceed with the joint authorization of both parties. At the same time, NOAA has issued protective regulations to restrict fishing activities around cable-laying vessels, such as a fishing ban within 1 nautical mile of cable laying/repairing ships, and within 0.25 nautical miles of buoys used as cable markers.[69]

4.3 FINAL REMARKS

Recommendation 4 calls on governments to clarify, in line with international law, who has jurisdiction and decision-making authority over submarine cables within their territorial sea, exclusive economic zone (EEZ), and other relevant maritime areas. Submarine cables are often governed by a mix of telecommunications law, maritime law, and environmental regulation. Without a coherent framework, this fragmentation can slow down deployment, complicate repairs, and create uncertainty for operators. Establishing clear legal authority ensures that responsibilities are well defined and that processes are predictable and transparent.

In addition, Recommendation 4 stresses the importance of operational readiness. To enable rapid decision-making, legal clarity must be accompanied by practical arrangements, such as streamlined permitting procedures, emergency response protocols, and designated contact points within government. When a cable is damaged, hours and days matter; governments that have predefined procedures and coordinated inter-agency mechanisms are better positioned to facilitate swift repairs and minimize disruption to connectivity, trade, and public services.

References to critical national infrastructure designation reflect the growing recognition that submarine cables are strategic assets. By formally identifying them as critical infrastructure, governments can strengthen protective measures, enhance monitoring, integrate cables into national resilience planning, and ensure priority treatment in crisis management. This approach aligns domestic governance with the reality that submarine cables underpin financial systems, cloud services, government communications, and digital economies, worldwide.

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[69] See NOAA, "International Section: Submarine Cables - Domestic Regulation", NOAA, Washington DC, https://www.noaa.gov/general-counsel/gc-international-section/submarine-cables-domestic-regulation (accessed 16 June 2026), and Congressional Research Service (CRS), *Protection of Undersea Telecommunication Cables: Issues for Congress*, CRS, Washington DC, 2023, https://www.congress.gov/crs_external_products/R/PDF/R47648/R47648.4.pdf (accessed 16 June 2026).

RECOMMENDATION 5: TREATY OBLIGATIONS

Treaty Obligations: Urge states to implement United Nations Convention on Law of the Sea (''UNCLOS'') article 113 (to make the damaging of cables a punishable offence) and International Hydrographic Office (IHO) resolution 4/1967 (regarding certain activities within 0.25-mile on either side of submarine cables).

5.1 DOMESTIC IMPLEMENTATION OF CABLE PROTECTION OBLIGATIONS

Article 113 of UNCLOS imposes a clear legal obligation on States to adopt domestic laws and regulations that make the intentional or negligent damage of submarine cables a punishable offence. The effectiveness of this article depends on national implementation, as the provision is not self-executing and does not establish offences or penalties without corresponding domestic legislation.

Unfortunately, the implementation of this Article remains uneven. In some States, the offence is not clearly defined, sanctions are insufficient, or enforcement mechanisms are weak. As a result, in practice, the deterrent effect intended by UNCLOS is often limited.

5.2 CAUTIONARY NOTES ON THE PRESENCE OF CABLES

Consistent with IHO Resolution 4/1967, implementing a cautionary note is one of the best practices previously established by the ICPC. This procedure establishes a precautionary standard concerning activities conducted in the vicinity of submarine cables. The IHO Resolution recommends the promulgation of warnings regarding certain maritime activities, such as anchoring, trawling, and dredging, within 0.25 nautical miles on either side of a submarine cable.

This measure generally requires strong support from government authorities, which can greatly enhance the level of protection.

In addition, the IHO has further described other submarine cable safeguards to be included in nautical charts in Part B–440, paragraph B-443 (Submarine Cables, page 272) of the IHO Publication, S-4 Chart Specifications.[70]

As explained further in Recommendation 7, the IMO could further integrate submarine cable protection considerations into maritime safety guidance, navigational practices, and awareness-raising among flag and port States. Likewise, the IHO, through its standardization work in areas such as chart specifications and data standards, could support consistent and up-to-date charting of submarine cables and protective zones. Coordinated action between States, the IMO, and IHO would reinforce legal obligations with operational and technical measures, strengthening global cable resilience.

[70] See IHO, "Standards and Specifications", IHO, Monaco, https://iho.int/en/standards-and-specifications (accessed 17 June 2026).

In addition, it has been observed that in some incidents involving cable damage, fishing vessel masters chose not to display submarine cable information on electronic charts during fishing operations, especially in bottom trawling activities. This practice may be motivated by a desire to reduce visual clutter on navigational displays while focusing on fishing tasks, but it can significantly increase the risk of unintended interaction with seabed infrastructure.

More complex situations may arise during attempts to recover lost fishing gear. In such cases, vessels may deploy grapnels or similar gear dragged along the seabed to retrieve nets or equipment, including gear belonging to other competitors. These activities differ from conventional anchoring operations and can create substantial risks for submarine cables, particularly where cable locations are not actively monitored or displayed.

In this context, Working Group 2 discussed the potential role of evolving digital navigation environments, including systems based on the S-100 framework, in supporting preventive awareness. It was noted that future electronic navigation systems could potentially provide alerts when vessel speed, movement patterns or operational behaviour indicated non-transit activities in proximity to submarine cables. Such alerts could be generated even when specific chart layers were not actively displayed by the user. The logging of such alerts within onboard navigation systems could also support post-incident analysis and contribute to evidentiary processes in cable damage investigations, or legal proceedings.

The introduction of compulsory alert functionalities in regulated navigation equipment falls within the remit of the IMO, specifically within its Sub-Committee on Navigation, Communications and Search and Rescue (NCSR). However, manufacturers of electronic navigation equipment, including electronic chart display and information systems (ECDIS) and chart plotters commonly used by fishing vessels, may voluntarily develop enhanced warning or logging functionalities beyond minimum regulatory requirements. This is particularly the case when dedicated and reliable submarine cable datasets become available.

Working Group 2 therefore highlighted the potential value of further cooperation between hydrographic authorities, equipment manufacturers and the submarine cable industry. This would support the development of standardized digital datasets and operational tools that enhance awareness and reduce the risk of cable damage.

Practice in Bermuda

The Government of Bermuda, in its Submarine Cables (Protected Areas) Order 2019,[71] specifies the detailed coordinates of protected areas and explicitly prohibits activities such as anchoring, trawling, and underwater blasting within them – although some activities may be conditionally permitted under specific conditions and at certain depths. The order also sets out the details of fines and imprisonment.

[71] See Government of Bermuda, *SUBMARINE CABLES (PROTECTED AREAS) ORDER 2019,* Minister of Home Affairs, Hamilton, 2019, http://www.parliament.bm/admin/uploads/statutory/998e11599d65d58672d7ea16a5a1a1ed.pdf (accessed 17 June 2026).

Practice in Australia

The Australian authority responsible for telecommunications, the ACMA, has also designated relevant submarine CPZs. In its *Rules for Operating Around Submarine Cables*[72] it provides detailed coordinates for the Sydney Protection Zone and a downloadable checklist of various illegal or criminal activities. Listed actions that intentionally or unintentionally cause damage to submarine cables mainly include underwater blasting, anchoring, and fishing activities (broken down by different fishing gear types), and are further categorized by water depth to indicate whether the activity is allowed, conditionally allowed, or completely prohibited. For example, the activity 'Anchoring in the Southern Sydney Protection Zone' is:

- not permitted in waters of greater than 100 metres deep
- permitted within 0-500 metres of the low-water mark
- permitted under certain conditions (such as anchor weight and control mechanism) within 500 metres of the low-water mark and 100 metres of water depth.

Practice in Colombia

Resolution No. 204 of 2012 of the Maritime Director General, Colombia (Articles 1-2) establishes safety zone rules that include the laying of submarine communications cables authorised by the General Maritime Directorate. These consist of parallels extending 0.25 nautical miles (500 metres) on each side of a cable located in an area of national maritime jurisdiction and duly marked on nautical charts.

In these zones, trawling and anchoring of any type of vessel is prohibited, as well as any type of maritime activity that maintains total or partial contact with the seabed. Any contravention of this is considered an infringement, unless proof of innocent passage through the said zone is provided, or the special circumstances of entry into the said zone are communicated in a timely manner to the Colombian Maritime Authority.

Practice in Uruguay

Maritime Provision No. 128 of 2011 from the National Navy Prefecture of Uruguay is this country’s relevant regulation. This prohibits the anchorage of any kind of vessel – and also the performance of any activity, including fishing – that wholly or partially maintains contact with the seabed in an area of 1 nautical mile each side of a submarine cable located in the exclusive economic zone and which is clearly marked on nautical charts published by the navy’s Department of Oceanography, Hydrography and Meteorology.

Penalties may be imposed on those who undertake any prohibited activities in these areas, even if the cables are not effectively damaged.

5.3 PENALTIES FOR NEGLIGENT DAMAGE TO SUBMARINE CABLES

In comparative law, recent legislative developments demonstrate a range of approaches to protecting submarine cables against negligent conduct. Penalties include:

- Australia: Three years imprisonment or a fine of up to approximately USD 28 000, or both

72 See ACMA, “Zones to Protect Sydney Submarine Cables”, ACMA, Canberra, https://www.acma.gov.au/zones-protect-sydney-submarine-cables (accessed 17 June 2026).

- New Zealand: Fine of approximately USD 150 000
- Uruguay: Fine of approximately USD 450 000.

5.4 FINAL REMARKS

Recommendation 5 calls on States to actively implement and enforce their international legal obligations concerning submarine cable protection. Article 113 of UNCLOS obliges States to adopt national legislation making the intentional or negligent damage of submarine cables a criminal offence. While most States are parties to UNCLOS, not all have fully translated this obligation into clear and enforceable domestic laws. Proper implementation ensures that cable damage, whether caused by deliberate acts or reckless maritime behaviour, can be investigated and prosecuted, reinforcing accountability and deterrence.

The Recommendation also highlights IHO Resolution 4/1967, which urges States to take protective measures within 0.25 nautical miles on either side of submarine cables. This buffer zone aims to reduce risks from anchoring, fishing gear, dredging, and other seabed activities that frequently cause cable faults; indeed, these are responsible for more than 80 per cent of total cable faults, globally. By incorporating this guidance into maritime regulations, nautical charts, and awareness campaigns for mariners, States can significantly lower the incidence of accidental damage.

Together, these measures promote a preventive and enforcement-based approach to resilience. Rather than reacting only after a disruption occurs, States strengthen legal protection, improve maritime awareness, and reduce the likelihood of avoidable incidents.

RECOMMENDATION 6: ENFORCEMENT LEGISLATION

Enforcement legislation: Encourage governments to engage law enforcement agencies to assist with cable damage investigations (where the cause may be a third party), consistent with national laws and national sovereignty. Encourage real-time data sharing between industry and government agencies on cable fault localisation and identification of suspect vessels aided by enhanced enforcement of Automatic Identification System (AIS) regulations and the use of other applicable technologies.

In developing legislation, clarify liability standards (intentionality, negligence) and penalty amounts.

6.1 CURRENT SITUATION

Effective investigation and accountability in submarine cable damage incidents depend not only on the existence of substantive legal provisions, but also on the capacity and readiness of law enforcement authorities to actively support technical and legal investigations.

In practice, such enforcement procedures are frequently undermined by fragmented institutional responsibilities, limited access to technical and operational data, and delays in information exchange between industry stakeholders and public authorities. Recommendation 6 therefore underscores the need for clear legal mandates requiring law enforcement agencies to assist in cable damage investigations. These involve undertaking measures that include evidence preservation, vessel identification, and coordination with maritime administrations and prosecutorial authorities.

6.2 MEASURES

As highlighted in ICPC Recommendation 19, "Preparatory Actions for Civil Claims Development for Cable Damage", an immediate response by law enforcement authorities is critical to preserve evidence, particularly before any suspected vessel departs from the relevant jurisdiction. Delays at this stage may irreversibly compromise both civil and criminal enforcement actions.

In addition, States may wish to enable real-time data sharing mechanisms between industry and government agencies, as further explained in Section 1.3 above. Timely access to cable fault localization data, vessel traffic information, and remote sensing tools, such as AIS/VMS data, satellite imagery, and seabed monitoring, can significantly enhance the identification of suspect vessels and the preservation of evidence. Establishing such cooperation through appropriate legal and regulatory frameworks strengthens both civil liability processes and criminal enforcement outcomes.

Many countries have strengthened monitoring and enforcement by integrating AIS with VMS. For example, the Uruguayan Navy operates a coordinated AIS-VMS framework that allows maritime authorities to track both commercial shipping and fishing vessels, improving visibility in areas where submarine cables are located. This integrated approach enhances the ability to identify vessels operating near cable routes and to investigate incidents more effectively when faults occur.[73] It also combines CPZs with active monitoring and real-time radio warnings to vessels navigating within or approaching designated cable areas. This preventive model does not rely solely on post-incident enforcement, either, but instead prioritizes early communication and risk mitigation. Other examples from other counties are also described in Section 10.1.

6.3 FINAL REMARKS

Recommendation 6 calls for stronger enforcement mechanisms to address submarine cable damage, particularly where incidents may involve third-party actions, such as anchoring, trawling, or other maritime operations. Consistent with national legislation and sovereign jurisdiction, governments are encouraged to ensure that law enforcement agencies, maritime authorities, and prosecutors are equipped and mandated to investigate suspected cable damage. In many cases, technical fault detection alone is insufficient; effective enforcement requires coordinated investigative capacity to determine whether damage was accidental, negligent, or intentional.

The Recommendation also underscores the importance of real-time cooperation between industry and public authorities. When a cable fault is detected, rapid localization and cross-referencing with vessel traffic data can significantly improve investigative outcomes. Strengthening compliance with AIS requirements and leveraging complementary technologies, such as satellite tracking and maritime domain awareness platforms, can help identify vessels present or near the incident site. Clear protocols for data exchange between cable operators

[73] See Fígoli, A., *Legal and Regulatory Aspects of Telecommunication Submarine Cables*: *Volume 2*, Amazon, 2025.

and enforcement bodies enhance transparency and accountability while preserving the safeguards of due process.

In parallel, national legislation should clearly define liability standards and penalties. Legal frameworks should specify what constitutes intentional damage versus negligence, establish appropriate evidentiary criteria, and set penalties that are proportionate yet dissuasive. Clarifying these elements reduces ambiguity, supports effective prosecution, and strengthens deterrence. A robust enforcement regime, combining investigation capacity, technological monitoring, and clear legal standards, helps ensure that submarine cable protection is not merely aspirational, but practically enforceable.

RECOMMENDATION 7: MARITIME TRAINING

Include navigating in proximity to submarine cables within the standard syllabus for the Basic Safety Training mandated by the International Maritime Organisation (IMO) under their International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW).

7.1 THE STCW

The BST syllabus mandated under the IMO relates to the framework of the STCW Convention and constitutes the foundational safety training required for seafarers serving on board seagoing vessels. It is designed to ensure that all crew members, regardless of rank or function, possess a minimum level of knowledge, competence and the practical skills necessary to respond effectively to emergencies, protect human life at sea, and contribute to the safe operation of ships.

Working Group 2 recommends including elements related to navigating in proximity to submarine telecommunications cables within the standard syllabus, with a view to enhancing awareness and reducing the risk of damage to critical seabed infrastructure. Existing IMO training frameworks already cover core elements of safe navigation, situational awareness and risk prevention. Yet, knowledge of cable protection considerations and safe navigation practices in cable areas may not be consistently addressed within standard maritime training programmes. Integrating cable-related awareness within these established structures could therefore represent an efficient and proportionate way to strengthen preventive capacity across the global fleet.

7.2 MEASURES

The STCW Convention is currently under comprehensive review within the IMO Sub-Committee on Human Element, Training and Watchkeeping (HTW). A possible course of action could be to request an amendment to the STCW Convention in the following ways:

- Awareness of submarine cables and associated navigational considerations could be incorporated into existing STCW training modules, including BST and relevant navigation or bridge resource management components, without creating significant additional training burdens.

- Possible measures to support maritime training institutions and administrations in addressing safe navigation in areas where submarine cables are present could include the development of guidance material, training aids or best practice references.

RECOMMENDATION 8: ANCHOR STOWAGE

Require adequate stowage and securing of anchors on vessels to be inspected under the Flag State and regular Port State Control Inspection to avoid anchor dragging against submarine cables.

8.1 ACCIDENTAL ANCHOR DEPLOYMENT WHILE UNDERWAY

Working Group 2 recommends promoting adequate stowage and proper securing of anchors on board vessels. It also recommends considering the verification of such arrangements within existing flag State inspection regimes and regular port State control inspections, with a view to reducing the risk of anchor dragging and unintended contact with submarine telecommunications cables.

The Working Group noted that anchor-related incidents represent one of the most frequent causes of damage to submarine telecommunications cables, globally. As further explained in Section 1.1, these incidents were responsible for 14 per cent of the overall causes of cable accidents in 2025, according to the ICPC. Such incidents may occur as a result of operational anchoring activities, anchor dragging during navigation, or unintended deployment of anchors due to insufficient securing arrangements.

It has been further observed that submarine cables are often located along heavily trafficked maritime routes and in proximity to anchorage areas, increasing the likelihood of interaction with vessel anchoring systems. While relevant international instruments and industry guidance already address aspects of safe anchoring and seamanship, practices regarding anchor stowage and securing may vary across vessel types and operators.

Preventing anchor dragging incidents can contribute not only to the protection of submarine cable infrastructure, but also to broader maritime safety objectives, including the prevention of navigational hazards and environmental risks.

8.2 MEASURES

Awareness among ship operators, masters and crews regarding the risks associated with anchor dragging in areas where submarine cables are present needs to be expanded. In addition, the consistent application of good seamanship practices related to anchor handling and stowage should be encouraged. The potential relevance of considering appropriate verification of anchor stowage and securing arrangements during flag State inspections and port State control inspections – in accordance with existing inspection procedures and taking into account vessel design and operational context – is also noted.

In addition to the measures described under Recommendation 1, strengthened cooperation between maritime authorities, hydrographic offices and the submarine cable industry could facilitate improved dissemination of information on cable locations and areas of elevated risk. This would thereby support preventive action by vessels.

A possible adjustment to IMO regulations, such as Resolution A.1206(34)), could clarify that anchors must be properly stowed and secured when not in use. Verification of this could be carried out under flag State and PSC inspections in order to prevent unintended contact between anchors and submarine cables.

RECOMMENDATION 9: MARINE SPATIAL PLANNING

Recognize the spatial requirements of existing and future submarine cables, including their avoidance of manmade and natural hazards, chokepoints, and coexistence with regulated uses of (or protective measures for) the seabed and marine environment, consistent with the jurisdictional provisions of UNCLOS and customary international law.

9.1 BASIC PRINCIPLES FOR SUBMARINE CABLE PLANNING AND OPERATIONS

Overview

Some principles for ensuring the protection of submarine cables and their resilience in the face of both natural hazards – such as earthquakes and tsunamis – and human activities – such as fishing and anchoring – are suggested below. These principles have been grouped into four types: planning, operations, protection, and resilience. These suggestions should also be adapted to local contexts, risks, and regulations. Furthermore, these principles reflect well-established practices, as advocated by organizations such as the ICPC, and contained within international agreements, such as UNCLOS.

Planning principles

- **Conduct comprehensive route surveys and risk assessments**
  - Such risk assessments should involve evaluating both technical and non-technical risk factors, including potential third-party influence on providers and cybersecurity risks. In terms of routes, detailed desktop studies and marine surveys should be performed prior to installation. This should be done in order to identify optimal routes that avoid hazardous seabed features, such as steep slopes and fault lines, and high-risk areas for human activities, such as fishing or dredging.
  - Environmental impact assessments should also be included in these surveys and early engagement with stakeholders should be undertaken. Stakeholders should include other marine industries – such as oil, gas, and renewables – as well as governments and local communities in order to minimize conflicts and ensure sustainable placement.
- **Promote geographical diversity and redundancy**
  - Cable systems should be designed with multiple, spatially separated routes and landing places to avoid chokepoints and single points of failure.

- International and regional diversity in cable infrastructure should be encouraged in order to enhance overall network resilience, reducing the impact of localized disruptions.

- **Incorporate marine spatial planning**
  - Submarine cables should be integrated into broader marine spatial planning frameworks. Coordination with other ocean users, such as the mining industry, wind farms, and underwater cultural heritage preservation societies, should be undertaken. This should be done through early consultations and crossing agreements that establish minimum separation distances – such as 500 metres in shallow waters or twice the water depth in deeper areas – and prevent overlapping activities.
- **Strategic considerations**
  - Planning must also consider the potential for foreign influence on suppliers and service providers, as well as ensuring data integrity and security.
- **Regulatory frameworks**
  - Update regulations to better coordinate policy areas, ensuring smoother permitting and faster repair processes.

Principles of protection

- **Bury armoured cables in vulnerable areas**
  - Deep burial in the near-shore and shallow-water areas where human activity is highest, such as trawling and anchoring, should be implemented. Burial depth should exceed potential anchor penetration, or fishing gear reach.
  - Appropriate cable armouring (single or double steel wire armour) should be utilized, based on a risk assessment of specific segments of the route. This might mean, for example, increasing the armouring in high-traffic zones, or where there is rocky seabed.
  - In deeper waters, route planning and surface laying where burial is impractical should be relied on.
- **Designate and enforce CPZs**
  - Governments should be worked with to designate CPZs, or no-anchor/no-trawl zones around cable routes, particularly near landing sites and in shallow waters.
  - Flexible protection zones around cables that are marked on nautical charts (without physical buoys to avoid attracting attention) should be established, with high-risk activities like anchoring or bottom trawling prohibited within these zones.
  - Vessel monitoring systems should be enforced via penalties, while awareness campaigns for mariners and fishers should be undertaken.
- **Mitigate fishing and anchoring risks**
  - Since these cause around 70 per cent of all faults, AIS/VMS should be mandated on all vessels. FADs should also be prohibited near cables, while fishing-cable liaison committees for education, gear compensation, and ghost gear removal should be created.
  - Notices to mariners should be issued and charts updated in real-time with cable locations.
- **Continuous surveillance and monitoring**

  - Real-time monitoring systems, such as distributed acoustic sensing (DAS) or distributed temperature sensing (DTS), should be employed to detect potential risks (such as vessel anchoring) near the cable.
  - Patrolling and periodic surveys should be undertaken, or remote surveillance used in critical shallow-water areas, or those prone to extensive sediment migration.

- **Adopt robust cybersecurity measures**
  - Cybersecurity measures, such as encryption and access controls, should be implemented throughout the cable lifecycle. These measures should include secure network design, regular risk assessments for data in transit/storage, and protections against unauthorized access, or cyberattacks.
  - Transparent ownership and governance structures for providers should be promoted.

- **Optimal route selection**
  - Thorough marine surveying (both geophysical and geotechnical) should be conducted to avoid high-risk areas such as active fault lines, steep slopes, areas prone to turbidity currents, or regions with strong fishing/anchoring activity.
  - Deep-water routes should be preferred, where feasible, as these offer inherent protection from most human activities, such as fishing and anchoring.
  - Proper separation from other existing cables should be ensured to prevent simultaneous damage events and cascading failure.

9.2 ROUTE PLANNING AND RISK AVOIDANCE

Comprehensive route engineering, based on submarine geology, fishing activity density, and overlaps with maritime navigation routes, should be conducted. Indeed, cable route engineering is undertaken to ensure that the installed cable is best able to withstand the rigours of the marine environment throughout the design life of the system. To achieve this goal, a whole series of different aspects must be considered. Many of these are contract dependent, but the main areas for review and selection during cable route engineering are contained within this document.

For deep water sections of the route, the primary consideration when creating post-survey routes is the bathymetry. In shallower waters where there is also a geophysical survey swathe (normally a 500 metre corridor width) the bathymetry and features should complement each other and be considered together in order to achieve the optimum route.

- **Bathymetry**

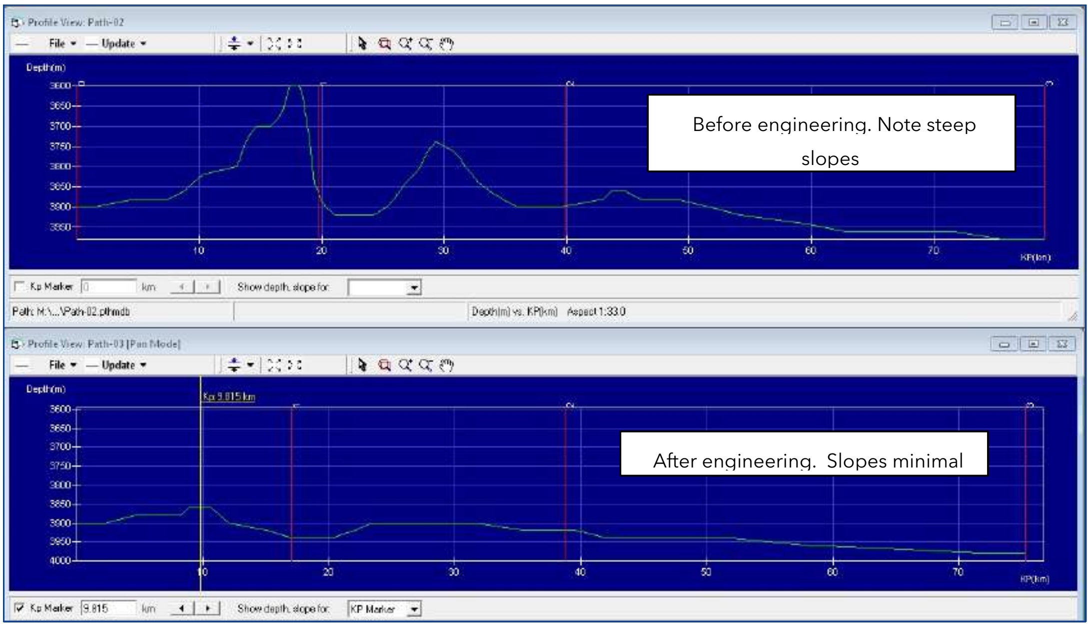
Bathymetry is the depth information which, post survey, is supplied to the route engineer. The bathymetry displays the depth contours and slope gradients. The cable route should follow the most benign route possible for the cable – although other restrictions, such as cable crossings, may prevent this being possible. Bathymetry data should be dealt with on a case-by-case basis with the final route selection optimized after taking into account all the routing constraints.

- **Slopes and routing**

In all water depths, the cable should be routed with the lowest slope angles possible. This is done by placing new alter course (AC) positions wherever required. Where steep seabed slopes are unavoidable, the route should be planned so that it runs as close to perpendicular up and/or down these features. This exposes the shortest section of cable possible to risk from suspensions, abrasion, and sediment slumps. Seabed depressions, ridges, canyons, seamounts should all be avoided, wherever possible.

The figure below shows the seabed profile before and after route engineering has taken place.

Figure 12: Seabed profile: Before and after engineering



9.3 INTERNATIONAL LAW: UNCLOS

Article 79 of UNCLOS[74] stipulates that all countries have the right to lay submarine cables on the continental shelf in accordance with the regulations. The Article also stipulates that coastal states shall not obstruct the laying or maintenance of such cables, albeit within the scope of their rights to explore the continental shelf, develop resources, and prevent pollution.

Coastal states may, however, still impose conditions on submarine cables entering their territory and/or territorial sea and retain jurisdiction over cables laid for exploring the continental shelf, developing resources, or operating artificial islands.

The Article therefore not only provides a legal basis for the construction and maintenance of numerous submarine cable projects on the continental shelf, but is also compatible with the coastal access laws of many countries, making it an important legal basis for the construction, maintenance, and repair of transnational and transcontinental infrastructure. Norway, for example, stipulates that newly constructed submarine cables on the Norwegian continental shelf are subject to Article 79 of UNCLOS.[75]

[74] See United Nations, *United Nations Convention on the Law of the Sea*, United Nations, New York, https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf

[75] See footnote 41.

9.4 SPATIAL PLANNING: SUBMARINE CABLE SPACING

Maintaining spacing between submarine cables allows for their independent operation while also reducing the possibility of interaction between cables during maintenance. Such spacing also reduces the risk of accidental contact, making spacing one of the most important measures in enhancing the resilience of submarine cables.

Practice in the United States

In 2014, the US Bureau of Ocean Energy Management (BOEM) issued its *Offshore Wind Submarine Cable Spacing Guidance*.[76] On page 13, this cites a standard from the US Bureau of Safety and Environmental Enforcement stating that Section 5.3.2 of this standard "discusses aspects of 'suitable' minimum horizontal distances between paired cables (not bundled)." For repair purposes, the Guidance states, while the standard gives conflicting figures, "generally, 2 x water depth or 50 [metres] minimum separation (may be less if there are engineering constraints)" is the rule followed.

Practice in the United Kingdom

In 2012, Red Penguin Associates released its *Cable Routing and Spacing Study*[77] research report for The Crown Estate in the United Kingdom. This report considers four major factors when determining the optimal spacing for submarine cables:

- appropriate spacing to minimise the risk of multiple cable hits from anchors inadvertently released with the vessel underway
- appropriate spacing to minimise the risks to existing cables during subsequent cable installation or maintenance
- reducing the effects of electromagnetic fields on the environment and local ecology
- avoiding interaction between transmission cables and therefore avoiding or minimising the need for crossing and/or proximity agreement.

The report also states that damage to submarine cables is often the result of multiple factors acting together. Each factor may also further vary according to the water depth, traffic density, and other conditions. For example, when anchoring, factors such as the amount of anchor chain dragging, the type of anchor and the actual penetration, the type of the seabed soil, and the weather conditions should all be taken into account.

The report therefore recommends that, "Due to the considerable variation in local issues and circumstances, the spacing between cables should be considered on a case-by-case basis."

[76] See BOEM, *Offshore Wind Submarine Cable Spacing Guidance*, US Department of Interior, BOEM, Washington DC, 2014, https://www.boem.gov/sites/default/files/renewable-energy-program/Studies/TAP/722AA.pdf

[77] See Red Penguin Association, *Export transmission cables for offshore renewable installations – Principles of cable routing and spacing*, Marine Data Exchange, The Crown Estate, London, 2012, https://www.marinedataexchange.co.uk/details/TCE-3481/2012-red-penguin-associates-the-crown-estate-research-cable-routing-and-spacing-study

The report also cites the concept of a burial protection index (BPI). This would be calculated by combining data on the seabed substrate with burial depth factors. It would therefore help to assess whether a submarine cable could be well protected against anchor strikes.[78]

The ICPC review

The ICPC considers spatial planning of submarine cables to be an important means of enhancing resilience. Such planning can prevent interactions between submarine cables, or between submarine cables and other pipelines. If maintenance is needed in the future, such planning can also avoid interference between different subsea elements.

The ICPC highlighted the importance of spatial planning in its material for the 2024 International Seminar on United Nations Global Geospatial Information Management conference.[79] This material made the following points:

- According to the cable installation scenario:
  - The minimum spacing between submarine cables is not recommended to be less than 50 metres, or twice the water depth (WD), whichever is greater. Ideally, this spacing should be more than three times the WD to allow greater margin for maintenance activities or in case of strong wind and waves.
  - In areas where the cable is buried, telecommunications industry practice is to maintain at least 500 metres of separation (or three times the WD, whichever is greater).
  - At crossing points and around repeaters in the crossed system, a clearance of three times the WD should be reserved.
  - In branching unit scenarios, along the main submarine cable, a clearance of four times the WD should be reserved; along the branch, a clearance of five times the WD should be reserved.
  - In crossing scenarios, the crossing angle of submarine optical cables should be as close to 90 degrees as possible and should not be less than 45 degrees. For submarine power cables, this angle should be 90 degrees.
- According to the WD:
  - For WDs of 75 metres or less, intervals of 500 metres.
  - For WDs greater than 75 metres, intervals greater than 500 metres, or twice the WD.

9.5 SHIPPING CHANNELS AND PORTS: MARITIME ELEMENT SAFETY ZONE PLANNING

Nowadays, in addition to traditional shipping activities and offshore oil and gas extraction, countries are paying increasing attention to emerging marine industries, such as offshore wind power, carbon capture, and deep-sea aquaculture. These activities may also, however, overlap with submarine cable routes. A series of safety spacing regulations therefore need to be implemented to avoid potential risks of interaction. Where shipping channels require regular maintenance dredging for navigation, submarine cables need to either avoid such areas, or be buried well below the dredged level in order to ensure their safety.

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[78] See Mole, P., J. Featherstone and S. Winter, "Cable Protection – Solutions Through New Installation and Burial Approaches", SubOptic '97 San Francisco, 1997.

[79] See Evans, G., *Submarine Cable Networks: the Geospatial Context*, ICPC, Portsmouth, 2024, https://ggim.un.org/meetings/2024/WG_Marine_Geospatial_6th_expert_mtg/documents/1.3_Graham_Evans.pdf

Singapore: Effective application of the Traffic Separation Scheme (TSS) navigation mechanism

- **TSS shipping channel planning and the mandatory Ship Reporting System in the Straits of Malacca and Singapore (STRAITREP)**

Coming into force on 1 May 1981, the TSS functions as a structured maritime highway for the Straits of Malacca and Singapore. Complementing this, in 1998, the IMO adopted STRAITREP, after the joint-proposal from Indonesia, Malaysia and Singapore. STRAITREP requires vessels to provide real-time data to a vessel traffic information system (VTIS) upon entering the Straits of Malacca and Singapore.

While primarily designed for the safety of navigation and to facilitate the movement of vessels, these mechanisms, which are administered by the Singapore Maritime and Port Authority (MPA), also contribute to submarine cable resilience. They do this by deconflicting the use of maritime space, as well as by providing proactive surveillance. In addition to these measures, the IMDA has also taken a proactive approach, collaborating with the MPA to establish sea corridors as protected zones, allowing cables to be deployed safely.

- **Anchorage management of ships within the TSS**

In its Port Marine Circular of January 2017,[80] the MPA referred to the International Maritime Organization Circular, SN.1/Circ.282, which vessels are advised not to anchor in all areas in the Straits of Malacca and Singapore between the landward limit of the TSS or precautionary areas, and adjacent port limits. Vessels are to anchor in the appropriate anchorages designated by the three littoral States. The Circular further informed that vessels found to be indiscriminately anchored and in contravention of Rule 10 (g) of the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) in the Singapore Strait will be reported to their flag State. Where submarine cable damage occurs, the MPA will promptly share information with the cable owner(s) and other interested parties to facilitate legal proceedings to recover compensation from the owners and masters of vessels responsible for the damage.

- **Submarine cable maintenance within the TSS, or in its vicinity**

The MPA primarily manages seafarers and vessels, while the protection of submarine cables within Singapore Port Limits is overseen by the IMDA. In its *Guidelines on Submarine Cable Repair in Singapore*,[81] the IMDA guides operators to supply the MPA with the following information before commencing repair work:

- an introduction to the applicant and the submarine cable system to be repaired
- an overview of operations, including the anticipated maintenance activities and the location of the work area marked on nautical charts
- detailed information on the submarine cable repair vessels and other ships (if any) involved in the project
- a communications plan and reporting procedures, including any use of VHF channels
- a work schedule plan

[80] See MPA, "PORT MARINE CIRCULAR, No. 03 of 2017, PROHIBITION OF ANCHORING IN THE STRAITS OF MALACCA AND SINGAPORE", MPA, Singapore, 19 January 2017, https://www.mpa.gov.sg/media-centre/details/prohibition-of-anchoring-in-the-straits-of-malacca-and-singapore (accessed 17 June 2026).

[81] See footnote 39.

- details of operation and work methods, such as operations involving ROVs for inspection, grappling, splicing, laying, burial, and other activities
- a detailed plan to ensure safety of navigation while performing the project within the TSS: the applicant should analyse the general direction of vessel traffic as much as possible and propose feasible operational processes and sequences
- contingency plans for the craft involved in the operation, with these including emergency procedures and a demobilisation plan from the work site
- details of any activity after the completion of the repair work
- the contact details of personnel responsible for the operation and for the craft on site.

Upon receiving MPA approval, operators may proceed to commence repair work on the submarine cable system. Operators should also submit a daily progress report to the MPA.

The ESCA Guideline safety zone scheme

Guideline No. 6[82] from the ESCA (formerly known as Subsea Cables UK) provides details of safety zones for submarine cable maintenance vessels. These zones are areas around a vessel that has restricted manoeuvrability due to its submarine cable maintenance or repair activity. A zone limits the approach of other vessels.

This measure is also compatible with the provisions of the 1972 International Regulations for Preventing Collisions at Sea (COLREGS). Vessel masters also usually make a request for a zone under Article 5 of the 1884 Convention for the Protection of Submarine Telegraph Cables.[83] This requires all vessels to keep a distance of at least 1 nautical mile from the submarine cable operation vessel during cable operations to allow the vessel to operate normally.

Faced with an increasing level of construction of new, offshore infrastructure, there is a general requirement (and an UNCLOS stipulation) that a safety zone of at least 500 meters be established during the construction of offshore facilities. Once those facilities enter long-term operation, this distance is generally set at 50 meters – although, given the underwater mooring and dynamic cable systems of floating wind turbines, this range may need to be further increased. The routing design of submarine cables, as well as subsequent construction and maintenance, must take this factor into account.

82 See ESCA, "The Proximity of Offshore Renewable Energy Installations and Subsea Cable Infrastructures", Issue 6, ESCA, November 2023, https://www.escaeu.org/download/?Id=123

83 See Centre for International Law, *1884 Convention for the Protection of Submarine Telegraph Cables*, National University of Singapore, Singapore, https://cil.nus.edu.sg/databasecil/1884-convention-for-the-protection-of-submarine-telegraph-cables-3/ (accessed 17 June 2026).

RECOMMENDATION 10: NAUTICAL CHARTING

Consider expanding the remit of nautical charting agencies to require them to regularly update the plotting of cables based on latest information from industry. Promote the maintenance of up-to-date cable system position records by cable owners, and encourage clear data flows where relevant from cable installers, owners and recovery companies to government and charting agencies to ensure accuracy, consistency and accountability.

10.1 NAUTICAL CHARTS AND DIGITIZATION: SUBMARINE CABLE RISK ZONING AND DYNAMIC UPDATES

Clear charting is an important measure that can effectively protect submarine cables and enhance cable awareness. This measure has also been repeatedly recognized by the ICPC as one of its recommended best practices for submarine cable protection.

Practice in the United Kingdom: The Marine Directorate of the Scottish Government and NMPi Platform

The United Kingdom has abundant fisheries resources, a long history of development, and thriving fishing activities. However, once fishing vessel activities (especially bottom trawling) interfere with submarine cables, they can cause incalculable damage to both the vessels and the cables.

Among the constituent countries of the United Kingdom, there are variations in marine environment policy. Taking Scotland as an example, the Marine Directorate of the Scottish Government clearly addresses the risks in the submarine cables section of its 2015 National Marine Plan (NMP).[84]

The plan recommends that submarine cables should be buried whenever feasible. It also recommends that their laying and protection should be considered on a case-by-case basis, according to specific circumstances. At the same time, in order to enhance situational awareness for participants in various maritime activities, layers of information on fisheries, offshore energy, and submarine cables can be accessed simultaneously on a geographical information system (GIS) platform, National Marine Plan Interactive (NMPi).[85] This allows users to make comprehensive comparisons and gain a more accurate understanding of cable locations.

Practice in Norway: The Marine Spatial Management Tool

Fisheries and offshore oil and gas extraction are Norway's two most important marine economic sectors. Several authorities are crucial in these industries: the Norwegian Directorate of Fisheries

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84 See Marine Scotland, *Scotland's National Marine Plan*, The Scottish Government, Edinburgh, 2015, https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2020/10/national-marine-plan-key-documents/documents/summary-of-objectives-and-policies/summary-of-objectives-and-policies/govscot%3Adocument/National%2BMarine%2BPlan%2BSummary%2Bof%2BObjectives%2Band%2BPolicies.pdf

85 See maps.marine.gov.scot, NMPi, Marine Scotland, Edinburgh, https://marinescotland.atkinsgeospatial.com/nmpi/ (accessed 17 June 2026).

obtains AIS trajectory data from fishing vessels that include their real-time positions and types of operations; meanwhile, the Energy Directorate establishes and maintains databases related to subsea pipelines and oil and gas platforms. Thirdly, the Norwegian Coastal Administration provides shipping data, while a range of other marine-related agencies provide GIS information for their respective marine elements.[86]

Bringing all this data together, the Norwegian Mapping Authority and related companies then create a GIS platform called the Marine Spatial Management Tool.[87] This overlays high-frequency fishing areas (such as trawl concentration zones), marine oil and gas pipeline protection areas, and submarine cable routes, generating a fisheries, oil and gas, and shipping activities-cable overlap heatmap. Darker colours indicate higher risk, while the fisheries data layers can be colour-coded according to the types of fishing gear used on the vessels (such as bottom trawls, purse seines, pelagic trawls). This heatmap is used as a reference to delineate particularly valuable and vulnerable areas. In regions where high-value fisheries zones overlap with cable routes, warnings are issued to fishermen to avoid high-risk cable areas and refrain from using gear such as bottom trawls. The heatmap also provides patrol vessels from the Norwegian Coastal Administration, known as Kystverket, with reference points for enforcement priority areas.

The ICPC review: High seas charting

The nautical charts of many countries – and international organizations – tend to concentrate on the underwater features that exist within and around particular territorial waters, such as within a country's EEZ, or along its continental shelf. This charting usually includes underwater features such as submarine cables. However, as deep-sea mining and deep-sea oil and gas development advance further out into seas with depths typically greater than 2 000 metres, they may also encounter international submarine cables far from EEZs and continental shelves. The routes of these deep-sea cables may also not be accurately indicated on nautical charts.

Currently, the ICPC,[88] the International Seabed Authority (ISA), and the IHO are jointly promoting the integration of deep-sea cable features into nautical charts. The current recommendation is that a case-by-case approach be adopted, with cable owners and seabed mining participants enhancing information sharing. The ICPC has also maintained a good interaction mechanism with the ISA, with each organization attending the other's annual meetings and jointly establishing platforms that invite cable owners and mining operators. Additionally, ISA Technical Study No. 14 of 2015[89] states that "…the best strategy is to avoid disputes and reduce risks with practical solutions by privileging dialogue and exchange of information, in compliance with the due regard obligation, and to adopt practical procedures to reduce risks."

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[86] See footnote 41.

[87] See Kystinfo, "Marine Spatial Management Tool," Kystinfo, Oslo, https://www.kystinfo.no/ (accessed 17 June 2026).

[88] For the ICPC position on charting cables end to end (except in certain cases where they are located at a depth of under 10 metres), see the ICPC website, https://www.iscpc.org/publications/icpc-viewpoints/charting-submarine-cables-is-critical-for-maritime-safety-and-infrastructure-protection/ (accessed 17 June 2026).

[89] See the ICPC, "Comments on ISA's Draft Regulations on Exploitation of Mineral Resources in the Area", ICPC, Portsmouth, 2023, https://www.isa.org.jm/wp-content/uploads/2023/03/ICPC-1.pdf (accessed 17 June 2026).

10.2 ENHANCING AWARENESS OF THE PRESENCE OF SUBMARINE CABLES

One key aspect in raising awareness of submarine cables is the provision of detailed information about them and clear marine charting of their position. Equally important, however, is how this information reaches the end users – namely, the fishing communities. In this, an active reporting mechanism run by government agencies or public owned platforms is a relatively effective measure.

Practice in Singapore

Singapore reduces submarine cable damage incidents caused by vessels entering operational areas by officially issuing notices about activities such as cable laying and maintenance. For example, Port Marine Notice No. 38 of 2025,[90] issued by the MPA, clearly outlines all the relevant information regarding maintenance work on an underwater cable, including the following elements:

- the date and time span
- a detailed location of the work area (with coordinates)
- the vessels participating in the operation
- details of the works and mitigation measures deployed
- precautions to be taken
- contact details/communication arrangement for further information
- a nautical map with the work area demarcated.

In addition, the list of latest edition Singaporean Nautical Charts can be found in the MPA's monthly Notices to Mariners.[91]

Practice in the United Kingdom

- **The *Mariner's Handbook* and official education**

Various agencies in the UK issue reminders to all types of vessels, including fishing boats, cargo ships, and pleasure craft, about the importance of submarine cables. This is done via manuals, official notices, and other means. For example, an MCA notice[92] calling for responsible anchoring practices clearly states that anchoring can not only damage submarine cables, but entanglement with them also poses significant risks to the vessel itself, such as electric shocks, capsizing, or damage to components.

The notice also mentions the *Mariner's Handbook*, which is published by the UK Hydrographic Office. It also points to the IHO "S-4 Part B, Section 400 – Hydrography and Aids to Navigation",[93]

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90 See the MPA, "PORT MARINE NOTICE NO. 38 OF 2025", MPA, Singapore, 3 April 2025, https://www.mpa.gov.sg/media-centre/details/port-marine-notice-no.-38-of-2025 (accessed 17 June 2026).

91 See the MPA, "Singaporean Nautical Charts", MPA, Singapore, https://www.mpa.gov.sg/port-marine-ops/marine-services/charts-tidal-info-atons-and-hydrography/singaporean-nautical-charts/ (accessed 17 June 2026).

92 See MCA, "MGN 661 (M+F) Navigation – safe and responsible anchoring and fishing practices", MCA, London, https://www.gov.uk/government/publications/mgn-661-mf-navigation-safe-and-responsible-anchoring-and-fishing-practices (accessed 28 June 2026).

93 See UK Hydrographic Office, *Admiralty Mariner's Handbook (NP100),* UK Hydrographic Office, Taunton, https://www.admiralty.co.uk/publications/publications-and-reference-guides/admiralty-mariners-handbook

which clearly marks linear underwater features, including abandoned submarine cables. This measure both raises awareness among vessels of the presence of submarine cables and protects the ships themselves. It also highlights the importance of clear and consistently updated charting work.

- **ESCA and Kingfisher Information Service (KIS) collaboration: The KIS-Offshore Renewables and Cables Awareness (ORCA) Information Release Platform**

As an organization composed of domestic and international companies that own, operate, or maintain submarine cables in Europe and its surrounding waters, ESCA aims to promote marine safety and protect submarine cables from both human and natural risks. Within this forum, there is also a fishing advisory, whose primary responsibility is to monitor fishing activities in the United Kingdom and other European countries, with a focus on their potential impact on submarine optical cables.[94]

The KIS is a core information service platform for the marine fisheries sector in the United Kingdom – particularly in Scotland. By integrating official data, industry needs, and scientific research, it provides 'one-stop' support for sustainable fisheries management. The existence of the KIS significantly improves the accessibility of fisheries information and the scientific basis of decision-making. The KIS also serves as an important support organization for the coordinated development of the UK marine economy and its ecological protection.[95]

Both ESCA and the KIS are fully aware that submarine cables can be damaged during trawling operations, and conversely, cable tension may also damage fishing vessels or even cause them to capsize. Therefore, for the purpose of timely information-sharing and risk avoidance, the two launched a collaboration, initiating the KIS-ORCA project. This provides fishers with accurate, up-to-date, and free information on European submarine optical cables and offshore renewable energy facilities. The information is updated annually in the form of fishing plotter files and awareness charts, which fishers can access for free on the KIS-ORCA website to improve their awareness of the location of cables and other assets and enhance avoidance practices. The project also provides emergency guidance for situations in which fishing vessels become entangled with cables.[96]

Practice in China

An annual, submarine cable protection awareness campaign is conducted in China, jointly supported by the telecom regulators and maritime authorities.[97] The initiative targets coastal communities – particularly fishers and other maritime workers – in towns and fishing ports near cable landing stations and in areas with high concentrations of submarine cables.

[94] See the ESCA website, https://www.escaeu.org/, for further details.
[95] See the KIS website, https://www.seafish.org/safety-and-training/kingfisher-information-services/, for further details.
[96] See the KIS-ORCA website, https://kis-orca.org/, for further details.
[97] See China Academy of Information and Communications Technology (CAICT), *Report on China's Participation in the Construction and Protection of International Communication Submarine Cables*, CAICT, Beijing, March 2025, https://www.caict.ac.cn/english/research/whitepapers/202507/t20250731_687653.html

Outreach activities include community workshops, illustrated pamphlets distributed at ports, public-service texts, and explanatory videos shared on social media platforms. The messaging emphasizes practical safety measures. These include:

- how to identify cable route markers
- how to avoid anchoring or trawling in legally designated protection zones
- how to follow correct procedures, if fishing gear snags a cable
- how to ensure that vessels switch on AIS when operating near these corridors.

Held over one week each year, the campaign regularly reaches more than 1 million people. It therefore raises situational awareness among key maritime users and helps prevent accidental damage to critical undersea infrastructure.

10.3 ENHANCING PREVENTIVE AWARENESS THROUGH NEXT-GENERATION DIGITAL NAVIGATION

The transition towards next-generation digital navigation systems represents a significant opportunity to enhance preventive awareness. This transition includes the implementation of the IHO-approved S-100 data framework, which is expected to be progressively implemented up to 2029. Digital systems are expected to enable the integration of more dynamic, standardized and user-adapted maritime information layers. Potentially, this can improve the visibility and usability of submarine cable data during operational decision-making at sea, as described in Section 5.2.1.

RECOMMENDATION 11: AUDITS AND STRESS TESTS

Audits and Stress Tests: Encourage relevant entities to conduct routine stress tests to verify submarine cable system robustness, assess network risks from choke points and/or route congestion/clustered landings, and disaster response. Regularly audit cable resilience and maintenance provisions to ensure adequate spares, repair agreements, and test the robustness of cable station and digital access security.

11.1 DEVELOPING REDUNDANCY IN SUBMARINE CABLE OPERATIONS

The concept of redundancy

Submarine cable redundancy is a strategic design principle implemented to ensure the reliability and resilience of global communication networks. It involves creating multiple, independent pathways and systems for data transmission that can operate simultaneously, enabling the network to maintain its functionality, even in the event of failures or disruptions. In submarine cable networks specifically, this means deploying multiple physical cable systems between two locations.

The core objective is to eliminate single points of failure, ensuring that if one cable route is disrupted, alternate routes remain. In 2023, for example, a south-east Asian country was able to reroute traffic through terrestrial connections with a neighbouring country and rely on locally cached content, despite a submarine cable outage. By constructing additional physical links to form multi-path transmission, redundancy eliminates system-wide outages caused by failures of a single cable. When multiple submarine cables simultaneously carry different types or volumes of traffic, for example, the failure of any one cable allows its traffic to be rerouted to others, thereby maintaining service continuity. As a case in point, during the West Africa submarine cable disruption in 2024, Internet traffic was restored through terrestrial cross-border circuits.

Implementing redundancy measures in submarine cable operations

Redundancy forms the structural foundation of a resilient network, supporting rapid recovery. It possesses the following advantages:

- **Instant failover capability**: When a cable is damaged, traffic can automatically and seamlessly switch to redundant cables. Users may not notice the switchover or may only experience minor latency increases. This directly achieves the goal of rapid recovery.
- **Improved impact resistance**: A highly redundant network can tolerate multiple simultaneous failures. The system absorbs shocks without suffering full-service outages.
- **Buffer time for repairs**: Redundancy allows communication services to continue operating on backup paths while repair teams locate faults, deploy repair vessels, and conduct the time-consuming process of submarine cable repair. Without redundancy, services would be completely interrupted during the repair period.
- **Multiple independent pathways:** Redundancy is achieved by deploying multiple submarine cables along different routes. These are often geographically separated to avoid common points of failure. This diversification minimizes the risk that a single event, such as an earthquake or ship anchoring, can disrupt all communication links simultaneously. For example, if multiple cables follow the same narrow strait, such as the Strait of Malacca or Suez Canal, or a major seismic zone, a single regional event, such as a major earthquake, submarine landslide, or geopolitical conflict, could disable all of them. This is known as 'concentrated redundancy risk'.

This can be addressed by adopting geographically diverse routes. Examples of this would include using both southern maritime corridors passing through South-east Asia, the Indian Ocean, and the Red Sea, and northern terrestrial cable routes traversing Asia and Europe.

- **Multiple landing points**: Having multiple landing stations connected to different terrestrial networks ensures that even if one landing point is compromised, others can sustain the connection. This segmentation enhances the overall redundancy of the system.
- **Use of diverse technologies**: Integrating different cable types, routing techniques, and technologies can also contribute to redundancy, making the network less vulnerable to specific technological failures or targeted attacks. Introducing cross-medium redundancy backups, for example, such as satellite communications (particularly emerging low Earth orbit constellations such as Starlink) can provide an ultimate backup for submarine cable systems. Although the bandwidth and latency of such backups may not match those of submarine cables, they can ensure that critical communications, such as financial transactions and government communications, are not completely disrupted.

Adopting technologies that enhance network and operational intelligence is essential. This is particularly so when redundancy paths exist, but the network either does not know how to switch over, or the switchover causes congestion on the backup path. This can be addressed through real-time monitoring and intelligent routing. A 24/7, network operations centre should be maintained to detect outages within seconds, with software-defined networking (SDN) able to automatically calculate and reroute data traffic to the optimal backup path.

Rapid fault localization and diagnosis to determine the exact break point – the distance from the landing station – is also a prerequisite for dispatching repair vessels.

- **Establishment of regional terrestrial routes**: Governments should collaborate to establish regional terrestrial routes to serve as redundancy paths to mitigate against submarine cable cuts or damage. Lessons can be gleaned from the examples above.

Further considerations

A number of other factors should also be considered, as outlined below.

- **Network diversification and redundancy**
  - Geographical diversity should be implemented by ensuring landing stations and backhaul connections are physically separate and not co-located in high-risk areas.
  - A mesh topology (or similar redundancy architecture) should be adopted, rather than a simple point-to-point connection. This ensures a service can be rerouted instantly if a single cable segment fails (for example, by using a 'ring', or multiple redundancy cables).
  - Multi-system and multi-vendor agreements for crucial network components and repair services should be established to avoid reliance on a single source.
  - Geographically diverse cable routes and landing points should be promoted, as these are key to mitigating disruptions and leaving no region isolated.
- **Repair readiness and logistics**
  - Repair and maintenance agreements (RMAs) with cable ship operators covering the cable's operational life should be secured.
  - To minimize mobilization time, strategic spares, such as cable types and repeaters, should be pre-positioned in accessible, secure depots near potential repair zones.
  - Detailed charts and accurate cable documentation should be maintained in order to facilitate rapid fault localization and repair operations.
- **Capacity planning and contingency**
  - Capacity should be over-provisioned beyond immediate traffic needs to handle traffic redistribution during a single-cable outage without service degradation.
  - Emergency response plans (ERPs) should be developed and simulation exercises for failure scenarios – such as cable cuts and landing station power losses – should be routinely conducted.

11.2 PRACTICE IN JAPAN

- **Line safety and redundancy design**

The JUNO Cable System, which connects the United States and Japan,[98] has landing stations at both Mie and Chiba in Japan. This improves both the utilization efficiency of the submarine cable and allows a backup route to be activated to maintain communication in the event of cable damage. This reflects the concept of resilient design, which is also highlighted by the Japanese Ministry of Internal Affairs and Communications (MIC) in its report, *Current Status*

[98] See NEC Corporation, "NEC to Build New Trans-Pacific Cable", NEC Corporation, Tokyo, 21 July 2022, https://www.nec.com/en/press/202207/global_20220721_01.html (accessed 18 June 2026).

and Related Issues of Submarine Optical Cables.[99] In this, multi-route, decentralized submarine cable routes and landing station designs are described as a good strategy for maintaining digital communication services during large-scale disasters.

- **Rapid repair and seismic factor tracking**

Japan has established professional repair teams that are led by the operators and supported by the government. The country has also prepared stocks of key repair resources. Operators such as NTT and KDDI have submarine cable emergency repair companies equipped with dedicated teams, vessels, ROVs, and other repair equipment. After completing the relevant repair work, maintenance companies can also obtain information from the Japanese Earthquake Research Committee.[100] This provides information on earthquake frequency and on high-risk areas, all of which can be used to assess the future status of submarine cables and evaluate developments in new submarine cable routing.

RECOMMENDATION 12: DECOMMISSIONING AND REDUNDANCY

> Decommissioning and redundancy: Promote information sharing and/or notification regarding submarine cable decommissioning to address any resilience gaps, particularly for Small Island Developing States (SIDS) reliant upon few international links.

12.1 DECOMMISSIONING AND REDUNDANCY

The decommissioning of submarine cable systems is often driven by commercial, technical, environmental, or lifecycle considerations. In certain contexts, however – particularly in countries or regions with limited international connectivity – the removal of legacy cable infrastructure may have unintended consequences for national and regional network resilience. Indeed, even when considered commercially obsolete or replaced by newer, high-capacity systems, existing submarine cables may continue to play an important role in providing redundancy, route diversity and contingency connectivity during outages or large-scale incidents. This is particularly relevant for SIDS, least developed countries (LDCs) and other jurisdictions that rely on a small number of international cable systems.

Older, or lower-capacity cables may serve as backup infrastructure when newer systems are affected by faults, natural hazards or operational disruptions. Indeed, simultaneous failures of multiple cables have demonstrated the importance of maintaining multiple available connectivity paths, even when some are not fully utilized under normal operating conditions. Decisions to retire cables may be taken primarily on commercial grounds without fully considering the system-level resilience implications at the national or regional levels. In underserved regions, the loss of a single cable system may significantly increase restoration times and economic disruption.

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[99] See MIC, *Current Status and Related Issues of Submarine Optical Cables*, MIC, Tokyo, 2025, https://www.soumu.go.jp/main_content/001040293.pdf

[100] See KDDI, *Repair of Submarine Cables Damaged by the Noto Peninsula Earthquake*, KDDI, Tokyo, 2024, https://seasat.iis.u-tokyo.ac.jp/CableWS/WS20241205/5.%E8%97%A4%E5%8E%9F%E5%85%AC%E9%96%8B%E8%B3%87%E6%96%99.pdf

12.2 MEASURES

National governments may wish to consider the following:

- The establishment of notification, or information-sharing mechanisms regarding planned submarine cable decommissioning.
- An assessment of the potential impact of cable retirement on network redundancy, emergency connectivity, and national resilience objectives.
- The encouragement of cable owners to evaluate whether old cable systems could continue to serve as strategic backup infrastructure, or be repurposed where feasible (i.e. in the case of unrepeated cables).
- The definition of mandatory minimum notice periods (e.g. 12-18 months) for decommissioning notifications to ensure sufficient time for national authorities and regional bodies to identify and mitigate potential connectivity gaps, particularly for SIDS.
- The mandating of a regional impact assessment as part of the decommissioning review process to evaluate cascading effects on shared cable routes and to identify alternative routing options before final retirement decisions are made.
- The development of technical guidelines and certification standards for the safe and effective repurposing of decommissioned cables as low-cost backup infrastructure, or for non-telecommunications uses (e.g. environmental monitoring), thereby maximizing the utility of existing assets.
- The promotion of transparency through a centralized public registry of decommissioning plans. This would enable investors, development agencies, and regional partners to proactively plan for redundancy investments and secure the necessary funding.
- Encouraging the inclusion of continuity clauses in decommissioning agreements. These would require cable owners to maintain service levels, or provide interim connectivity solutions until a permanent replacement or mitigation strategy is fully operational.

RECOMMENDATION 13: CLS AND OUTSIDE PLANT (OSP) SECURITY

Enhance and expand industry guidance on hardening the security and surveillance of cable stations, fronthaul cables and outside plant and digital access portals (command and control systems).

13.1 DATA SECURITY

The protection of CLS and associated fronthaul cables is key in ensuring the security of data in transit and storage, while it is also central to preventing unauthorized access and misuse for dual purposes. Unfortunately, this is also the most vulnerable part of the end-to-end submarine cable network, due to these facilities' easy access.

Fronthaul cables are vulnerable to civil works, such as excavators accidentally cutting cables during operations around the CLS. They are also vulnerable to a degrading of their cables in the BMH when operators install a new cable. In addition, they are even vulnerable to locals who want to demonstrate their disapproval of the cable installation. The CLS is also subject to a high risk of energy disruption, fire, or wilful misconduct and vandalism.

13.2 MEASURES

National governments may wish to consider the following actions:

- **Follow published ICPC recommended best practices** for securing both the CLS and other

OSP between the facility and the cable landing. These recommended practices include:

  - Securely locked chamber covers for fronthaul cables and BMHs.
  - Redundancy of fronthaul cables when built in an area with a lot of civil works, along with fibre sensing on fronthaul cables between the BMH and CLS. These measures have proved highly effective at both identifying construction work and intervening before cable damage occurs.[101]
  - Cable stations should have batteries and back-up generators to enable them to withstand power outages on the grid for several hours or days. Stations should also have fire protection alarms and video protection linked to a 365/7/24 network operating centre, which should be able to respond rapidly.

- **Formally designate cable landing stations as critical infrastructure.** A number of governments have done this, leading to the adoption of enhanced physical and operational security requirements.

In some jurisdictions, such as Chile and the United States, this has included obligations to establish permanent guarded access points, controlled entry systems, and strengthened surveillance arrangements at CLS and associated facilities.

13.3 REAL-TIME MONITORING AND EARLY WARNING FOR FRONTHAUL CABLES

Advanced sensing and surveillance technologies can be provided by systems such as DAS. The following paragraphs outline the rationale for this technology and its uses.

- **Shifting from reactive to proactive cable protection**

Current monitoring of terrestrial and underwater infrastructure typically relies on detecting performance degradation, or conducting periodic inspections. This means that responses to damage are fundamentally reactive. Real-time monitoring, however, allows for more appropriate protection of these assets. By using advanced DAS – also known as distributed optical fibre sensing (DFOS) – the terrestrial or undersea cable itself is turned into a highly sensitive, distributed sensor array. This provides real-time information along the entire infrastructure.

- **What DAS/DFOS is and how it works**

DFOS works by measuring the backscattered light from optical fibres. When there is an incident, a small amount of power is scattered in all directions due to local non-homogeneities. A fraction of this is guided backwards to where it can be analysed. DAS uses Rayleigh scattering, in which the backscattered light has the same wavelength as the incident light.

[101] See Tanner, B., "FiberSense and Southern Cross Deploy Shore-End Monitoring on NZ Subsea Network Portion," *Submarine Telecoms Forum,* 9 August 2024, https://subtelforum.com/fibersense-southern-cross-monitor-nz-subsea-network/ (accessed 7 July 2026).

In the use associated with submarine cable real-time monitoring, DAS determines strain variations between positions along the cable. The cumulative variations describe the fibre length dynamics. These strain variations can be generated by different events occurring close to the cable that generate acoustic waves. Such events can include construction activities, excavations, piling, trawling, anchoring, cable movement, landslide, earthquakes or tsunamis.

From a hardware point of view, a DAS monitoring system essentially comprises a laser light source, detection electronics, and a computer control and data processing system. All this equipment is located in the CLS. Since the data rate can be high, signal processing and event detection is often implemented using edge computing. This can limit the output monitoring system data rate in communicating with operating centre dashboards.

The level of DAS sensitivity depends on several factors. These include:

- the intensity of the signal inducing the fibre strain (the released energy)
- the distance of the source from the cable
- the mechanical properties of the soil (the propagation of signals)
- the cable layout.

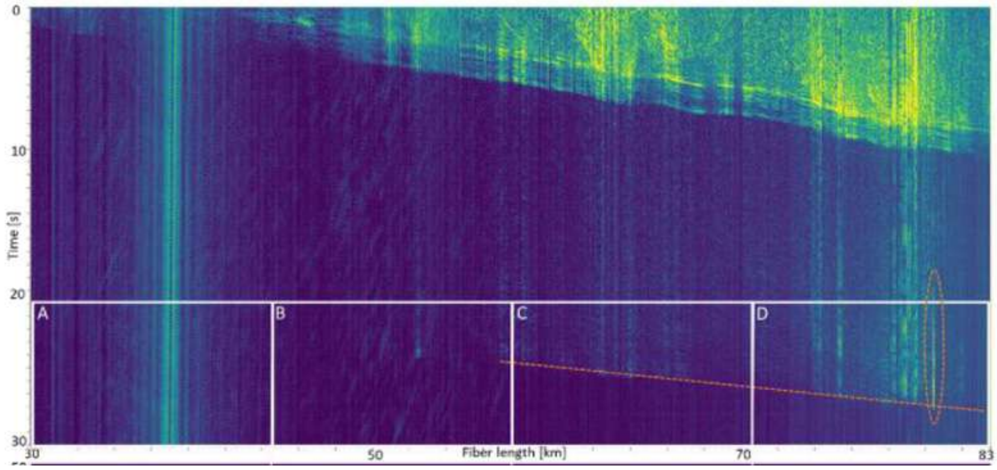
Quantitative signal processing and machine-learning detection is made possible with DAS, which acquires both the intensity and the phase of the scattered light as a function of the distance. The phase measurement makes it a linear sensor, i.e. the same perturbation results in the same signal can be used for training purposes and subsequently processed consistently. The spatial resolution of DAS is on the metre-scale.

- **Examples**

DAS data are often shown on a waterfall plot as variations in time and distance. In the following diagram, the horizontal axis represents the distance (in kilometres) from DAS monitoring in the CLS, while the vertical axis represents the time variation (in seconds).

Figure 13 shows a few minutes of data along a subsea telecom cable. The figure shows surface vessel noise and an earthquake, with the first of these events visible on the left side of the top screen (Box A and above). The surface vessel is travelling at 7 metres per second. Along the top, above boxes B, C, and D, is the signature of an earthquake.

Figure 13: DAS waterfall plot of a surface vessel and an earthquake



Source: Brenne, J. K., *et al.* [102]

- **The benefits of DAS**

DAS has a number of monitoring uses, including:

- the detection of seabed interference, such as anchor drag and bottom-trawl fishing
- the surveillance of terrestrial front-haul fibre routes from BMH to CLS to detect construction activities or the opening of manholes
- the monitoring of changes to cable burial or cable movements
- the surveillance of surface vessels
- seismological monitoring, including monitoring of earthquakes, submarine landslides and the issuing of tsunami warnings
- the monitoring of electric faults in power cables.

Anchors and trawl equipment generate significant forces when dragged along the seabed. These actions can also be seen in DAS data, as they produce propagating waves with an amplitude and range that depends on the weight of the gear and the tow speed. Trawl gear can therefore be tracked up to 3 kilometres away from the cable. For cable protection applications, this means that potential external risks moving on the seabed can be detected upon approach and with a lead time for proactive mitigation. The responsible mariner can be contacted, for example, or guard ships can be directed to the location. Whether or not construction workers are aware of the cable location can also be checked. If an incident occurs, real-time and direct confirmation of the presence of a seabed object near or at the cable can be used to trigger a rapid response and prevent further incidents at other nearby assets.

DAS data is also sensitive to environmental signals related to water flow. This makes it possible to determine cable burial status and detect any segments that have become exposed. Cable movements or cable interactions with, for example, rocks on the seabed can be automatically evaluated in order to determine the risk of developing cable damage.

- **DAS performance**

[102] See Brenne, J. K., Sladen, P. Pecci, *et al.*, "Non-Intrusive DAS Coexisting in Telecom Networks", 2024 Optical Fiber Communications Conference and Exhibition (OFC), San Diego.

State-of-the-art DAS systems have low instrument noise and a long range, at 150 kilometres. Recent developments in DAS technology have also enabled optical amplification techniques taken from telecoms to further extend the sensing range. Using an auxiliary Raman pump and a remote optically pumped amplifier (ROPA) allows DAS measurements at up to 300 kilometres. By installing a device at both ends of a cable, a total cable length of 600 kilometres can therefore be monitored with no active components in the wet plant. DAS is also compatible with repeater technology, making the sensing range scalable to distances of thousands of kilometres.

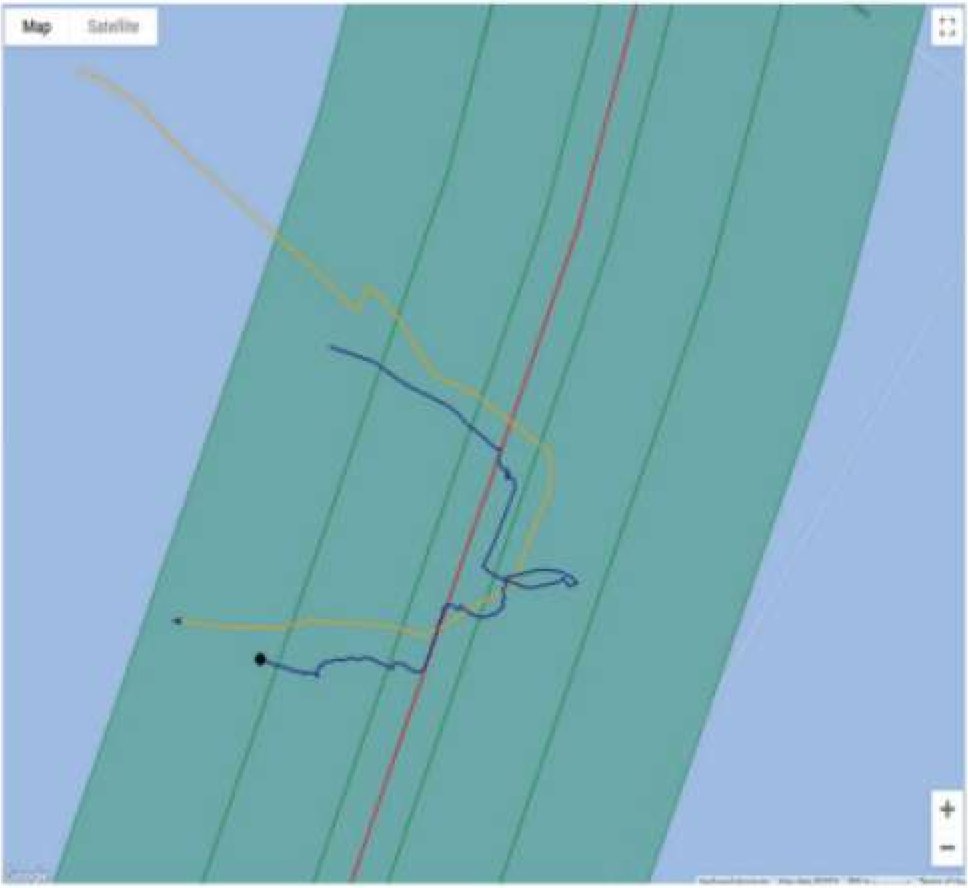
- **Combining DAS with other technologies**

The association of DAS technology with AIS technology allows us to improve threat detection performance. In particular, it allows for determination of the type of threat, as well as allowing action to be taken to mitigate that threat. When the threat detected by the DAS is identified as a vessel, for example – perhaps a trawler or a vessel dropping anchor – DAS permits the network operating centre to identify the vessel. Once this has been done, the vessel can be contacted and the captain informed that there is a cable nearby and they should stop their activities, or they will potentially be held responsible if the cable is damaged.

For terrestrial front-haul sections of a submarine cable – those between the BMH and CLS – the chances of being able to make a successful intervention are also much higher, thanks to DAS. Responders can be despatched at short notice to assess whether any construction activities involving excavation or piling are in close proximity to the cable and liaise with the personnel on site.

As Figure 14 shows, DAS detections can also be interpreted alongside AIS vessel position data. This can help determine the identity of a vessel operating seabed gear.

Figure 14: Comparison of an AIS fishing vessel track (yellow line) with DAS-measured seabed object movements (blue line) around a submarine cable (red line)



Source: Morten, J.P. *et al.*, 2023[103]

RECOMMENDATION 14: INVESTMENT IN ENHANCING CABLE PROTECTION

Evaluate the benefit of higher upfront Investment to reduce the risk of future outages. Industry is encouraged to share detailed recommendations on survey, route planning, engineering and installation (including burial) to enhance cable protection.

14.1 HISTORICAL PRICE PRESSURES AND COMPROMISED RESILIENCY

The best performing submarine cable systems are those that are appropriately engineered and protected at the design and installation phase. Cable owners and investors should therefore budget accordingly, rather than being lured by cost-cutting measures that will ultimately result in more outages and reduced resilience. One example of this is the practice of selecting a shorter route, even if its associated risks – such as those from mooring areas, landslides

[103] See Morten, J.P. *et al.*, "Integrating monitoring technologies to secure submarine cables", *SubTel Forum Magazine*, May 2023.

and fishing activities – are higher. Other cost-cutting measures include reducing the cable armouring, hasty installation speeds and compromised shore-end protection.

When compared to the subsea power cable sector, submarine telecoms cables do not undergo the same level of rigour in the planning and engineering stages.

14.2 MEASURES

For cable route planning and protection, national governments should refer to the ICPC recommendations. These recommendations should also be more prescriptive when offering a clear explanation of the best engineering and installation practices that should be applied in the following fields:

- **Cable route planning**: The basic rules of route planning are presented under Recommendation 9 above. Such plans should be detailed and adapted to new risks linked to changing weather patterns, such as changing currents, storm patterns and sand movements close to landings. The ICPC may wish to propose comprehensive route engineering guidelines that limit the risks posed by factors such as submarine geology, the density of fishing activity, the presence of strong current zones that prevent proper burial, and any overlaps with maritime navigation routes.
- **Cable protection:** Some basic, cable protection rules are presented below. These align with the ICPC recommendations and are adapted to the new risks mentioned above that are linked to changing weather patterns. The ICPC may wish to propose comprehensive engineering guidelines for cable protection according to the nature of the threat and the cable type and burial.
- **Cable surveillance:** Real-time monitoring techniques are described in Recommendation 2 above. The ICPC or other stakeholders may wish to encourage the use of AIS surveillance and DAS surveillance of cables from the CLS in order to anticipate and mitigate risks linked to vessels, trawlers, dragged anchors, cable movements, earthquakes, submarine landslides and tsunamis.

Several countries have already begun to reflect the above approach in their legislative and regulatory frameworks. This generally comes as part of a broader strategy to attract submarine cable investment and enhance network resilience. Singapore, for example, has a long-standing practice of incorporating resilience and protection considerations into its policies – both when facilitating new cable projects and when overseeing existing cable systems. Meanwhile, Indonesia has been carefully analysing measures related to cable routing and separation as part of an ongoing development of its regulatory framework.

At the regional level, the 2026 Enhanced ASEAN Guidelines for Strengthening Resilience and Repair of Submarine Cables[104] also provide a relevant example. These encourage the adoption of international best practices – both to strengthen the protection and maintenance of submarine cables and to expedite repairs to damaged cables in support of more reliable and investment-friendly connectivity environments.

[104] See ASEAN Digital Ministers Meeting (ADGMIN), "Enhanced ASEAN Guidelines for Strengthening Resilience and Repair of Submarine Cables", ASEAN, 16 January 2026, https://asean.org/wp-content/uploads/2026/01/Enhanced-ASEAN-Guidelines-for-SR-and-Repair-of-Submarine.pdf (accessed 28 June 2026).

14.3 BURIAL AND ARMOURING TECHNIQUES

Cable protection is enhanced by both appropriate burial depth standards and the adoption of adaptive burial methods that are suited to local seabed conditions. Typical techniques include ploughing, water jetting, and ROV-assisted trenching. These ensure an optimal balance between protection, cost, and repair feasibility under varying sediment types.

This section will now look in more detail at the different armouring and burial types and techniques.

- **Armouring**

This section describes the different cable types available and the circumstances under which each type should be considered.

o **Rock armour heavy (RAH)**

RAH is a double armour, cable-over-lightweight (LW) variety that is similar to double armour heavy (DAH), but with the outer armour bound in a tighter helix. RAH is used where burial is not possible and there is a risk from aggressive fishing that may result in the cable being exposed to impact from trawl boards. The tighter armour helix gives additional protection against just such trawl-board impact. This type of cable can be buried in WDs of less than 200 metres. RAH is often superseded by special purpose double armour (SPDA), or DAH. This is because RAH is particularly stiff, making it difficult to handle, while the tensions required during its laying operations can also be challenging.

o **Double armour/medium double armour (DA/MDA)**

The cable type selected for shore ends will almost always be the maximum armour type for the cable family being used. An exception to this rule is when a bore pipe has been horizontally drilled using horizontal directional drilling (HDD). In these cases, it is often necessary to down-armour from the BMH until shortly before the cable exits the bore pipe. This method is used to prevent the wider diameter DA/MDA cable jamming in the pipe during installation.

DA/MDA cable is used as standard out to at least the 15 metre WD contour, regardless of seabed type. For surface lay segments, this is often increased to a standard, 200 metre WD, or even a WD of up to 500 metres, should the cable be perceived to be at risk from external aggression, suspension, or seabed abrasion. In more complex areas of seabed, sections of DA/MDA can be inserted in individual sections where the cable is assessed as 'at risk'.

In buried segments, DA/MDA should be used from the BMH to beyond the initial post-lay deployment slack (PLDN) position. Careful attention to the burial assessment study (BAS) is required to determine if additional sections of DA/MDA are required. The fact that cable is buried denotes that a perceived risk is present. If, for whatever reason, the cable cannot be buried, or there is a significantly reduced burial (i.e. less than 0.5 metres) anticipated, then DA/MDA should be considered in WDs of less than 500 metres.

o **Double armour sheathed (DAS)**

DAH is the preferred cable type for sections of the cable that may be exposed to aggressive fishing and where burial is likely to be very poor. DAH has a similar tensile strength and performance to SPDA (see below), but is easier to store and handle during lay operations.

DAS consists of standard MDA cable enrobed in a plastic sheath. The protective sheath guards the cable against anodic reaction, which causes accelerated degradation of the cable.

- **DAH**

DAH is a cable type for sections of the cable that may be exposed to aggressive fishing and where burial is likely to be very poor. It has similar tensile strength and performance to SPDA, but is easier to store and handle during lay operations. SPDA, or RAH, may also be selected in these environments.

- **Double armour heavy sheathed (DAHS)**

In areas of strong seabed currents – those greater than 1.6 knots – and other aggressive seabed conditions, installed cables are at risk from abrasion due to the potential for movement of the cable on the seafloor. In these situations, once the serving around the unsheathed armour has been compromised, deterioration can occur very quickly. To mitigate this risk, applying a protective sheath to armoured OALC4 cable significantly reduces the risk by increasing density to stabilise the cable and provide additional resistance to abrasion by protecting the cable serving. This also prevents rapid degrading, if superficial damage is incurred. This cable should be considered in areas of strong bottom currents and/or large swells and aggressive seabed conditions where a cable may be subject to movement.

The additional weight of this cable makes it impractical to bury beyond 250 metres of WD, however. Normally, the fact that this cable has been selected means that surface lay is anticipated, for if burial was proposed and feasible, then the requirement for DAHS would have been somewhat negated. Between 250 metres and 500 metres of WD the decision is straightforward, as if burial is to be considered, then DAHS is not suitable. If burial is not feasible or at risk, then DAHS should be planned for and surface laid.

- **SPDA**

SPDA is a double armour cable (close to DAH) with wire protection over a light-weight protected (LWP)-type cable (see below), instead of a standard light-weight (LW) cable (also see below). SPDA has the strongest tensile strength and crush resistance and should be utilized where cable cannot be buried, or very poor burial is anticipated, with the cable at risk from bottom trawling, 'hooking' and anchors. DAH is usually recommended in these conditions, but SPDA may be considered if the cable might be exposed to a threat such as boulders or small anchors striking it. In such cases, the superior crush resistance properties of SPDA are advantageous. This type of cable can be buried to 250 metres of WD; however, it is normally surface laid, as if burial were possible, it would not usually be selected.

- **Single armour heavy (SAH)**

SAH is similar to DAH, but without the second layer of wrapped wire protection. Due to the reduction in weight this creates, SAH may be considered for sections of cable between 500 metres and 1 500 metres of WD where aggressive fishing and poor burial conditions are anticipated.

- **Single armour (SA/SAL)**

For surface lay, SA/SAL should be selected for all cable sections below 1 500 metres of WD where DA/MDA is not being used.

For proposed burial areas the same rule applies. SA/SAL cable should be allocated in areas of more than 500 metres of WD where there is high confidence that burial will be at least 0.5 metres below the seabed surface. Between 500 metres and 2 000 metres of WD, SA/SAL cable is the maximum standard protection that can be allocated. Most systems will require armoured cable to at least 1 500 metres of WD.

o **Deep water armour (DWA)**

DWA is similar in construction to SAL, but has lighter armour wires. DWA should be considered in WD greater than 2 000 metres and where the preferred cable, if not restricted by depth, would be SA/SAL; in other words, where the cable is deemed at risk for abrasion due to very aggressive seafloor conditions, or entanglement/hooking from fishing lines or FAD moorings. DWA can be deployed to 2 500 metres of WD, transitioning to LWP at this depth.

o **Deep water protected (DWP)**

DWP cable is similar to SAL cable, but with each alternate armour wire substituted by polypropylene. DWP is used at WDs of between 2 500 metres and 5 000 metres where a cable route crosses trenches, steep slopes (more than 30-35 degrees), or in rough, aggressive seabed conditions which cannot be avoided by conducting route development.

o **LWP**

LWP cable is used as standard for cable in WDs of between 1 500 metres (or the end of armoured cable, if deeper) and 2 500 metres. This is to provide additional protection in what is still reasonably shallow water. LWP has also been proven to provide protection from shark bite.

In WDs beyond 2 500 metres and up to maximum cable depth qualification, a decision must be made between LW and LWP cables.

The usual rules of LWP usage are:

- from the end of an armoured cable (from 1 500 metres to 2 000 metres of WD) out to 2 500 metres of WD
- in WDs greater than 2 500 metres out to the maximum design depth, in cases in which surveys have identified rugged topography indicating steep slopes and a high probability of the presence of rocky outcrops
- if any information indicating a bottom current has been acquired.

In deeper waters (those deeper that 2 500 metres), the choice of LWP is mainly based on the topography of the sea floor. In other words, the primary factor with regard to cable selection is the ruggedness of the seabed. This can be assessed by reviewing the route position list (RPL) profile and slope severity. Consideration should also be given to upgrading from LW to LWP when seabed average slopes reach 20 degrees or above. Other considerations when selecting cable type include consulting the available fault history and the protection used on existing cables in the vicinity.

o **LW**

LW cable should be allocated to all areas that are deeper than 2 500 metres of WD and where LWP is not required.

- **Burial**

Most cable systems require burial in their shallow water sections. This has proved to be the most effective way of protecting a cable from any external aggression, such as anchor strikes, fishing gear strikes and any other human activity that may interfere with the seabed. Burial also stabilises the cable, preventing movement, and as such significantly reduces the risk of abrasion.

There are two methods of burial: ploughing and jetting. Jetting is normally conducted by divers or ROVs, while ploughing is conducted by the main lay vessel only. The plough is the primary tool used for cable burial.

WORKING GROUP REPORT 3: FOSTERING CONNECTIVITY AND GEOGRAPHICAL DIVERSITY

Co-facilitated by the World Bank and the Caribbean Telecommunications Union

RECOMMENDATIONS[105]

WORKING GROUP 3 RECOMMENDATIONS
FOSTERING CONNECTIVITY AND GEOGRAPHICAL DIVERSITY

1	Promote the establishment of blended-finance platforms and initiatives for submarine cable investments, with emphasis on Small Island Developing States ("SIDS"), Landlocked Developing Countries ("LLDCs"), and underserved remote coastal regions, de-risking projects which may deliver high development impact but may not be commercially viable.
2	Encourage engagement among financing institutions, governments[3] and operators early in the submarine cable design process to promote potential investments benefiting SIDS, LLDCs and other underserved regions.
3	Support the design and implementation of partnership structures, including public-private partnerships, for marine cables to underserved regions, enabling routes that would not achieve commercial viability through purely private consortiums alone.
4	Encourage the development of insurance mechanisms to 1) improve project bankability for SIDS, LDCs and other underserved regions and (2) reduce insurance costs for all systems.
5	Encourage governments to develop clear, predictable policy and regulatory frameworks for submarine cable licensing and permitting to reduce costs and project implementation delays resulting from uncertain regulatory environments, and improve project bankability.
6	Encourage non-discriminatory access to cable landing stations, consistent with national regulations and national security requirements, in underserved regions, enabling competing carriers to secure capacity for domestic and international terrestrial service driving wholesale price reductions benefiting end-users, digital economy development and landlocked neighboring countries.
7	Promote the integration of branching units into the initial design of major trunk submarine cable routes, creating opportunities for concessional financing to promote cost-effective connectivity for SIDS, LDCs and other underserved regions.
8	Encourage governments to consider options to develop anchor-tenancy on systems designed for underserved regions by purchasing minimum bandwidth capacity on new submarine cable systems de-risking private sector and public investment.
9	Support the implementation of good practices from new and existing toolkits, where feasible, with the intention to enable rapid national submarine cable project deployments, with emphasis on SIDS, LDCs and other underserved regions, to reduce costs and time to develop and deploy submarine cable systems and backup arrangements.
10	Encourage, through industry best practice, the use of guidelines for assessing and fulfilling route diversity and resiliency needs of SIDS, LDCs and other underserved regions, to prevent disruptions resulting from environmental and human-made hazards.

105 The wording of these recommendations is as it was approved in the original document, unedited.

(continued)

11	Support capacity-building and technical assistance for regulators and policy makers in developing countries, to enable countries to adopt good practices for submarine cable deployment, adapted to local contexts.
12	Encourage comprehensive hazard vulnerability assessments for new submarine cable deployments and recommissioning projects to SIDS, LDCs and underserved regions to mitigate identified hazards when possible.
13	Encourage the implementation of regulatory frameworks which incentivize shared landing infrastructure in underserved regions, reducing duplication of vulnerable facilities while maintaining the benefits of competition and diverse routing.
14	Develop and adopt, where feasible, technical and operational protocols enabling seamless failover to satellite, microwave, or other backup systems during extended submarine cable outages.

*Any reference to "national" or "government" is understood to extend to regional economic integration organisations (REIOs) within their respective area of competence.

This report is guided by the above 14 key recommendations, all of which were developed by Working Group 3 and approved by the International Advisory Body (IAB) on 2 February 2026. The recommendations are set out in the table below[106] and grouped into the following three, colour-coded thematic areas that foster connectivity and geographical diversity through submarine cables:

- financing and risk mitigation for inclusive connectivity (green)
- policy, regulatory and institutional frameworks (blue)
- geographical diversity and network resilience (orange).

#	Recommendation
1	Promote the establishment of blended-finance platforms and initiatives for submarine cable investments, with emphasis on Small Island Developing States ("SIDS"), Landlocked Developing Countries ("LLDCs"), and underserved remote coastal regions, de-risking projects which may deliver high development impact but may not be commercially viable.
2	Encourage engagement among financing institutions, governments and operators early in the submarine cable design process to promote potential investments benefiting SIDS, LLDCs and other underserved regions.
3	Support the design and implementation of partnership structures, including public-private partnerships, for marine cables to underserved regions, enabling routes that would not achieve commercial viability through purely private consortiums alone.
4	Encourage the development of insurance mechanisms to 1) improve project bankability for SIDS, LDCs and other underserved regions and (2) reduce insurance costs for all systems.

106 The wording of these recommendations is as it was approved in the original document, unedited.

(continued)

#	Recommendation
5	Encourage governments to develop clear, predictable policy and regulatory frameworks for submarine cable licensing and permitting to reduce costs and project implementation delays resulting from uncertain regulatory environments, and improve project bankability.
6	Encourage non-discriminatory access to cable landing stations, consistent with national regulations and national security requirements, in underserved regions, enabling competing carriers to secure capacity for domestic and international terrestrial service driving wholesale price reductions benefiting end-users, digital economy development and landlocked neighboring countries.
7	Promote the integration of branching units into the initial design of major trunk submarine cable routes, creating opportunities for concessional financing to promote cost-effective connectivity for SIDS, LDCs and other underserved regions.
8	Encourage governments to consider options to develop anchor-tenancy on systems designed for underserved regions by purchasing minimum bandwidth capacity on new submarine cable systems de-risking private sector and public investment.
9	Support the implementation of good practices from new and existing toolkits, where feasible, with the intention to enable rapid national submarine cable project deployments, with emphasis on SIDS, LDCs and other underserved regions, to reduce costs and time to develop and deploy submarine cable systems and backup arrangements.
10	Encourage, through industry best practice, the use of guidelines for assessing and fulfilling route diversity and resiliency needs of SIDS, LDCs and other underserved regions, to prevent disruptions resulting from environmental and human-made hazards.
11	Support capacity-building and technical assistance for regulators and policy makers in developing countries, to enable countries to adopt good practices for submarine cable deployment, adapted to local contexts.
12	Encourage comprehensive hazard vulnerability assessments for new submarine cable deployments and recommissioning projects to SIDS, LDCs and underserved regions to mitigate identified hazards when possible.
13	Encourage the implementation of regulatory frameworks which incentivize shared landing infrastructure in underserved regions, reducing duplication of vulnerable facilities while maintaining the benefits of competition and diverse routing.
14	Develop and adopt, where feasible, technical and operational protocols enabling seamless failover to satellite, microwave, or other backup systems during extended submarine cable outages.

* Any reference to "national" or "government" is understood to extend to regional economic integration organizations (REIOs) within their respective area of competence.

Subsequent chapters further elaborate on the background, rationale and supporting evidence for the recommendations, grouped by theme.

CHAPTER 1. FINANCING AND RISK MITIGATION FOR INCLUSIVE CONNECTIVITY

1.1 DIAGNOSIS OF INVESTMENT AND COST BARRIERS

Vulnerability caused by the geographical concentration of submarine cable routes

Global internet traffic, carried through submarine cables, is often subject to geographical concentration in a limited number of chokepoint corridors in which these cables traverse narrow straits and shallow waters. This creates a systemic vulnerability that extends far beyond individual cable failures.

Key examples of high concentration areas include:

- **The Bab el-Mandeb Strait at the southern gateway to the Red Sea**: This is the most concentrated area in the world, with at least 17 cables – carrying an estimated 17-20 per cent of global Internet traffic – passing through waters less than 14 miles wide.[107]
- **The Suez Canal corridor**: This funnels an estimated 90 per cent of Europe-Asia communications through waters where cables must traverse shallow depths for over 100 miles before entering the Mediterranean Sea.[108]

This high geographical concentration of cables creates a significant risk from, *inter alia*, anchor drag, seismic activity and geopolitical conflict. These can result in global connectivity disruptions that no individual operator can mitigate through private investment alone. [109]

Recent submarine cable outages have exemplified the economic impact of downtime in submarine connectivity. These impacts have also been compounded in areas of significant cable system concentration. Indeed, single system outages have already generated quantifiable economic losses that exceed cable repair costs. This demonstrates that single-route dependencies impose severe fiscal burdens on national economies and justify public investment in redundant infrastructure.

The January 2022 Hunga Tonga-Hunga Ha'apai volcanic eruption, for example, severed an oceanic country's sole international submarine cable at two locations. This caused near-total digital isolation for 61 days. It also generated estimated damages and economic losses that in United States dollar (USD) terms amounted to approximately USD 182 million. This was equivalent to 38.7 per cent of the oceanic country's 2021 gross domestic product (GDP).[110] Remittances, which constituted 40 per cent of the nation's GDP and 30 per cent of its household

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[107] See Monaghan, S, et al., "Red Sea Cable Damage Reveals Soft Underbelly of Global Economy", Center for Strategic and International Studies (CSIS), 7 March 2024, https://www.csis.org/analysis/red-sea-cable-damage-reveals-soft-underbelly-global-economy (accessed 20 June 2026).

[108] See Moss, S., "Egypt's submarine cable stranglehold", DataCenterDynamics, 15 September 2022, https://www.datacenterdynamics.com/en/analysis/egypts-submarine-cable-stranglehold/ (accessed 20 June 2026).

[109] See IAB Working Group 2 report, *Risk identification, monitoring and mitigation,* for further detail on risks to subsea cable systems.

[110] See International Monetary Fund (IMF), Tonga: 2022 Article IV Consultation-*Press Release; Staff Report; and Statement by the Executive Director for Tonga,* IMF, Washington DC, 2022, https://www.elibrary.imf.org/view/journals/002/2022/282/article-A001-en.xml.

consumption, were effectively frozen during the outage period. This disproportionately affected women, who tended to rely heavily on international transfers for family support.[111]

The 2024 outage in West Africa provides another example of the costs of cable disruption. On that occasion, multiple cables serving 12 countries along the continent's western coast were disrupted. The outage resulted in one country alone losing an estimated USD 590 million over four days, as e-commerce platforms, digital banking services, and international business communications collapsed.[112] In southern Africa, meanwhile, dual cable breaks in both 2020 and 2023 occurred simultaneously due to rock falls in the Congo Canyon. Although backup routing through alternative cables was able to maintain limited connectivity, users experienced severe throttling and service degradation, which disrupted financial markets, cloud services, and cross-border data flows.[113]

These documented case-studies demonstrate a consistent pattern: **economies dependent on single cables or limited route diversity are at high risk of significant economic losses; these losses also vastly outweigh the annualized cost of deploying redundancy cable infrastructure**. This establishes a compelling financial case for public-sector co-investment in redundancy and resilience.

Systemic and geographical barriers to route diversity

Submarine cable networks are strongly path-dependent: once certain routes are established, they gain infrastructure advantages that make alternative routes uneconomical for new investors. This further concentrates connectivity in the same geographical corridors.[114]A transatlantic cable spanning 7 000 kilometres can cost in the range of USD 250 million, while trans-Pacific routes can cost USD 400 million. Deploying a cable along an established route where cable landing stations, power-feeding equipment, terrestrial interconnections, and local regulatory frameworks already exist can reduce total deployment costs by 15-30 per cent, compared to opening a new route.[115]

In addition, because cable operators often function as consortiums that collectively bear financial and technical risks, individual members face strong incentives to share capacity on proven routes, rather than speculate on alternative corridors where demand uncertainty and first-mover costs could erode returns on investment. Where landing stations cluster, new entrants may also face a difficult choice between higher costs and the operational complexity of deploying entirely new routes or maintaining the existing route. This 'lock-in' effect is reinforced by positive network externalities: additional cables landing at established hubs increase the hub's value to subsequent investors and end-users by expanding available capacity. This

[111] See World Bank, *The January 15, 2022 Hunga Eruption and Tsunami, Tonga: Global* Rapid Post-Disaster Damage Estimation *(Grade) Report*, World Bank, Washington DC, 2022, https://thedocs.worldbank.org/en/doc/b69af83e486aa652d4232276ad698c7b-0070062022/original/GRADE-Report-Tonga-Volcanic-Eruption.pdf.

[112] See Ajibade, A, "Nigeria loses over $593.6 million amid undersea cable repair", NetBlocks (via Techpoint Africa), 18 March 2024, https://techpoint.africa/news/nigeria-loses-millions-undersea-cable-repair/ (accessed 20 June 2026).

[113] See Global Digital Inclusion Partnership (GDIP), Good Practices for Subsea Cables Policy: Investing in Digital Inclusion, GDIP, 2024, https://globaldigitalinclusion.org/wp-content/uploads/2024/01/GDIP-Good-Practices-for-Subsea-Cables-Policy-Investing-in-Digital-Inclusion.pdf.

[114] See Gervasi, P., "Diving Deep into Submarine Cables: Undersea Lifelines of Internet Connectivity", Kentik, 28 March 2023, https://www.kentik.com/blog/diving-deep-into-submarine-cables-undersea-lifelines-of-internet-connectivity/ (accessed 20 June 2026).

[115] See Burdette, L., "The Economics of Submarine Cables", TeleGeography, 4 September 2025, https://resources.telegeography.com/the-economics-of-submarine-cables (accessed 20 June 2026).

creates a self-reinforcing cycle that marginalizes alternative geographical options and leaves secondary routes unexplored – despite their potential to enhance resilience.

Capital-expenditure models and premiums for diverse routing

Submarine cable capital expenditure exhibits economies of scale and route-distance relationships that create systematic financial incentives favouring highly utilized, geographically concentrated routes over resilient, diverse alternatives. The baseline capital cost for a modern submarine cable system ranges from USD 30 000 to USD 50 000 per kilometre, inclusive of fibre-optic cable, submarine repeaters, power-feed modules, and marine installation labour. Large transatlantic and trans-Pacific cables of 15 000-20 000 kilometres in length typically range from USD 250 million to USD 500 million in total deployment cost.[116] Deploying a secondary cable along an alternate geographical route incurs a 'diversity premium' of approximately 15-25 per cent in additional cost. This is because new routing typically bypasses existing cable landing stations, requires new permitting and environmental assessments, and cannot leverage pre-existing terrestrial interconnection infrastructure.[117] This diversity premium can render alternative routing commercially unattractive, given that cable operator consortium members assume commercial debt rates over 25-year amortization schedules when calculating returns on capital.

Cable landing station development and terrestrial backhaul upgrades can also add a further USD 15-30 million to alternate-route deployment, depending on whether landing country infrastructure requires new power stations, customs facilities, or security enhancements. These are costs that are often borne entirely by landing-country governments seeking cable connectivity, but lack fiscal capacity to fund them privately.

This cost structure explains why more than 80 per cent of new submarine cable investment continues to concentrate on established routes. A consortium member investing in a transatlantic cable expects returns to sufficiently justify long-term debt service, while alternate-route investment economics cannot compete without government co-investment, public anchor tenancy commitments, or explicit resilience subsidies that compensate for lower commercial utilization.

Challenges in operational and maintenance expenditure and repair vessel scarcity

The operational and maintenance cost structure for submarine cables reveals a second critical barrier to resilience: repair-vessel scarcity and the geographical concentration of maintenance capacity. These factors create escalating operational expenditure (OPEX) burdens that penalize operators of secondary and remote-route systems disproportionately. The global shortage of specialized cable repair vessels has become an acute financial constraint: in 2025, of the more than 80 dedicated submarine cable repair and laying vessels operating worldwide, nearly half were concentrated in the northern hemisphere.[118] Average repair cost per incident is between

[116] See Runde, D.F., E. L. Murphy, and T. Bryja, "Safeguarding Subsea Cables: Protecting Cyber Infrastructure Amid Great Power Competition", CSIS, 16 August 2024, https://www.csis.org/analysis/safeguarding-subsea-cables-protecting-cyber-infrastructure-amid-great-power-competition (accessed 20 June 2026).

[117] See Reverdy, D., and I. Skenderoski, Submarine Cables: Structuring and Financing Options, Salience Consulting, January 2015, https://salienceconsulting.ae/wp-content/uploads/2018/09/Submarine_Cables_Structuring_and_Financing_Options_Jan_2015.pdf

[118] See Global Security and Innovation Summit (GSIS), "Monthly Executive Briefing: Strengthening Resilience to secure Europe's submarine cables", GSIS, Hamburg, 2025, https://www.gsis-hamburg.com/fileadmin/gsis/2025/pdf/gi25_executive_briefing_20250619_archive.pdf (accessed 20 June 2026).

USD 645 000 and USD 1.3 million and in certain jurisdictions it may reach USD 1.5-2 million, with between 30 per cent and 70 per cent of the total cost driven by vessel mobilization fuel costs, rather than the repair itself.[119]

Between 2015 and 2023, average cable repair time also increased, from 22 days to 40 days. This was directly attributable to the shortage of available vessels. In February 2023, a nation in southeast Asia experienced all five of its cables being damaged simultaneously, resulting in a 75 per cent capacity loss. Repairs took until late November 2023 to complete – a period of 9 months. This was because repair ships were busy with other projects, forcing telecommunications operators to purchase costly, emergency terrestrial capacity.[120]

Financing barriers, bankability criteria and credit-rating considerations

Commercial banks and institutional investors have established stringent bankability criteria for submarine cable projects. These criteria systematically disadvantage geographically diverse, secondary routes in favour of major international corridors in which revenue predictability is highest.

Bankability assessment focuses on three core metrics: 1) revenue certainty, which is typically measured by the ratio of pre-sold capacity to total cable capacity, with the former measured in terms of indefeasible rights of use (IRUs); lenders typically demand a minimum of between 40 per cent and 60 per cent pre-sales before commitment; 2) operator creditworthiness, with preference for established telecommunications operators and hyperscalers that are rated investment-grade or equivalent; and 3) geopolitical and regulatory stability, with a higher cost of capital applied to routes crossing territories with unstable governance, unclear regulatory frameworks, or contested maritime claims.[121]

Secondary routes connecting SIDS, remote coastal nations, and emerging markets face bankability challenges because demand from local operators is episodic and unproven. Consequently, financial institutions often classify these as high-risk, applying premiums above standard lending rates for comparable mature infrastructure assets. Geopolitical uncertainty compounds these constraints: cables crossing disputed territorial waters face extended permitting processes, regulatory rejection risk, and increased insurance costs, with commercial underwriters imposing *force majeure* clauses and elevated premiums that raise financing costs.

The result is credit-rating compression: submarine cable operators in emerging markets or geopolitically sensitive regions often receive subinvestment grade ratings even when backed by government shareholders. This effectively locks them out of public capital markets and constrains them to more expensive bilateral lending. For alternate routes offering lower pre-sales prospects and higher geopolitical risk, commercial cost of capital is substantially higher than major-corridor cables. This mathematically precludes project financial closure without government subsidy, blended-finance instruments, or explicit resilience-focused public investment.

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[119] See Fígoli, A., "Sustainability in the Submarine Cable Repair Market", SubCables, 21 May 2025, https://www.subcables.com/post/sustainability-in-the-submarine-cable-repair-market (accessed 20 June 2026).

[120] See Recorded Future, Submarine Cable*s Face Increasing Threats Amid Geopolitical Tensions and Limited Repair Capacity,* Recorded Future, 17 July 2025, https://www.recordedfuture.com/research/submarine-cables-face-increasing-threats, and VietNamNet, "Internet connection from Vietnam to international fully restored in October", VietNamNet, Hanoi, 2 October 2024, https://www.vietnam.vn/en/ket-noi-internet-tu-viet-nam-di-quoc-te-khoi-phuc-hoan-toan-trong-thang-10 (accessed 20 June 2026).

[121] See footnote 11.

A fundamental economic barrier that confronts underconnected countries is the high unit cost of connectivity resulting from unfavourable economies of scale, whether submarine or terrestrial. The cost of submarine cable systems is largely fixed (regardless of distance), meaning that for SIDS in particular, per-kilometre costs for long-distance routes are amortized over fewer users and lower revenue bases.[122] Unit cost differentials result in commercial investment returns becoming impossible without public subsidies or anchor-tenant commitments from government agencies and universities. Limited fiscal space and bankability constrain the ability of SIDS and LLDCs to finance infrastructure: many face high sovereign risk ratings, limited currency reserves, and constrained fiscal capacity as a result of dependence on tourism and – for SIDS in particular – fisheries revenues that are vulnerable to climate disruption.[123]

Challenges in achieving commercial investment returns arise because the revenue base from small populations is insufficient to justify private capital deployment. Current approaches to this challenge typically require development assistance grants, soft loans, or hybrid public-private structures in which governments commit to 'anchor tenancy' guarantees on minimum bandwidth purchases. Even with such commitments, however, many SIDS remain unable to finance both new cable deployment and climate adaptation of existing infrastructure simultaneously. This creates prioritization dilemmas in which aging systems continue operating despite recognized vulnerabilities, or new cables are deployed without adequate landing-station protection. The development of partner support and innovative business models are necessary to expand submarine cable infrastructure for small states, yet funding flows remain inadequate to address the dual imperatives of universal connectivity and climate resilience.[124]

Climate-proofing submarine cable infrastructure also presents distinct financial barriers that constrain investment in resilience – particularly for operators and nations with limited capital availability. Cable landing station adaptation and protection represents a substantial cost multiplier. Many existing cable landing stations were designed for different, historical climate conditions and are located only 1-2 metres above mean sea level in coastal zones vulnerable to storm surge, flooding, and saltwater intrusion.[125]

Retrofitting these facilities with elevation systems, waterproof vaults, surge barriers, and enhanced cooling systems capable of withstanding flooding and temperature variations adds additional investment costs to the original landing station capital cost. This requires careful coordination to avoid service disruptions.

1.2 EXISTING AND PROPOSED FINANCIAL AND RISK-TRANSFER TOOLS

Blended finance instruments and development bank partnerships

Empirical evidence demonstrates exceptional economic returns on submarine cable connectivity investments in underserved markets. In the Democratic Republic of the Congo, the arrival of the West African Cable System (WACS) in 2012 catalysed a 19 per cent increase in

[122] See Internet Society, *Ensuring Internet Connectivity in* Small Island Develop*ing* States, Internet Society, 26 May 2017, https://www.internetsociety.org/resources/doc/2017/sidsreport/

[123] See Organization for Economic Co-operation and Development (OECD), *Capacity Development for Climate Change in Small Island Developing States*, OECD, Paris, 2023, https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/11/capacity-development-for-climate-change-in-small-island-developing-states_58d9c5c7/888c870a-en.pdf

[124] See Raina, R., "Connectivity and Information and Communications Technology", in A Sustainable Future for Small States: Pacific 2050, Commonwealth Secretariat, London, 2019, and footnote 16.

[125] See Hoover Institution, *Climate Change Impacts on Subsea Cables and Landing Infrastructure*, 2025.

GDP per capita by 2017 and an 8.2 per cent increase in likely employment in fibre-connected areas.[126] World Bank-supported cable projects have delivered 50-90 per cent reductions in international connectivity costs, with projects creating thousands of jobs through improved business connectivity and digital services expansion.[127] These quantified impacts demonstrate that concessional development finance generates substantial economic multipliers, justifying blended-finance models.

Blended-finance structures, which combine concessional development finance with commercial investment capital, have emerged as the most effective mechanism for enabling submarine cable routes that would not achieve commercial viability through private consortiums alone. This has been particularly the case in SIDS, least-developed countries (LDCs), and remotely located Pacific and African coastal economies. Strategy 2030 from the Asian Development Bank (ADB) establishes a mobilization target of USD 2.50 of long-term co-financing for every USD 1.00 of ADB private-sector financing, with blended finance mechanisms including credit enhancements, guarantees, and subordinated equity tranches that improve risk-return profiles and attract institutional investors.[128]

Elsewhere, the Programme for Infrastructure Development in Africa (PIDA) from the African Union mobilized USD 82 billion in infrastructure investment between 2012 and 2022. PIDA Priority Action Plan 2 (2021-2030) identified 69 priority projects requiring USD 160.7 billion in funding, emphasizing climate resilience and leveraging blended instruments to crowd in private capital at optimal leverage ratios.[129] In euro (EUR) terms, the European Bank for Reconstruction and Development (EBRD) has also deployed EUR 88 million to support Fulgor SA's submarine cable manufacturing capacity expansion, structured as EUR 62.8 million in EBRD concessional financing blended with EUR 25.2 million in European Union (EU) Recovery and Resilience Facility funds, channelled through the Greek Ministry of Finance. This demonstrates how multi-layered public capital can de-risk investment in cable infrastructure.[130]

For routes connecting SIDS and underserved coastal zones, development bank participation reduces the cost of capital from commercial rates (which are typically applied to project finance in emerging markets with currency and political risks) to highly concessional rates, such as those offered by the World Bank International Development Association (IDA). These are set at 0.75 per cent for regular credits and 0 per cent for grants.[131] The ADB, meanwhile, offers a 1 per cent rate to SIDS, enabling projects with lower revenue requirements, while also

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126 See O'Connor, A. C., et al., "Economic Impacts of Submarine Fibre Optic Cable and Broadband Connectivity in the Democratic Republic of the Congo", RTI International, 2020, https://www.rti.org/publication/economic-impacts-submarine-fiber-optic-cables-broadband-connectivity-democratic-republic-congo (accessed 20 June 2026).

127 See World Bank, Western Africa Regional Communications Infrastructure Project - Implementation Completion Report, World Bank, Washington DC, 25 February 2022, https://documents1.worldbank.org/curated/en/920521646421347997/pdf/Western-Africa-Regional-Communications-Infrastructure-Project.pdf

128 See Merchant, A., "Key Role for Blended Finance in Asian Development Bank's Strategy 2030", *convergence.finance*, 18 August 2018, https://www.convergence.finance/news/6U8X86Gpqwa4iEw8cMSEcQ/view (accessed 20 June 2026).

129 See African Union conference material, "Mobilizing Climate Finance for Africa's Infrastructure Future", African Union, Addis Ababa, 9-12 June 2025, https://au.int/en/newsevents/20250609/mobilizing-climate-finance-africas-infrastructure-future-pida-roundtable (accessed 20 June 2026).

130 See Aristeidou, O., "EBRD Funds Underwater Cables for a Sustainable Future", EBRD, London, 27 April 2023, https://www.ebrd.com/home/news-and-events/news/2023/ebrd-funds-underwater-cables-for-a-sustainable-future.html (accessed 20 June 2026).

131 See IDA, "IDA Financial Products - Lending Rates & Fees", IDA, World Bank Group, Washington DC, https://treasury.worldbank.org/en/about/unit/treasury/ida-financial-products/lending-rates-and-fees (accessed 20 June 2026).

substantially improving commercial viability in markets where demand is growing, but not yet sufficient to justify purely private investment.[132]

The World Bank has also invested in submarine cable connectivity across underserved regions through schemes such as the Pacific Regional Connectivity Programme (PRCP). This consists of USD 135.7 million of investment across Tonga, Samoa, Palau, and the Federated States of Micronesia (FSM). Other World Bank facilities include the Caribbean Regional Communications Infrastructure Project (CARCIP), with USD 36.9 million of investment, and the West Africa Regional Communications Infrastructure Project (WARCIP), with USD 121 million. The International Finance Corporation (IFC) has also contributed USD $32.7 million to the Eastern Africa Submarine System (EASSy) and mobilized over USD 200 million in additional investment.[133]

With the PRCP, the investment was made across multiple phases. These included: the Tonga-Fiji submarine link, which became operational in August 2013; the Palau-FSM connectivity – which benefitted from a USD 47.5 million World Bank IDA grant; and the Tui-Samoa cable to Fiji, which received a USD 16 million World Bank grant with ADB and Australian co-financing.[134] PRCP Phase 1 in Tonga reduced international connectivity costs and strengthened the telecommunications regulatory framework, improving the enabling environment for information and communications technology (ICT) and fostering healthier market competition.[135] The Tui-Samoa submarine cable system, a 1,470-kilometre cable connecting Samoa and Fiji, provides redundancy through the Southern Cross Cable Network and dramatically increases bandwidth capacity at substantially lower costs than satellite connectivity.[136]

These successful projects demonstrate that the effectiveness of blended finance depends on a strategic categorization of which specific assets and services to finance. In determining this, account has to be taken of five core investment categories that address distinct market failures and require differentiated financing approaches. These include:

1) Branching unit financing: Branching units (undersea junction boxes enabling single trunk routes to serve multiple landing points) represent the highest-return, public investment category for geographical diversity. While specific unit costs vary by project, incremental capital investment in branching units enables SIDS to share backbone infrastructure, rather than

[132] See ADB, "ADB Announces More Concessional Lending Terms for Small Island Developing States", ADB, Manila, 12 November 2023, https://www.adb.org/news/adb-announces-more-concessional-lending-terms-small-island-developing-states (accessed 20 June 2026), and footnote 11.

[133] See footnote 21 and World Bank, "World Bank Approves Additional Financing for Eastern Caribbean Telecommunications", World Bank Group, Washington DC, 26 March 2020, https://www.worldbank.org/en/news/press-release/2020/03/26/world-bank-approves-us119-million-additional-financing-for-telecommunications-development-in-the-eastern-caribbean (accessed 21 June 2026) and World Bank Group, FSM-Palau Connectivity Project Document, World Bank Group, Washington DC, 2014, https://ewsdata.rightsindevelopment.org/files/documents/92/WB-P130592_E9IXWvV.pdf

[134] See World Bank Group, "Northern Pacific Islands Headed for Greater Connectivity", World Bank Group, Washington DC, 17 December 2014, https://www.worldbank.org/en/news/press-release/2014/12/17/northern-pacific-islands-greater-connectivity (accessed 21 June 2026) and World Bank, "ADB, World Bank, Australia-Supported High-Speed Broadband Goes Live in Samoa", World Bank Group, Washington DC, 9 February, 2018, https://www.worldbank.org/en/news/press-release/2018/02/09/adb-world-bank-australia-supported-high-speed-broadband-goes-live-in-samoa (accessed 21 June 2026).

[135] See World Bank, Closing the Digital Divide in Tonga, World Bank Group, Washington DC, 2019, https://www.worldbank.org/en/results/2019/09/16/closing-the-digital-divide-in-tonga

[136] See Samoa Submarine Cable Company (SSCC), "Tui-Samoa Submarine Network Lands in Apia, enhancing broadband connectivity across the Pacific islands," SSCC, Apia, 1 November 2017, https://www.ssccsamoa.com/tui-samoa-submarine-network-lands-in-apia-enhancing-broadband-connectivity-across-the-pacific-islands/ (accessed 21 June 2026).

requiring individual full-capacity participation. Concessional development finance directed at branching unit pre-financing (which is deployed before cable construction approval) crowds in private operator commitment to include secondary landing points that would otherwise be economically marginal.

Regional programmes across the Pacific islands and the eastern Caribbean have cost efficiencies through shared infrastructure models. By configuring the submarine cable system as a trunk with branching cable segments to serve individual islands, CARCIP, for example, provided USD 36.9 million to connect Grenada, Saint Lucia, Saint Vincent and the Grenadines, and smaller islands including Bequia, Mustique, Canouan, Union Island, and Carriacou.[137]

2) IRU purchase support: IRU capacity commitments provide revenue certainty to cable operators while enabling governments to secure international bandwidth at known, long-term pricing. This can also be done without requiring full equity participation in cable consortiums. Public finance directed to IRU purchases (particularly when governments commit to minimum capacity thresholds over 10-25-year purchase agreements) provides cable operators with the pre-sales certainty necessary for financial closure. At the same time, it also enables government procurement to allocate capacity to national telecommunications authorities, educational institutions, and healthcare systems in order to obtain universal service deployment.

The IRU purchase support category represents the most cost-efficient public investment lever, as IRU capital requirements – typically between 5 per cent and 20 per cent of total cable cost – generate 100 per cent revenue certainty, as opposed to equity stakes, which require ongoing participation in governance. Development institutions such as the World Bank have successfully deployed this mechanism through WARCIP, enabling The Gambia, Guinea, and Burkina Faso to access the Africa Coast to Europe (ACE) cable system.[138]

3) Landing station infrastructure and power feed equipment: Landing station clustering at established hubs creates lock-in effects and monopoly pricing pressures that penalize secondary routes and underserved markets. Public co-investment in landing station infrastructure at secondary or resilient locations, including power-feed equipment, cable terminating equipment shelters, and terrestrial fibre interconnections, removes the cost barriers that prevent private operators from deploying geographically diverse routing. Development finance structures should deploy targeted grants, rather than loans, for landing station infrastructure at secondary locations, as inherently, these are lower-revenue facilities that cannot service debt from commercial interconnection fees. This investment category addresses the competitive disadvantages facing secondary and resilient alternatives.

4) Regional demand aggregation and pooled procurement: Public finance directed at regional coordination mechanisms – creating shared regulatory frameworks, standardized cable specifications, and joint procurement platforms – enables multiple SIDS and underserved nations to pool demand and improve negotiating leverage with cable manufacturers and

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[137] See World Bank, "World Bank approves US$11.9 million additional financing for telecommunications development in the Eastern Caribbean", World Bank Group, Washington DC, 26 March 2020, https://www.worldbank.org/en/news/press-release/2020/03/26/world-bank-approves-us119-million-additional-financing-for-telecommunications-development-in-the-eastern-caribbean (accessed 21 June 2026); World Bank, Building the Caribbean Digital Economy Bit by Bit, World Bank Group, Washington DC, 11 May 2022, https://www.worldbank.org/en/results/2022/05/11/building-the-caribbean-digital-economy-bit-by-bit (accessed 21 June 2026); and Government of St. Vincent and the Grenadines, Grievance Redress Mechanism for CARCIP, Government of St. Vincent and the Grenadines, 2019, https://finance.gov.vc/finance/images/PDF/Final--SVG_CARCIP_GRM.pdf

[138] See footnote 21.

service providers. Aggregated regional demand allows volume-based pricing discounts on cable manufacturing, terminal equipment, and installation services, while standardized technical specifications can reduce per-project engineering and certification costs. This investment category generates regional cost reductions when compared to individual bilateral negotiations. This has been demonstrated in regional programmes that have shown that pooled coordination reduces both per-country costs and implementation timelines.[139]

5) Financing term calibration: Calibrating concessional financing to each investment category amplifies development impact. Branching unit financing and IRU purchases, which generate documented cost reductions for participating nations, should be considered for highly concessional terms, recognizing their high development multipliers.[140] Landing station infrastructure should receive below-market concessional rates reflecting lower revenue-generating capacity. Regional demand aggregation should receive technical assistance grants, as these investments are inherently catalytic. This differentiated approach ensures that limited concessional finance is deployed where it generates the maximum leverage effect. This is consistent with multilateral development bank (MDB) and development finance institution (DFI) frameworks for appropriate concessionality across sectors.[141]

Subsidized second-route financing specifically addresses the single-cable dependency vulnerability affecting most SIDS. DFIs can structure concessional financing that makes the financial premium for deploying a diverse, seismically de-risked second route commercially feasible for SIDS, rather than requiring each island nation to absorb the full cost differential.[142]

Anchor tenancy, universal service obligations and novel anchor use-cases

Anchor tenancy agreements – in which governments, educational institutions, or healthcare systems commit to long-term capacity purchases at fixed rates – provide the financial certainty necessary to underwrite submarine cable construction costs. This is particularly so for routes serving public-good objectives, including universal connectivity, e-health delivery, and remote education. The anchor tenancy model directly addresses the commercial viability barriers affecting underserved markets by converting a speculative revenue stream into contractually guaranteed cash flows: a cable operator can calculate precise debt service coverage ratios and equity returns when a government pre-commits to lock in 25-30 per cent of available capacity at known pricing.

The 2014 anchor tenancy contract between the Government of New Zealand and Hawaiki Cable Limited (Ltd.) exemplifies this model. The government side committed USD 65 million – including a USD 15 million upfront capital contribution and 25-year annual fees – to secure dedicated international cable capacity for the nation's research and education broadband network (REANNZ). This enabled the cable's financial closure and construction without requiring commercial telecom consortiums to dominate.[143]

139 See footnote 21.
140 See footnote 25.
141 See ADB, DFI Working Group on Blended Concessional Finance for Private Sector Projects: 2023 Update, ADB, Manilla, 2023, https://www.adb.org/sites/default/files/institutional-document/876671/dfi-bcf-joint-report-2023-update.pdf
142 See footnotes 16 and 18.
143 See beehive.gov.nz, "Government signs USD 65 million contract on new international cable", New Zealand Government, Wellington, 2 July 2014, https://www.beehive.govt.nz/release/govt-signs-65-million-contract-new-international-cable (accessed 21 June 2026).

Novel anchor use-cases have also now expanded beyond traditional telecom operators. Nowadays, they include ministries of health that have committed to e-health and telemedicine platforms requiring reliable international connectivity. Also included are education ministries that need to secure capacity for distance-learning and university research collaborations, as well as development institutions that need to purchase connectivity to support broadband-dependent development programmes. Where governments structure anchor tenancy agreements with performance requirements – such as mandatory open-access interconnection at cable landing stations, maximum retail pricing constraints, and service level guarantees – the public investment simultaneously de-risks the project and ensures that the cable's economic benefits flow through to consumer-level price reduction and universal access. This converts a capital transfer into a policy tool for market competitiveness.

Collaborative ownership structures

Submarine cable ownership structures have bifurcated into two increasingly distinct models: traditional telecommunications operator consortiums and hyperscaler-led private systems. Each offer distinct advantages for route diversity and resilience that regulatory policy should explicitly consider when evaluating applications and allocating support.

Traditional telco consortiums have historically dominated submarine cable development, with operators collectively sharing capital expenditure (CAPEX) and OPEX costs while negotiating pre-sales (IRUs) to secure revenue. This model, however, sometimes demonstrates longer periods of decision-making, as consortium members must achieve consensus on routing, landing points, and technical specifications. The model can also demonstrate lengthy approval processes, often taking 4-6 years from conception to ready-for-service. There is also a tendency with such models toward path-dependent routing, as consortium members default to established landing hubs where interconnection infrastructure already exists.[144]

Hyperscaler-led systems have altered competitive dynamics by deploying privately-owned cable infrastructure to globally connect their own data centres, bypassing traditional telco consortiums entirely. Hyperscalers now account for over 80 per cent of trans-Pacific bandwidth demand and are rapidly expanding control in transatlantic and intra-Asia corridors. Recent examples of this include Google's USD 1 billion investment in Pacific Connect cables (the Proa, Taihei, and interlink systems) connecting Japan, the Commonwealth of the Northern Mariana Islands (CNMI), Guam, and Hawaii with diverse routing through the Pacific islands, rather than traditional direct routes between Asia and the United States.[145]

A transformative hybrid model has also emerged in the Pacific and Latin America through PPPs that couple government strategic investment with hyperscaler deployment expertise. Google's Pacific Connect initiative partnered with the Fiji National Provident Fund (FNPF) to expand submarine cable capacity. The partnership saw the signing of a statement committing to collaboration on Pacific connectivity, green ICT capabilities, and data-driven ecosystem development. This demonstrated an alignment of private infrastructure investment with public development objectives.[146]

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[144] See footnote 11.
[145] See Google Cloud Blog, *Pacific Connect Initiative to Expand* 2024
[146] See Warua, E., "Google Invests in Pacific Connect Initiative", Fiji One News, 9 June 2024, https://fijionenews.com.fj/google-invests-in-pacific-connect-initiative/ (accessed 21 June 2026).

Other examples include the 2025 agreement between the Republic of Chile and Google to create Humboldt Connect. This is a 50-50 joint venture between the Government of Chile (via Desarrollo País, a state-owned infrastructure company) and Google. The project establishes a governance model wherein public and private partners share equal equity stakes, investment commitments, and commercial control of a submarine cable route connecting Australia, French Polynesia, and Chile.[147] This hybrid structure thus blends government strategic investment objectives with hyperscaler deployment expertise and capital.

The Humboldt model explicitly positions the government as a strategic infrastructure partner, ensuring that route diversity serves national connectivity objectives and resilience requirements. At the same time, it also retains Google's operational and technical capabilities to accelerate deployment and optimize performance. This structure may be directly applicable to SIDS, LLDCs, and other underserved markets seeking to negotiate submarine cable projects that balance development impact with commercial sustainability.

Operational efficiencies: Joint maintenance agreements and pooled vessels

The chronic shortage of submarine cable repair vessels and their geographical concentration create a compelling economic case for joint maintenance agreements (JMAs). They also make a strong case for regionally pooled repair-vessel consortia that can substantially reduce mean time to repair (MTTR) and lower per-incident repair costs through asset sharing and coordinated capacity allocation. Fuel charges constitute up to 70 per cent of spot-repair costs, with JMAs significantly lowering repair costs by reducing mobilization distances.[148] The global fleet of 80-100 dedicated cable repair and laying vessels remains heavily concentrated in Europe and northern Asia, leaving the South Pacific, West Africa, and Latin America severely underserved.[149]

JMAs enable multiple cable operators serving a geographical region to collectively fund a shared repair vessel stationed locally or under retainer contract. This can guarantee priority response within contractually defined, service-level agreements. Such agreements typically enable vessel mobilization within 48-96 hours, compared to 3-6 weeks for vessels mobilized from distant ports. Early feasibility models for regional pooled repair-vessel arrangements, such as those originally evaluated for the Cook Islands and the broader South Pacific, have also demonstrated the financial viability of accepting less immediate response times – such as a projected 4-5 weeks, rather than the standard 10 days. These arrangements are typically made in exchange for considerably lower fixed costs, compared to maintaining dedicated repair vessels.[150]

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[147] See Qiu, W., "Chile and Google Create 50%-50% Joint Venture Humboldt Connect", *Submarine Networks* 10 June 2025, https://www.submarinenetworks.com/en/systems/trans-pacific/humboldt-cable/chile-and-google-create-joint-venture-humboldt-connect (accessed 21 June 2026), and Chilean Ministry of Foreign Affairs, "Humbolt Connect is Born", *Submarine Telecoms Forum*, 4 June 2025, https://subtelforum.com/chile-google-launch-humboldt-connect-jv/ (accessed 21 June 2026).

[148] See footnote 13.

[149] See Munga, J., "Beneath the waves: Addressing vulnerabilities in Africa's undersea digital infrastructure", Carnegie Endowment for International Peace, 3 April 2025, https://carnegieendowment.org/research/2025/04/beneath-the-waves-addressing-vulnerabilities-in-africas-undersea-digital-infrastructure (accessed 21 June 2026), and VietnamNet, "Submarine cable repairs postponed, delaying full connectivity for Vietnam", VietnamNet, 31 October 2024, https://vietnamnet.vn/en/submarine-cable-repairs-postponed-delaying-full-connectivity-for-vietnam-2337461.html (accessed 21 June 2026).

[150] See ADB/Cook Islands, Report on the Feasibility of an International Submarine Cable System for the Cook Islands, Government of the Cook Islands, 2013, https://www.cookislands.gov.ck/images/documents/CEO_docs/Other-Reports/201305_ADB_Report-on-the-Feasibility-of-an-International-Submarine-Cable-System-for-the-Cook-Islands_Final.pdf

The Caribbean Telecommunications Union and Pacific Islands Forum have convened regional stakeholder meetings to address the challenges of submarine cable resilience and explore cooperative frameworks for repair capacity and restoration measures.[151] Beyond dedicated vessel procurement, JMAs facilitate standardized inventories of spare-parts, such as submarine repeaters, fibre-optic cable segments, and specialized tools. They also include pre-negotiated port access agreements and joint training programmes for repair crews. These are operational efficiencies that reduce per-repair costs by 20-30 per cent, compared to individual operators contracting ad hoc repair services in competitive spot markets during crisis periods.

Insurance, catastrophe bonds and risk-transfer programmes

Parametric insurance and catastrophe bonds are innovative financial instruments that can enable submarine cable operators – particularly those that are state-owned enterprises, or regional consortiums serving SIDS and underserved markets – to transfer repair-cost and revenue-loss risks to capital markets and specialized insurers. This reduces the credit-enhancement requirements and capital reserves that constrain project bankability.

Traditional indemnity insurance for submarine cables, such as ordinary risk insurance, is effectively unavailable because physical damage assessment requires expensive, remotely operated vehicle (ROV) surveys in deep water. This creates months-long claims-settlement processes that are incompatible with the operator's need for immediate repair financing.

Parametric insurance may help to address this problem by triggering automatic payouts based on predefined measurable events. Such incidents could include an earthquake with a magnitude exceeding a specified threshold at a designated seismic station. They could also include a certain cyclone wind-speed recorded at a meteorological observation point, or a series of cable-fault notifications logged by network monitoring systems. Claims for these events could be processed without requiring post-loss damage assessment.[152]

As an example, the Pacific Catastrophe Risk Insurance Company (PCRIC) has partnered with Willis Towers Watson to design a parametric insurance policy for the state-owned Papua New Guinea (PNG) Data Company. This policy would be triggered by earthquakes that were expected to damage submarine fibre-optic cables. Under the policy, when seismic activity meets predefined magnitude and location thresholds derived from Global Earthquake Model (GEM) seismic hazard profiles, the PNG Data Company receives a rapid payout (typically within two weeks). This enables it to fund emergency repairs without waiting for government budget appropriation or commercial loan approval.[153]

In parallel, governments and international organizations should consider measures to stimulate the supply-side of the insurance market for submarine cables. Such measures could include risk-sharing facilities, PPPs, and regulatory clarity to reduce underwriting uncertainty. By lowering

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[151] See CTU, Strengthening Submarine Fibre Optic Cable Resilience in the Caribbean, CTU virtual conference, 22 May 2025, https://ctu.int/event/strengthening-submarine-fibre-optic-cable-resilience-in-the-caribbean/ (accessed 21 June 2026).

[152] See Jimenez-Sanchez, K., "PCRIC and WTW launch parametric quale cover for Papua New Guinea submarine cable network", *Reinsurance News*, 23 May 2024, https://www.reinsurancene.ws/pcric-and-wtw-launch-parametric-quake-cover-for-papua-new-guinea-submarine-cable-network/ (accessed 21 June 2026).

[153] See PreventionWeb, Parametric insurance for Papua New Guinea telecommunications infrastructure against earthquakes, UNDRR, 6 May 2025, https://www.preventionweb.net/resource/case-study/parametric-insurance-papua-new-guinea-telecommunications-infrastructure-against (accessed 21 June 2026).

barriers for insurers and reinsurers, such measures can help expand the availability of traditional and hybrid insurance products beyond niche or pilot applications.

Catastrophe bonds extend this risk-transfer mechanism to capital markets: an operator or regional consortium issues bonds to institutional investors, with principal and interest payments contingent on the non-occurrence of specified catastrophic events. Such incidents could include the simultaneous failure of three or more cables in a regional network, or earthquake-triggered cable breaks exceeding USD 50 million in aggregate repair costs. Investors receive premium yields – typically 300-800 basis points above risk-free rates – in exchange for bearing tail-risk exposure. This effectively converts operator balance-sheet risks into tradable securities.

Parametric triggers for submarine cable catastrophe bonds, if deployed, could include aggregate annual fault counts exceeding statistical thresholds. If, for example, there are more than 20 incidents in a year for a five-cable network, compared to a 15-incident historical average, then the bond is triggered. Another example might be an intensity-based index incorporating tsunami wave heights, seismic ground acceleration, or cable-route proximity to active fault zones – calibration methodologies already demonstrated for tsunami catastrophe bonds in Japan.[154]

Blended finance mechanisms for SIDS, however, have not yet systematically incorporated climate resilience and seismic risk premiums as structured cost categories within financing envelopes. Dedicated climate and seismic resilience funds could be established by development institutions to provide financial guarantees and loss-absorption capacity. This could specifically cover extraordinary costs from climate-triggered cable failures and seismic-related landing station damage affecting SIDS-serving infrastructure. Such funds would operate on a parametric insurance model similar to the Caribbean Catastrophe Risk Insurance Facility: when a triggering event occurs, the fund immediately pays predefined amounts enabling emergency repairs, temporary satellite connectivity, or accelerated recommissioning, all without requiring post-disaster loss assessments.[155] Triggering events could include an earthquake exceeding a specified magnitude, or a sea-level rise surpasses defined thresholds. They could also include a documented, climate-related cable outage For SIDS cable systems, such funds could cover emergency repair costs when climate events damage cables They could also cover the costs of emergency landing station rehabilitation, and/or temporary satellite-based connectivity restoration while submarine infrastructure is repaired.

Critical to the success of parametric instruments is regulatory risk mitigation. With this, governments should commit to policy stability frameworks that preclude arbitrary changes to cable-repair permitting. They should also commit to foreign-exchange convertibility for insurance payouts and taxation of insurance proceeds, as regulatory uncertainty can inflate insurance pricing by 150-250 basis points. Cross-border risk-transfer frameworks enabling regional risk pooling across multiple SIDS jurisdictions would further improve pricing efficiency. Such frameworks would do this by diversifying earthquake, cyclone, and anchor-drag risks that otherwise concentrate geographically.

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[154] See Goda K., *et al*. "Parametric Catastrophe Bonds for Tsunamis: CAT-in-a-Box", *Earthquake Spectra*, 55(1), pp. 113-136, University of Bristol, 2019, https://research-information.bris.ac.uk/ws/portalfiles/portal/197138621/Full_text_PDF_final_published_version_.pdf (accessed 28 June 2026).

[155] See Disaster Risk Financing and Insurance Programme, Caribbean Catastrophe Risk Insurance Facility, World Bank Group, Washington DC, 2012, https://documents1.worldbank.org/curated/en/319251467999348409/pdf/97469-BRI-Box391476B-PUBLIC-study-CCRIF-Final.pdf

Finally, consideration could be given to encouraging submarine cable owners to maintain adequate insurance coverage as part of broader resilience and risk-management frameworks. Such approaches would not only enhance financial preparedness for repair and recovery, but also contribute to the development of a more mature, transparent, and competitive insurance market for submarine cable infrastructure.

In this regard, the International Maritime Organization (IMO) could play a supportive role by promoting best practices, facilitating dialogue between maritime, telecommunications, and insurance stakeholders, and encouraging the integration of insurance considerations into existing maritime risk-management and safety frameworks. This may include the development of non-binding guidelines or recommendations that incentivize submarine cable owners to secure appropriate insurance coverage. This should also be done while taking into account the specific operational, environmental, and geopolitical risks associated with submarine cable systems.

Strategies for cost reduction

Shared infrastructure and collective investment models distribute climate adaptation costs across multiple operators, substantially reducing expenditure per-operator. Cable landing stations (CLS) serving multiple international cable systems present opportunities for shared protective infrastructure, such as combined elevated platforms, unified flood defence systems, or distributed backup power networks that serve all co-located cables. Shared infrastructure can substantially reduce individual operator costs, creating potential savings of 30-50 per cent, depending on co-location patterns and governance arrangements.[156]

Regional maintenance consortiums, such as the Atlantic Cable Maintenance and Repair Agreement (ACMA) and the South East Asia and Indian Ocean Cable Maintenance Agreement (SEAIOCMA), already provide cost-shared repair vessel assets; extending this model to jointly-owned landing station protection infrastructure and coordinated recommissioning schedules would enable developing nations and smaller operators to access climate resilience that would not be feasible if they acted independently.

Collective action could also be expanded further through pool resilience and economies of scale. For example, regional blueprints could be developed that transform the individual investment decisions of SIDS from isolated, high-cost markets into consolidated, strategic investment opportunities through integrated, multi-national cable architectures. Regional blueprints could be developed for key ocean basins establishing coordinated planning frameworks that reflect geological and climate risk profiles specific to each region.[157] These blueprints could define a standardized spur-line model, establishing clear technical and commercial interfaces for connecting individual national spurs to shared regional trunk cables. This would enable smaller nations to economize by sharing backbone infrastructure costs while maintaining sovereign control over national landing infrastructure and service retail policies.

[156] See World Bank, Lifelines: The Resilient Infrastructure Opportunity, World Bank Group, Washington DC, 2018, https://documents1.worldbank.org/curated/en/111181560974989791/pdf/Lifelines-The-Resilient-Infrastructure-Opportunity.pdf

[157] See Pacific Islands Forum (PIF), "54th Pacific Islands Forum Leaders Communique", PIF, Honiara, 8-12 September 2025, https://forumsec.org/sites/default/files/2025-09/54th%20Pacific%20Islands%20Forum%20Leaders%20Communique_final.pdf (accessed 22 June 2026).

Similarly, a collective financing facility could address the capital mobilization barrier by establishing a dedicated regional fund that aggregates demand and de-risks investment for the entire region. This facility could function as a public-private vehicle in which development institutions provided concessional capital matched by participating SIDS governments and private operators. This would enable the pooling of resources to finance regional trunk infrastructure and secure favourable pricing through volume negotiation with cable manufacturers and service providers.[158] Furthermore, the financing facility could include an anchor tenant pool. In such instances, participating SIDS governments would collectively commit to the long-term purchase of a defined block of capacity on a new cable system.

Submarine cable systems equipped with environmental sensing capabilities, such as Science Monitoring and Reliable Telecommunications (SMART) subsea cables, can generate additional public-good benefits. These include tsunami early warning, climate monitoring, ocean observation and cable resilience. These benefits also strengthen the case for concessional finance, as investments deliver returns beyond connectivity, including disaster risk-reduction and climate resilience.

Another approach could be the development of a facility for project onboarding that can provide modular, financial de-risking tools specifically designed for sovereign projects that meet resilience standards. The facility could offer a standard grant that funds pre-approved specialists to conduct comprehensive submarine route surveys and develop full business cases aligned with toolkit models. This would eliminate the front-end engineering design (FEED) cost barriers that have historically prevented many SIDS from even initiating feasibility studies.[159] A government anchor-tenant backstop fund could provide financial guarantees for national governments, committing them to minimum bandwidth purchases. Such a fund would also effectively de-risk private operator participation by guaranteeing baseline revenue streams and reducing perceived sovereign risk for lenders evaluating project financing.[160]

Matching grants could also cover the cost premium for choosing geographically diverse landing sites, or selecting resilient cable architectures over baseline options. This would ensure that climate and seismic resilience becomes cost-neutral for participating sovereigns.[161] Collectively, these mechanisms reduce effective total project costs for typical SIDS national systems, while ensuring integrated climate resilience and redundancy.

1.3 KEY RECOMMENDATIONS

The following recommendations are numbered in accordance with the 'Recommendations' table featured at the beginning of this report.

Recommendation 1: Promote the establishment of blended-finance platforms and initiatives for submarine cable investments, with emphasis on Small Island Developing States ("SIDS"), Landlocked Developing Countries ("LLDCs"), and underserved remote coastal regions, de-risking projects which may deliver high development impact but may not be commercially

[158] See Bergmann, C.v.Z., "Perspectives on the Financing of Submarine Cable Projects", *WFN Strategies*, Ashburn, Virginia, 30 March 2022, https://wfnstrategies.com/perspectives-on-the-financing-of-submarine-cable-projects/ (accessed 22 June 2026).

[159] See footnote 16.

[160] See footnote 53.

[161] See World Bank, *Implementation Completion and Results Report: Pacific Regional Connectivity Programme, Phase 3 – Samoa (P128904)*, World Bank, Washington DC, 30 September 2023, https://documents1.worldbank.org/curated/en/099100323123557640/pdf/BOSIB00dbf92e50750af140074cc9234fc4.pdf

viable. Blended finance platforms combine concessional public or development bank capital with commercial investment to lower the overall cost of capital for submarine cable projects in higher risk markets. This approach directly addresses bankability constraints in which purely commercial projects on secondary or remote routes often fail to meet lenders' presale and risk thresholds, despite strong development benefits. By derisking these projects, blended finance makes it possible to extend connectivity and route diversity to SIDS, LLDCs and other underserved regions that would otherwise remain excluded from global networks.

Recommendation 2: Encourage engagement among financing institutions, governments[3] and operators early in the submarine cable design process to promote potential investments benefiting SIDS, LLDCs and other underserved regions. Early joint planning between financiers, individual governments and operators allows resilience and inclusion objectives to be built into route selection and system architecture from the outset, rather than retrofitted at higher cost. Once path-dependent investment decisions are locked in along major corridors, alternative routes to underserved regions become significantly more expensive and harder to justify commercially. Structured early engagement can identify opportunities to extend spurs, branching units or new landings to SIDS and LLDCs while financing structures and risk sharing mechanisms are still flexible.

Recommendation 3: Support the design and implementation of partnership structures, including public-private partnerships, for marine cables to underserved regions, enabling routes that would not achieve commercial viability through purely private consortiums alone. PPPs and hybrid ownership models allow individual governments and development partners to share risks and returns with telecommunication operators and hyperscalers, making marginal but high-impact routes investable. Individual government equity stakes, guarantees, or anchor tenancy commitments can unlock routes that private consortiums would otherwise reject due to uncertain demand or elevated risk. Well-structured PPPs can also embed open access, resilience and SIDS/LLDC oriented requirements directly into project governance and contractual arrangements.

Recommendation 4: Encourage the development of insurance mechanisms to 1) improve project bankability for SIDS, LDCs and other underserved regions and (2) reduce insurance costs for all systems. Traditional indemnity insurance is often unavailable or prohibitively expensive for submarine cables, particularly in emerging markets and high-hazard regions. Parametric insurance and catastrophe bonds are promising alternatives that provide fast, rules-based payouts triggered by defined events. This thereby reduces the need for large contingency reserves and improves lenders' confidence. Scaling such instruments, including through regional pools, can lower overall insurance costs while specifically improving the bankability of routes serving SIDS and LLDCs. In parallel, efforts should also be made to promote the availability of more comprehensive insurance products covering submarine cable infrastructure across its full lifecycle. This should include cover for risks arising from third-party damage, natural hazards, abrasion, and scenarios where repair is not economically viable and decommissioning or scrapping is required. Policy frameworks should aim to stimulate both demand and supply in the insurance market, including through regulatory clarity and risk-sharing mechanisms that reduce underwriting uncertainty. Relevant international organizations, including the IMO, should support these efforts by promoting best practices and encouraging submarine cable owners to maintain adequate insurance coverage as part of broader resilience and risk-management frameworks.

Recommendation 8: Encourage governments to consider options to develop anchor-tenancy on systems designed for underserved regions by purchasing minimum bandwidth capacity on new submarine cable systems de-risking private sector and public investment. Anchor tenancy agreements, under which individual governments or public institutions commit to long-term capacity purchases, convert uncertain future demand into predictable cash flows that can support debt service. Such arrangements have been critical to enabling cables to reach smaller markets by providing revenue certainty that commercial operators alone could not guarantee. When designed with open access and affordability conditions, anchor tenancy also ensures that public commitments translate into broader market benefits, rather than locking-in monopoly advantages.

CHAPTER 2. INSTITUTIONAL, REGULATORY, AND POLICY FRAMEWORKS

2.1 REGULATORY AND INSTITUTIONAL BARRIERS, INCLUDING THOSE FOR SIDS AND LLDCS

Complexities in permitting, delays, and costs

Regulatory unpredictability and opacity regarding permit processing and timelines can inflate project duration and administrative financing costs while deterring investment in geographically diverse routes. These delays can compromise bankability by creating uncertainty – a factor that investors must then account for through higher costs of capital and extended planning horizons.[162] Furthermore, submarine cable landing approvals, as well as repairs, may require coordination and harmonization across multiple government entities, from maritime authorities to telecommunications regulators, and environmental ministries to customs agencies. These bodies also often operate under conflicting legal frameworks without standardized procedures or inter-agency coordination mechanisms.

Many jurisdictions impose additional regulatory constraints, including foreign-equity caps, technology restrictions, or national-security clearance requirements. These also deter international cable operators from pursuing diverse routing through territories perceived as having high regulatory risk.

Complex environmental permitting processes, such as environmental impact assessments, marine mammal protection protocols, maritime protected areas, and coastal-zone management reviews, can also substantially delay approval timelines. Private companies that track permitting have documented that permit applications increasingly exceed statutory processing timescales, with applications often taking over 12 months to achieve final approval, particularly in jurisdictions with detailed environmental sensitivity assessments or complex ecological protections.[163]

In complex coastal contexts, such as the Mediterranean, Caribbean, or Pacific regions, where multiple marine protection designations, shipping lanes, and fishing interests overlap, environmental approval can extend to between 24 and 36 months – or longer. This effectively precludes the deployment of alternative routes, unless the cable operator perceives a compelling competitive or resilience justification.[164]

2.2 POLICY, REGULATORY AND CAPACITY-BUILDING MEASURES

Streamlined deployment through single-window permitting

Regulatory streamlining through unified single-window permitting frameworks can substantially reduce submarine cable deployment timelines and lower administrative costs. It can also remove bureaucratic barriers that artificially inflate project timelines and financing costs while deterring investment in geographically diverse routes.

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162 See footnote 7.
163 See OceanIQ, "Permitting", OceanIQ website, https://oceaniq.co.uk/permitting/ (accessed 22 June 2026).
164 See NOAA, Policy and Permit Guidance for Submarine Cable Installation, NOAA, Washington DC, 2011, https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/archive/library/pdfs/subcable_final_guidance_2011.pdf

The regulatory framework in Singapore exemplifies this efficiency. There, the Infocomm Media Development Authority (IMDA) serves as the central coordinator, providing a structured framework for applications for a facilities-based operations licence. The IMDA also facilitates consultation and approvals-seeking from agencies such as the Urban Redevelopment Agency (URA), the Maritime and Port Authority (MPA), the Singapore Land Authority (SLA), and other relevant bodies. It can thereby provide predictable timelines and transparency regarding inter-agency requirements.[165]

Streamlined permitting is therefore achievable through institutional coordination, pre-published timelines, and the establishment of a single point of contact that performs all the required administrative procedures within the state.

Non-discriminatory and simplified licensing for competition and cost reduction

Non-discriminatory access to CLS, particularly when infrastructure is funded by public resources, can ensure market benefits flow to all consumers. Such access can achieve this by enabling competitive carriers to reduce wholesale, Internet protocol (IP) transit pricing and drive reductions in broadband costs.

Cabo Verde's transition toward an open-access policy, for example, which culminated in regulatory interventions following the ACE cable landing, facilitated significant price reductions. Wholesale Internet bandwidth transit costs in the region eventually fell from over USD 1 200 per megabytes per second (Mbps) – the rate under legacy, single-cable dependency – to approximately USD 150-200 per Mbps.[166]

Open-access regimes are critical for fostering competition and can achieve cost reductions of 30-60 per cent in wholesale IP transit pricing.[167] Furthermore, open fibre standards, such as interoperable repeater modules, standardized line-termination equipment interfaces, and vendor-neutral network management protocols, reduce capital costs for competing operators. They do this by enabling technological diversity and multi-vendor procurement, eliminating lock-in to single suppliers and creating benefits for resilience through equipment supply-chain diversification.

Simplified licensing, such as for private networks, can further reduce costs and the time-to-market of new systems. The EU framework enabling private networks to operate submarine cable infrastructure without traditional telecommunications licensing requirements, for example, has attracted hyperscaler investment in geographically diverse routes. Google's Equiano cable landing in South Africa also has an open access commitment, reducing regulatory uncertainty and certification costs. Broader adoption of these exemptions would encourage private infrastructure investment in underserved regions where commercial telecommunications operators face prohibitive licensing requirements.

165 See IMDA, Guidelines on Deployment of Submarine Cables into Singapore, Footnote 7, IMDA, Singapore, https://www.imda.gov.sg/-/media/imda/files/regulation-licensing-and-consultations/codes-of-practice-and-guidelines/subcablelanding.pdf, and Murphy, E. L. and T. Bryja, The Strategic Future of Subsea Cables: Singapore Case Study, CSIS, 2025, https://www.csis.org/analysis/strategic-future-subsea-cables-singapore-case-study

166 See World Bank, *Digital Cabo Verde*, World Bank Group, Washington DC, 18 November 2019 https://ewsdata.rightsindevelopment.org/files/documents/99/WB-P171099.pdf , and footnote 7.

167 See footnote 7.

Transparency and predictability in policy regimes

Transparent and predictable processes for cable licensing, landing station development, and obtaining permits for emergency repair all reduce investor uncertainty and accelerate project deployment.[168] The approach of the Republic of Peru, for example, to attracting international cable investment demonstrates how systematic removal of ownership barriers can facilitate infrastructure deployment. Peru has enabled foreign investment in its telecommunications sector, with this accelerating mobile broadband deployment and creating favourable conditions for subsea cable investment.[169]

Regional analysis shows that straightforward, transparent regulatory regimes are critical for encouraging submarine cable infrastructure investments. SIDS, LLDCs and other underserved countries can adapt this approach by enacting transparent, publicly-available legal frameworks. These can specify cable landing rights based on environmental and security compliance, as well as make available interconnection agreements that mandate open access to landing stations. In order to reduce compliance costs, such frameworks can also make available equipment standards consistent with international norms.

Capacity building for governments

Many SIDS, LLDCs, and other vulnerable economies face acute submarine cable resilience challenges, but lack the specialized regulatory, technical, and planning capacities needed to address them effectively.[170] Many telecommunications regulators in these contexts are staffed and structured around terrestrial markets, with limited experience in submarine cable engineering, international consortia, marine permitting, climate and seismic risk assessment, or emergency repair coordination. This forces officials to navigate complex licensing and permitting decisions without standardized tools or precedents.

Capacity-building and technical assistance programmes for telecommunications regulators and public authorities in developing countries could enable greater capacity in a range of areas, from permit streamlining to emergency protocols, and open-access frameworks to the establishment of key performance indicators (KPI). This, in turn, would enable countries to adopt international best practices adapted to local contexts. These initiatives could also provide hands-on training, including study tours to jurisdictions with best-practice frameworks, embedded advisors supporting implementation of regulatory reforms, and access to template documents – including model cable landing licenses, open-access interconnection regulations, and emergency response protocols. This would eliminate the need for each jurisdiction to develop frameworks independently.

Furthermore, regional or global organizations could promote knowledge-sharing platforms and communities of practice. In these, countries facing similar resilience challenges, such as SIDS, remote regions, LLDCs, and landlocked economies dependent on cross-border cables,

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168 See Jorge, S., E. Namara, and T. Iqbal, "Good Practices for Subsea Cable Policy", *SubTel Forum* 28 March 2024, https://subtelforum.com/bridging-digital-divide-subsea-cables/ (accessed 22 June 2026).

169 See Fhon, J. M., "Regulating submarine cable infrastructure", Cullen International, 1 September 2025, https://www.cullen-international.com/news/2025/09/Regulating-submarine-cable-infrastructure.html (accessed 22 June 2026); footnote 7; and Abecassis, D. *et al., Economic impact of Google's submarine cable network in Latin America,* Analysis Mason, December 2022, https://www.analysysmason.com/contentassets/45baaaa7225849e090c1d6853ee96d94/analysys-mason_economic-impact-of-google-submarine-cable-in-lac_english.pdf

170 See footnotes 16 and 17.

can exchange lessons learned, coordinate on regional solutions, and access templates for emergency protocols and regulatory frameworks.[171]

In 2024, the Association of Southeast Asian Nations (ASEAN), for example, formed the ASEAN Working Group on Submarine Cables. This is a platform for member states to participate in joint capacity-building initiatives, collaborate in information-sharing and exchange experiences and challenges. Through this platform, ASEAN member states also jointly enhanced the *ASEAN Guidelines for Strengthening Resilience and Repair of Submarine Cables*. This involved adding best practices in protecting submarine cables and reducing regulatory requirements for timely submarine cable repairs. The enhanced Guidelines were then successfully endorsed at the 6th ASEAN Digital Ministers Meeting in January 2026.[172]

This process could also be included among examples of the development of online collaboration platforms hosting document repositories. Such data banks can include model regulations and case studies documenting successful implementation. They can also include discussion forums that enable regulators to pose questions and receive peer-to-peer advice from counterparts in comparable jurisdictions. In addition, regional workshops and annual conferences can provide in-person networking opportunities, with development banks and agencies of the United Nations providing travel funding. This would ensure participation by resource-constrained countries that would otherwise be excluded from knowledge-sharing opportunities.

2.3 KEY RECOMMENDATIONS

The following recommendations are numbered in accordance with the 'Key Recommendations' table featured at the beginning of this report.

Recommendation 5: Encourage governments to develop clear, predictable policy and regulatory frameworks for submarine cable licensing and permitting to reduce costs and project implementation delays resulting from uncertain regulatory environments, and improve project bankability. Unpredictable permitting processes, opaque requirements and fragmented responsibilities increase the time and cost of deployment and are major deterrents to investors considering new or diverse routes. Clear, streamlined, harmonized and preferably single-window regulatory frameworks reduce transaction costs, limit political and regulatory risk premiums, and accelerate time to service. This regulatory certainty directly supports project bankability by improving the predictability of revenue timing and reducing the perceived risk of investing in underserved or complex jurisdictions.

Recommendation 6: Encourage non-discriminatory access to cable landing stations, consistent with national regulations and national security requirements, in underserved regions, enabling competing carriers to secure capacity for domestic and international terrestrial service driving wholesale price reductions benefiting end-users, digital economy development and landlocked neighbouring countries. Closed or highly concentrated access to landing stations can entrench monopoly pricing, limit competition and suppress downstream digital ecosystem development, especially in small markets. Non-discriminatory, open access regimes enable multiple operators to purchase capacity and interconnect, which in turn drives

171 See footnote 44.

172 See ASEAN, "Enhanced ASEAN Guidelines for Strengthening Resilience and Repair of Submarine Cables", ASEAN Digital Ministers Meeting, 2026, https://asean.org/wp-content/uploads/2026/01/Enhanced-ASEAN-Guidelines-for-SR-and-Repair-of-Submarine.pdf (accessed 28 June 2026).

wholesale price reductions and service innovation. For landlocked and neighbouring countries that depend on a small number of coastal gateways, open landing station access is particularly important to ensure affordable, reliable regional connectivity.

Recommendation 9: Support the implementation of good practices from new and existing toolkits, where feasible, with the intention to enable rapid national submarine cable project deployments, with emphasis on SIDS, LDCs and other underserved regions, to reduce costs and time to develop and deploy submarine cable systems and backup arrangements. International and regional toolkits already distil lessons on permitting, environmental assessment, open access, resilience standards and emergency protocols, but uptake is uneven, particularly in capacity constrained administrations. Applying these standardized templates can significantly shorten preparation times and reduce transaction costs, especially for first-time or small-market projects. Prioritizing rollout of such toolkits in SIDS, LLDCs and underserved regions helps accelerate both primary cable deployments and backup arrangements, improving resilience at lower cost.

Recommendation 11: Support capacity-building and technical assistance for regulators and policy makers in developing countries, to enable countries to adopt good practices for submarine cable deployment, adapted to local contexts. Measures such as sophisticated climate risk assessments, modern open access regimes and innovative financing arrangements require regulatory and institutional capabilities that are not yet in place in all countries. Targeted technical assistance and training can help authorities understand complex cable economics, resilience trade-offs and regulatory design options. When tailored to local legal systems and market structures, this capacity building enables regulators and policy-makers to adopt good practices in a way that is both effective and politically feasible.

Recommendation 13: Encourage the implementation of regulatory frameworks which incentivize shared landing infrastructure in underserved regions, reducing duplication of vulnerable facilities while maintaining the benefits of competition and diverse routing. In smaller, or resource constrained markets, individual operators may not be able to justify separate climate-hardened landing stations, leading either to underinvestment in resilience or costly duplication. Shared, climate resilient landing facilities are a way to pool capital for better protection while maintaining competition at the service and capacity levels through open access rules. Regulatory frameworks can support this by offering incentives and setting conditions that ensure shared infrastructure does not become a new bottleneck, but instead underpins route diversity and robust redundancy.

CHAPTER 3. GEOGRAPHICAL DIVERSITY AND NETWORK RESILIENCE

3.1 REDUNDANCY GAPS, PHYSICAL AND CLIMATE RISKS

Coastal, geological, and climate risks

Submarine cables form the backbone of global communications, yet changing weather patterns and environmental hazards are increasingly threatening their integrity. These risks affect countries facing similar resilience challenges in particular, including SIDS, remote regions, LLDCs, landlocked economies and other geographies.

While most submarine cables are armoured and buried beneath the seabed to reduce physical risks, shore-end and terrestrial components, including landing stations, beach manholes (BMHs), and coastal power feed systems remain.[173] Climate-driven impacts result in operational disruptions, higher maintenance and repair costs, and the reduced reliability of international connectivity (see Table 7).

The interconnected physical threats undermining the reliability of global communications networks include rising ocean temperatures that accelerate chemical corrosion of cable materials. Elevated sea levels also increase hydrodynamic forces on cables and expose landing infrastructure to saltwater intrusion and flooding. The International Cable Protection Committee (ICPC) notes that submarine cables and their landing stations are vulnerable to a growing array of climate-driven hazards, including storm surges, extreme wave action, intensified cyclones, submarine landslides activated by seabed instability, and ice scouring in polar regions.[174]

Countries in tectonically active regions face compounded geological risks, with these amplified by changing weather patterns and sea-level rise. Seabed instability and undersea landslides threaten cable integrity in zones of active vulcanism, major fault lines, and steep submarine canyons. Countries located within areas where volcanic and seismic activity is pronounced, such as the Pacific Ring of Fire or the Congo basin, are subject to multiple hazard pathways, including direct damage from volcanic eruptions, submarine landslides triggered by seismic activity, and turbidite currents from disrupted seabed sediments.[175]

Near-shore and terrestrial vulnerabilities compound submarine cable risks, as CLS are typically located in coastal areas vulnerable to earthquake shock, tsunami inundation, and storm surge. Many SIDS landing stations suffer from aging facilities, poor drainage, inadequate power backup, and a lack of redundancy in connections between the physical cable termination and data centres. This can create cascading failure modes during climate and seismic events. A critical challenge is that most SIDS lack the local technical expertise to conduct comprehensive site surveys, assess geological hazards, design climate-resistant landing infrastructure, or execute repairs when systems fail.

Table 7 sets out the types, impacts and locations of the geological and climate hazards that subsea cable systems can face.

173 See ICPC, Submarine Cable Protection and the Environment, ICPC, Portsmouth, September 2023, https://iscpc.org/publications/submarine-cable-protection-and-the-environment/ICPC_Public_EU_September_2023.pdf
174 See footnote 67.
175 See Smithsonian Institution, Global Volcanism Programme, "Hunga Tonga-Hunga Ha'apai Volcano", Smithsonian Institute website, https://volcano.si.edu/volcano.cfm?vn=243040, and footnote 18.

Table 7: Climate hazards and their impact on subsea cable systems

Process/ activity	Effects of changing weather patterns	Potential impacts for subsea cables or landing stations	Anticipated locations of most significant impacts (hotspots)
Sea-level rise	A general pattern of sea-level rise (up to 20 millimetres/year) worldwide in response to melting ice cover and warming oceans.	Inundation of data centres, power stations, landing stations, and terrestrial cables.	The areas with the most significant sea-level rise are the central and south Pacific islands, the Philippines, Indonesia, Japan, the western Caribbean, the Gulf of Mexico, and north-west Australia.
Storm tides	The effect of sea-level rise means storm tide heights will be more significant in the future. Changing weather patterns and sea-level rise are likely to increase the frequency and magnitude of extreme sea-level events.	Direct impacts of storms on built infrastructure, including scouring and abrasion of cables, undermining landing stations, and beach utility hole covers. Storm surges may reach up to 9 metres above normal.	North-western Europe, high latitude North and South America, eastern United States, East Africa, Bangladesh, Gulf of Mexico, north-west Australia.
Tropical and extra-tropical cyclones	There is a global increase in average cyclone intensity and surface speeds, but the pattern is geographically variable. A general poleward shift of cyclone tracks. Coastal flooding via rainfall and storm surge.	Enhanced scour and abrasion. This also causes slopes to fail, forming turbidity currents that can damage cables. Increased storminess and wave height reduce working windows for offshore surveys, installation, and repairs, reducing project delivery times and costs.	Complex global pattern. Increased extra-tropical storminess is anticipated in north-east Atlantic and north Pacific. Increased tropical cyclone activity is expected in the north-west and south Pacific, central Atlantic, and Indian Oceans.
Coastal erosion and seafloor sediment transport regime	Global trend of shoreline retreat due to ambient shoreline dynamics and sea-level rise. A general increase in near-bed currents and sediment mobility due to global changes in storm frequency, duration, wind speed, and wave height.	Expose, suspend, and abrade previously buried cables, undermining shore-based infrastructure, including shore-end, beach utility hole covers, and front haul routes.	Geographically widespread, but hotspots include central and eastern North America, Central America, south-east South America, central Europe, East and West Africa, South Asia, northern Australia, the Pacific, and the Caribbean, with median values of more than 100 metres of coastal retreat by 2100.

Table 7: Climate hazards and their impact on subsea cable systems (continued)

Process/ activity	Effects of changing weather patterns	Potential impacts for subsea cables or landing stations	Anticipated locations of most significant impacts (hotspots)
Ocean currents	The intensity, location, direction, and timing of ocean currents may shift due to sea-level rise and changes in ocean temperature, salinity, and wind-forced circulation.	Impact on surveying, cable laying, and maintenance. Enhanced sediment mobility, or scour, around cables causes abrasion and suspension-based fatigue.	Acceleration of ocean circulation is most prominent in tropical oceans, particularly the tropical Pacific Ocean. Increase and modification of currents in the Southern Ocean.
Offshore weather	Storminess is changing and becoming more intense in some regions. Under high emissions scenarios, wave height and period are projected to change by between 5 per cent and 15 per cent and change direction by between 5 degrees and 15 degrees.	Impact on surveying, cable laying, and maintenance. Decrease in previous optimal weather windows.	The largest increases in significant wave heights in the Southern Ocean and tropical, eastern Pacific Ocean are due to increasing Southern Ocean swells that reach the tropics and the poleward shift of the tropical cyclone belt.
River flooding	Warming climate generally increases the risk of floods, wherein once-a-century events may recur on much shorter timescales.	Flooding of land-based facilities. Triggering of slope failures and offshore sediment flows that can break multiple cables (most likely where rivers flow into submarine canyons).	Flood frequency is predicted to increase significantly in many regions, particularly in South-east Asia, India, East and West Africa, and much of South America (excluding the extreme south), while also including the United Kingdom, Ireland, France, and south-western USA.
Submarine landslides	Submarine landslides may become more likely in regions where sediment supplies increase and triggering factors are heightened.	Cyclic shelf and slope sediment loading trigger slope failures and offshore sediment flows that can break multiple cables.	Offshore from rivers where sediment supply is increased (for example, East Africa, the Congo River, South-east Asia) or where storm triggering is likely (for example, the Caribbean, South-east Asia, South Pacific).

Table 7: Climate hazards and their impact on subsea cable systems (continued)

Process/ activity	Effects of changing weather patterns	Potential impacts for subsea cables or landing stations	Anticipated locations of most significant impacts (hotspots)
Arctic sea ice and icebergs	Pressure ridges and coastal ice pile up. Coastal erosion. Calved icebergs. Enhanced river discharge.	Underwater iceberg keels scour seabed to damage cables. Reduced ice cover and increased storms expose the coast to erosion, while pile-up may affect coastal infrastructure. Scoring of shelf and upper slope. Increased river discharge into the Arctic Ocean may raise the risk of turbidity currents.	From 1979 to 2018, sea ice has likely declined for all months, and this trend is projected to continue. The record for 1900 to 2008 shows a highly variable discharge of east Greenland icebergs, with the highest rates in the 1990s.
Relocated fishing grounds due to changing ocean	Global warming, ocean acidification, and overfishing push stocks into newer habitats that are often cooler due to higher latitude and increased depth.	Fish stock relocation may create new conflicts between seabed users and damage to unarmoured and unburied cables by fishing gear.	Underwater iceberg keels scour seabed to damage cables. Reduced ice cover and increased storms expose the coast to erosion, while pile-up may affect coastal infrastructure. Scouring of the shelf and upper slope. Increased river discharge into the Arctic Ocean may raise the risk of turbidity currents.
New shipping routes due to changing conditions	Warming oceans and melting ice will open up previously ice-covered ocean routes.	New shipping routes intersect existing cable corridors, increasing the risk of damage to seafloor cables by anchoring. Other activities, such as resource extraction, may need to be considered.	Previously ice-covered parts of the Arctic.

Source: Adapted from ISOC, 2025[176]

Single cable and routing vulnerability

These vulnerabilities are compounded by the structural risk of single-cable dependency. In this, several SIDS and underserved regions may rely on only one international submarine cable for connectivity, creating severe risks to digital isolation if that cable is damaged.[177] This risk is further exacerbated when operators do not actively pursue branching opportunities to

[176] Clare, M., "Are Subsea Cables Feeling the Heat From Climate Change?", *Internet Society Pulse*, 2 July 2024, https://pulse.internetsociety.org/en/blog/2024/07/are-subsea-cables-feeling-the-heat-from-climate-change/ (accessed 22 June 2026).

[177] See footnote 16.

nearby, unconnected islands/countries. This can result in nations losing cost-effective access to international fibre connectivity.[178]

At the same time, CLS in the SIDS are often concentrated in low-lying coastal areas, at or below 10 meters above sea level. This makes them highly exposed to projected sea-level rises,[179] intensified tropical cyclones/hurricanes, storm surge, and coastal erosion – all of which threaten both submarine cables and associated terrestrial backhaul infrastructure. Where international connectivity is concentrated through a single landing station, a flood, landslide, or other localised hazard can also sever a country's access to international communications for hours, days, or even weeks. This is particularly so where repair capacity and satellite backup are limited and no alternative domestic landing infrastructure exists.

In addition to single cable risk, dependence on common routing pathways creates related vulnerabilities. International traffic may remain concentrated along a single geographical corridor, even where multiple submarine cables or systems are present. In such cases, hazards affecting the shared corridor, such as seismic events, underwater landslides, anchor drags, or geopolitical disruptions, can simultaneously damage several systems. This can lead to regional or even inter-regional outages, despite apparent cable redundancy.

This concentration risk is particularly acute at maritime chokepoints and along constrained coastal shelves, where engineering, permitting, and cost incentives drive repeated use of the same paths over time. For many SIDS, LLDCs and underserved coastal states, dependence on a single routing corridor means that failures in that corridor can have macroeconomic consequences comparable to those of single cable dependency. This underscores the need for public policy and financing instruments that support diverse routing across distinct geographical corridors.

3.2 TECHNICAL/ARCHITECTURAL AND OPERATIONAL RESILIENCE MEASURES

Strategies for enhancing redundancy

Regulatory frameworks for diversity planning could include incentivizing submarine cable network operators and regulators to evaluate and document route diversity as part of infrastructure planning. Multi-landing station strategies demonstrate resilience, as in the experience of southern Africa. Simultaneous dual cable breaks experienced there underscored how diversity at the national operator level, with multiple landing points and cables, is crucial.[180] This incident demonstrated the critical value of having multiple landing points geographically separated and multiple cable systems providing redundancy.

Policy frameworks can incentivize multiple independent CLS per nation, where geographical size merits it, with cables arriving at landing points separated by minimum distances to prevent common-mode failure from localized environmental hazards or mishaps.

178 See footnote 18.
179 See footnote 17.
180 See Vermeulen, J., "Slow Internet Speeds in South Africa – Break in Undersea Cables", SubTel Forum, 7 August 2023, https://subtelforum.com/south-africa-undersea-cables-break/ (accessed 22 June 2026), and Madory, D., "Dual subsea cable cuts disrupt African internet", APNIC Blog, 20 September 2023, https://blog.apnic.net/2023/09/20/dual-subsea-cable-cuts-disrupt-african-internet/ (accessed 22 June 2026).

Strategic cable routes minimize exposure to high-risk zones while also building redundancy into network architecture. Avoidance of high-risk zones ensures that cable routes circumvent seismically active regions, steep continental slopes, and erosion-prone coastal zones, wherever possible. Dual-landing and loop configurations build redundancy through dual-landing systems and loop network designs, enabling seamless traffic rerouting during localized disruptions.

Geographical diversification encourages geographically diverse landing points. When these are also across national borders, a practice which enhances international connectivity during regional outages, digital resilience can be ensured beyond jurisdictional boundaries. To increase the resiliency of the global submarine network as a whole, underutilized routes could also be explored via coordinated approaches.

Engineering for resilience

Engineering innovation is central to climate adaptation and risk mitigation in submarine cable systems. To ensure long-term operational reliability, infrastructure design can incorporate both passive protective measures – such as cable armouring and optimized burial – and active monitoring and redundancy systems that provide real-time insights and flexible response capabilities.[181] Modern resilience engineering emphasizes future-proofing through modularity, adaptability, and interoperability, integrating environmental forecasting, data analytics, and international standards into cable system design and maintenance cycles. Furthermore, environmental sensing utilizing submarine systems, such as SMART cables, can enable proactive mitigation of natural and anthropogenic disturbances.[182]

Landing stations represent critical choke points where oceanic and terrestrial networks converge. Resilient design features can significantly reduce vulnerability. Landing stations increasingly incorporate elevated infrastructure, flood-resistant design standards, and backup power systems to maintain operational continuity during storm surge or temporary flooding events. Elevation and waterproofing involve raising landing facilities above predicted flood levels and reinforcing with waterproof vaults and surge barriers. Energy and systems redundancy includes the installation of redundant power feeds, surge-protection systems, and modular cooling to sustain operations during extreme weather events.

Sustainable power integration, meanwhile, utilizes renewable micro-grids, such as hybrid solar and battery storage systems, to ensure continuous operation during grid outages. Thermal resilience involves designing cable housings and repeater vaults that can withstand temperature variations resulting from changing weather patterns. As an example, in 2023, Singapore outlined its approach to a masterplan for the country's digital connectivity in its Digital Connectivity Blueprint. As one of its strategic priorities, this made provision for the number of submarine cable landings to double within the following 10 years. As part of the coordination between the IMDA and other agencies, such as the URA and the National Water Agency (PUB), infrastructure-related considerations were included in holistic long-term planning for coastal protection

[181] See OECD, *Enhancing the Resilience of Communication Networks*, OECD, Paris, May 2025, https://www.oecd.org/content/dam/oecd/en/publications/reports/2025/05/enhancing-the-resilience-of-communication-networks_a47d78a1/d6920477-en.pdf

[182] See JTF SMART Subsea Cable Initiative, *Report: 10th Workshop on SMART Cables*, International Telecommunication Union, Geneva, 23-24 January 2025, https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2025/0123/Documents/Workshop_report_Final.pdf

against rising sea levels.[183] Modular and floating landing stations could begin testing and providing adaptive solutions for areas prone to flooding.

To enable critical infrastructure resilience, additional approaches include the application of the United Nations Office for Disaster Risk Reduction (UNDRR) Sendai Framework Indicators (2015–2030) to national digital strategies. In addition, the development of probabilistic models linking sea-level rise, storm intensity, and seabed movement to expected failure rates and financial impacts can also be undertaken. To develop integrated vulnerability maps for submarine cable infrastructure, a further measure would be collaborative data-sharing between the ICPC, national hydrographic agencies, and private operators.[184]

Multi-hazard assessments and resilience hubs

Environmental and risk assessment can be conducted at an early stage in submarine cable route planning to identify and quantify environmental, seismic, and climate-related risks along candidate routing corridors. This enables operators and regulators to make informed trade-offs between cost-minimizing direct routes and resilience-preferred diverse paths. Climate-informed route assessment can incorporate historical seabed instability data, tsunami-wave modelling, ocean current patterns affecting cable scouring risk, and projections of shifting environmental hazard zones that have resulted from changing weather patterns. The latter could include altered tropical cyclone tracks or expanding oxygen-minimum zones that correlate with cable corrosion acceleration.

Studies by the University of Durham and Angola Cables have demonstrated that detailed geological and hydrographic assessment can identify high-risk corridors such as the Congo Canyon. This enables operators to select alternative routes or implement enhanced protection measures where routing through hazard zones is unavoidable, with operators selecting routes that balance cost minimization with environmental stability.[185]

Effective climate resilience for submarine cables begins with systematic multi-hazard assessments. Using time horizons of 25-50 years, these quantify exposure to sea-level rise, storm surge, seismic activity, tsunamis, coastal erosion, and other climate-related risks.[186] Operators should integrate these assessments into GIS-based vulnerability maps. These can overlay coastal erosion and storm surge zones with existing and planned cable routes and landing stations, providing an evidence base for protective infrastructure investments, relocation, or decommissioning decisions.

Preparedness requires regularly updated emergency response plans that incorporate this spatial risk data. Preparedness also requires formal coordination channels between meteorological and disaster management agencies, along with routine simulation exercises and tabletop drills. These can ensure that crew, vessels, and control centres can execute predefined response actions under stress. Real-time monitoring and early-warning systems, including artificial

[183] See Telecom Review Asia, "Submarine Cables and Climate Change Intersect", Telecom Review Asia, 19 February 2025, https://www.telecomreviewasia.com/news/featured-articles/12503-submarine-cables-and-climate-change-intersect/ (accessed 22 June 2026), and footnote 60.

[184] See United Nations, Sendai Framework for Disaster Risk Reduction 2015-2030, United Nations Office for Disaster Risk Reduction, Geneva, https://www.undrr.org/media/16176/download?startDownload=20260622, and footnote 76.

[185] See SubTel Forum, "2020 SAT-3 & WACS Faults Possibly Caused by Mudslide", SubTel Forum, 2 June 2021, https://subtelforum.com/sat-3-wacs-faults-possibly-caused-by-massive-mudslide/ (accessed 22 June 2026).

[186] See footnotes 67 and 76.

intelligence (AI)-enabled anomaly detection, further strengthen preparedness. They can do this by identifying cable strain, temperature anomalies, and external disturbances before they escalate into full outages, thus enabling pre-emptive maintenance or controlled shutdowns. Together, these measures shift operators from reactive repair to proactive risk management, reducing both the frequency and impact of climate-driven disruptions.

Regional JMAs tailored to SIDS should formalize pooled repair resources, spare parts caches, and trained workforce capacity, enabling rapid response across island nations. The example of ASEAN Cableship Pte. Ltd. demonstrates how regional cooperation can address repair capacity constraints by pooling resources. Formed in 1986 by the telecommunications authorities of Thailand, Philippines, Indonesia, Brunei Darussalam, Singapore, and Malaysia, ASEAN Cableship operates a fleet of four cable-laying and repair ships – ASEAN *Explorer*, ASEAN *Restorer*, ASEAN *Protector*, and ASEAN *Challenger*. These serve the SEAIOCMA zone, which runs from Djibouti to Guam to Australia.[187] SEAIOCMA coordinates emergency repairs for approximately 45 cable owners and operators, with vessels stationed at strategic ports enabling rapid deployment within 24-48 hours of fault detection.[188]

The ASEAN *Challenger*, equipped with advanced ROV systems capable of cable burial and maintenance operations, represents an ongoing fleet modernization that addresses both technical capacity and climate adaptation requirements. The June 2024 decision by the Malaysian government to exempt foreign cable-repair ships from cabotage policies demonstrates how regulatory flexibility enhances regional resilience by enabling rapid mobilization across borders.[189]

Cost and time efficiencies through cooperative frameworks reduce MTTR by pooling assets and enabling rapid mobilization. In South-east Asia, the 2019 ASEAN Guidelines for Strengthening Resilience and Repair of Submarine Cables (known as the '2019 Guidelines') sought to simplify permitting processes across jurisdictions to improve response times for maintenance operations. In February 2024 and January 2025, the ASEAN Digital Ministers (ADGMIN) reiterated commitments to "build a secure, diverse and resilient submarine cable network" and facilitate regional cooperation in deploying, repairing, and protecting cables.[190] In addition, the ASEAN Working Group on Submarine Cables was formed in 2024 and through the collaborative efforts of its member states, the 2019 Guidelines were enhanced with the best practices in cable protection and the facilitation of timely repairs. These enhanced Guidelines were then successfully endorsed at the 6th ADGMIN in January 2026.

Emergency response speed is critical for SIDS in particular, given that repair vessel mobilization from distant regional bases can create unacceptable connectivity disruptions. Governments should adopt fast-track regulatory protocols enabling the rapid deployment of foreign repair vessels following disasters, with the ICPC recommending expedited permits for repairs to minimize downtime. Pre-authorized protocols should be established through cooperation

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187 See ASEAN Cableship Pte. Ltd. (ACPL), "About Us", ACPL website, https://www.aseancableship.com/about-us/, and Yadav, N., "ASEAN Cableship announces fourth cable ship", *DataCenterDynamics*, 23 September 2024, https://www.datacenterdynamics.com/en/news/asean-cableship-announces-fourth-cable-ship/ (accessed 22 June 2026).

188 See SubTel Forum, "ASEAN Restorer to Repair CANI Cable Near Nicobar", *SubTel Forum* 13 October 2025, https://subtelforum.com/asean-restorer-to-repair-cani-cable-near-nicobar/ (accessed 22 June 2026).

189 See S. Rajaratnam School of International Studies (RSIS), "Strengthening Undersea Cable Resilience in the Indo-Pacific", RSIS, Singapore, 23 May 2025, https://rsis.edu.sg/rsis-publication/rsis/strengthening-undersea-cable-resilience-in-the-indo-pacific/ (accessed 22 June 2026).

190 See footnote 60 and 68.

with maritime authorities, telecommunications regulators, and environmental agencies, to streamline vessel clearances and emergency repair permits when disasters occur.[191]

Resilience hubs should also be established. These are strategic maritime centres where repair vessels, spare repeaters, cable sections, and landing-gear modules have been pre-positioned, enabling mobilization within 48-72 hours of an incident.[192] Interoperability allows hubs to serve multiple systems and operators, improving efficiency during widespread weather events such as regional cyclones or tsunamis. These hubs provide shared maintenance, training, repair coordination, and spare parts stockpiling. In turn, this enables a more rapid response to climate-triggered emergencies and more efficient recommissioning operations. Furthermore, such hubs can also distribute capital and operational costs across multiple operators and governments, reducing individual financial burdens while improving mean time to repair.

Europe's Digital Cable Hub Initiative, supported through the European Commission Cable Security Action Plan and Digital Europe Programme, aims to enhance submarine cable resilience across European sea basins. It aims to do this through shared maintenance infrastructure, workforce training, and emergency response coordination.[193] Europe faces some critical challenges, however. These include aging repair vessel fleets with limited investment certainty, and cross-border permitting obstacles creating critical delays during emergencies, Another challenge is a workforce shortage, with an insufficient pipeline of cable engineers and jointing experts.[194]The European Subsea Cables Association and IMCA recommend public-private investment to modernize fleets and stockpile spares. They also recommend national training programmes to address skills gaps, and the streamlining of emergency fast-track approvals and cross-border permitting.

Failover protocols

Failover protocols ensure that when hazards disrupt submarine cable systems, critical connectivity is maintained and recovery is accelerated through pre-defined technical and institutional arrangements.[195]

At the network layer, operators should implement automated traffic rerouting to geographically diverse cables, terrestrial backhaul, or cloud-based systems. With SIDS and other highly exposed economies in particular, this should be combined with pre-engineered satellite backup integration for extreme scenarios in which all fibre paths are compromised.

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[191] See SubTel Forum, "ICPC Addresses Red Sea Cable Damage", *SubTEl Forum*/ICPC, 28 February 2024, https://subtelforum.com/icpc-addresses-red-sea-cable-damage/ (accessed 22 June 2026), and ICPC, Government Best Practices for Protecting and Promoting Resilience of Submarine Telecommunications Cables, ICPC Portsmouth, https://www.iscpc.org/publications/icpc-best-practices/

[192] See footnote 76.

[193] See European Parliament, EU preparedness: From concept to strategy?, European Parliamentary Research Service, Brussels, June 2025, https://www.europarl.europa.eu/RegData/etudes/BRIE/2025/772898/EPRS_BRI(2025)772898_EN.pdf

[194] See ESCA and IMCA, "Industry Warns of Repair Gaps in Europe's Digital and Energy Networks", IMCA website, 11 August 2025, https://www.imca-int.com/news-events/imca-news/news/critical-undersea-infrastructure-at-risk-industry-warns-of-repair-gaps-in-europe-s-digital-and-energy-networks/ (accessed 22 June 2026), and Subsea Cables (SSC), "EU urged to act on weakness in undersea cable repairs", SSC/Telecom Review, 20 August 2025, https://www.subseacables.net/industry-news/eu-urged-to-act-on-weaknesses-in-undersea-cable-repairs/ (accessed 22 June 2026).

[195] See United Nations Office on Drugs and Crime (UNODC), *Global Maritime Crime Programme: Submarine Cables Handbook*, UNODC, Vienna, 2025, https://www.unodc.org/res/piracy/index_html/GMCP_Submarine_Cables_Handbook.pdf

Operational failover requires internal incident-response playbooks that define escalation paths, stakeholder notification timelines, and decision thresholds for repair vessel deployment. In addition, such playbooks should define pre-negotiated agreements with repair consortia and port authorities that guarantee vessel mobilization and expedited clearances within 24-48 hours of event detection.

At the governance level, harmonized fast-track protocols aligned with International Telecommunications Union (ITU) resilience guidance and United Nations disaster frameworks can exempt emergency cable repairs from standard customs and cabotage constraints. This can prevent administrative delays from extending outages from days to weeks. Robust post-event procedures complete the failover cycle by feeding lessons-learned back into engineering standards, preparedness planning, and future redundancy investments. Such procedures should include rapid damage assessment via ROVs, the activation of alternative routes, post-incident reviews, and updates to national and ICPC incident databases.

3.3 KEY RECOMMENDATIONS

The following recommendations are numbered in accordance with the 'Key Recommendations' table featured at the beginning of this report.

Recommendation 7: Promote the integration of branching units into the initial design of major trunk submarine cable routes, creating opportunities for concessional financing to promote cost-effective connectivity for SIDS, LDCs and other underserved regions. Integrating branching units during initial system design is far cheaper and technically smoother than retrofitting them later, when engineering constraints and traffic commitments are already fixed. Preplanned branching points make it easier to add spurs to SIDS and remote coastal states when concessional finance or new anchor tenants become available. This design choice effectively "keeps the door open" for future, cost effective inclusion of underserved regions into major corridors, improving resilience and development impact.

Recommendation 10: Encourage, through industry best practice, the use of guidelines for assessing and fulfilling route diversity and resiliency needs of SIDS, LDCs and other underserved regions, to prevent disruptions resulting from environmental and human-made hazards. Traffic is heavily concentrated through a few chokepoints, leaving many countries dependent on one or two vulnerable routes. Systematic guidelines for route diversity assessment, such as factoring climate, seismic, geopolitical and human activity risks, enable operators and policy-makers to identify least-risk paths and prioritize alternative landings. Applying such guidelines consistently in SIDS and LLDC contexts helps ensure that new investments incrementally reduce systemic vulnerability, rather than reinforcing existing single point failures.

Recommendation 12: Encourage comprehensive hazard vulnerability assessments for new submarine cable deployments and recommissioning projects to SIDS, LDCs and underserved regions to mitigate identified hazards when possible. Climate, seismic, tsunami and human induced risks are highly location-specific and often correlated across cables, particularly near deltas, canyons and narrow straits. Comprehensive, multi-hazard assessments covering climate projections, seabed conditions, human activity, and critical infrastructure collocation are therefore essential inputs into route design, landing site choice and engineering standards. Embedding such assessments in both new builds and recommissioning cycles allows operators and regulators to target mitigation where it has the greatest effect, especially in high-risk SIDS and underserved coastal areas.

Recommendation 14: Develop and adopt, where feasible, technical and operational protocols enabling seamless failover to satellite, microwave, or other backup systems during extended submarine cable outages. Even with improved route diversity, certain hazards and multi-cable events will periodically cause prolonged outages, as case studies have documented. Preplanned operational playbooks play a crucial rule in operation resilience. They can define how traffic is prioritized and shifted to satellite, microwave or alternative terrestrial routes, while also setting agreed service-level expectations during crises. Implementing such protocols in advance, particularly for SIDS and remote regions, can substantially reduce the humanitarian, economic and security impacts when submarine cables fail.

4. PREVIOUS IAB OUTPUTS AND DECLARATIONS

INTRODUCTORY NOTE

In addition to the analyses and recommendations developed by the three Working Groups, this publication also brings together key milestones previously agreed by members of the IAB.

In particular, the recommendations adopted at the Porto Summit, as well as the Abuja Declaration and the Porto Declaration, reflect important stages in the collective efforts of the IAB to advance international cooperation, strengthen policy awareness, and promote concrete actions to enhance submarine cable resilience.

These earlier outputs have informed and complemented the work of the Working Groups, contributing to the identification of priority areas, the exchange of good practices, and the formulation of the forward-looking recommendations presented in this report.

Their inclusion in this publication aims to provide a comprehensive and coherent overview of the IAB's work to date, highlighting both the evolution of discussions and the convergence of perspectives among stakeholders.

LIST OF RECOMMENDATIONS AGREED AT THE PORTO SUMMIT[196]

WORKING GROUP 1 RECOMMENDATIONS
TIMELY DEPLOYMENT & REPAIR

	Streamline Permitting, Approval and Regulation
1	**Encourage governments* to streamline permitting and regulatory processes** to reduce cable deployment and repair timelines, including: **(a)** establishing transparent and predictable permitting frameworks (e.g., by publishing i. clear guidelines on permitting requirements and permitting timelines, and ii. Information on the regulatory bodies and application/permitting documents necessary for installation and repair); **(b)** reducing regulatory barriers (e.g., by, where permitted by national laws, facilitating customs clearance and cabotage procedures, removing or exempting customs duties, allowing pre-clearance of ship and crew, ensuring emergency repairs can proceed expeditiously, etc.); and **(c)** designating a government body to be the Single Point of Contact ("SPOC"), where permitted by national laws, to facilitate coordination across government agencies.
2	**A voluntary database or directory indicating countries' SPOCs** to provide the industry with a centralized and definitive point of reference who can communicate permitting requirements and timelines.
3	**Encourage the utilization of existing regional forums or, where permissible, intergovernmental cooperation frameworks, and foster new ones if none already exist (e.g., an industry regional cable protection committee or CPC in Asia),** to discuss submarine cable resilience to support local cooperation and promote regulatory alignment. This would help mitigate against operators having to navigate differing regulatory requirements across the region. As part of this, encourage government engagement with regional submarine cable associations and ICPC best practices.
	Strengthen Global Repair Architecture
4	**Encourage the creation or expansion of incentives to expand repair assets from a diversity of companies and countries** (that consider vessels and spare parts) which may also help address needs in high-risk or remote areas and to reduce mobilization time for emergency repairs. This could include removal of regulatory barriers as referenced in recommendation 1.
5	**Consider establishing plans for shallow-water rapid-response units**: To have plans in hand for using small modular teams with lightweight gear and shallow-water remotely operated vehicles (ROVs) for near-shore incidents.

[196] The wording of these recommendations is as it was approved in the original document, unedited. The full list is available at: https://www.itu.int/digital-resilience/submarine-cables/events/iab-deliverable/

(continued)

6	**Promote mutual assistance and shared infrastructure models:** Continue to strengthen maintenance-zone and private-agreement cooperation for shared vessels and spare pooling where feasible under the commercial arrangement. Encourage jointly funded/multi-contracted vessels based at critical hubs which may also help address needs in regions with insufficient repair resources.
7	**Global Repair Asset Optimization Framework (GRAOF)**: Encourage industry associations to map global coverage gaps to help clarify where repair resource shortfalls exist and to support investment decisions. Encourage cable owners and cable repair & maintenance companies to promote long-term maintenance contracts, joint vessel funding, and encourage public–private partnerships (PPPs) maintenance hubs in underserved regions.
8	**Encourage maintenance agreements to collaborate on industry best practices (**e.g., through ICPC Recommendations for repair best practices on topics such as safety, proximity, coordination, etc.), to support an effective approach to cable repair/ maintenance.
9	**Encourage training & knowledge platforms**: Encourage the development of training opportunities (for jointing, deep-sea operations, ROV, HSE or (Health, Safety and Environment) and cable engineering) and contribute to existing digital repositories for best practices.
	Strengthen Public-Private Partnership and Regional Cooperation
10	**Encourage voluntary data sharing:** Encourage governments, industry and regional organizations to share best practices. This should leverage existing mechanisms where possible, e.g. existing ICPC efforts for data sharing between industry and governments.
11	**Encourage national public-private cooperation mechanisms (e.g., fora/platforms/ committees)** between competent authorities and cable owners/operators to support predictable coordination for deployment, protection and repair, including to: **(a)** maintain a designated "single front door" interface for operational coordination (aligned with national arrangements e.g. the designated SPOC as per recommendation 1); **(b)** maintain validated 24/7 contact lists and escalation paths; **(c)** support periodic multi-stakeholder exercises and post-incident learning; and **(d)** maintain a light set of practical artefacts (notification templates, decision pathways, agreed evidence packs)

WORKING GROUP 2 RECOMMENDATIONS
RISK IDENTIFICATION, MONITORING & MITIGATION

	National, Regional and Global Cooperation, Coordination and Collaboration
1	Encourage governments to develop National level strategies based on data evidencing the risks: encourage relevant national authorities to collaborate with cable landing licensees to enhance visibility and oversight of submarine cable faults and vulnerabilities within and beyond their waters, taking into account considerations for storage, sharing, and security of such data.
2	Knowledge sharing between industry and government: Foster greater cooperation and improvements to knowledge sharing between industry and national governments, to ensure national policy frameworks include appropriate measures to help enhance resilience. To be coordinated via the International Cable Protection Committee ("ICPC") and/or regional Cable Protection Committees ("CPC") or other recognized industry organizations, and further supported by consultative bodies with submarine cables expertise to inform relevant governmental bodies on technical aspects of cables industry best practice (Ministries, National Regulatory Authorities, Marine & Environmental regulators, Customs, etc.
3	Encourage the development of a standard reporting mechanism for governments and ICPC/regional CPCs or recognized industry organizations to share, on a voluntary basis, anonymised information they collect on submarine cable delays, marine faults and other outages on a disassociated basis from cable systems with other governments and/or industry stakeholders.
	Cable Protection Legislation and Enforcement
4	Jurisdiction and Authority: Encourage national governments to establish clear legal and operational frameworks that are consistent with international law for the management of submarine cables in their waters, including critical national infrastructure designation where appropriate.
5	Treaty Obligations: Urge states to implement United Nations Convention on Law of the Sea ("UNCLOS") article 113 (to make the damaging of cables a punishable offence) and International Hydrographic Office (IHO) resolution 4/1967 (regarding certain activities within 0.25-mile on either side of submarine cables).
6	Enforcement legislation: Encourage governments to engage law enforcement agencies to assist with cable damage investigations (where the cause may be a third party), consistent with national laws and national sovereignty. Encourage real-time data sharing between industry and government agencies on cable fault localisation and identification of suspect vessels aided by enhanced enforcement of Automatic Identification System (AIS) regulations and the use of other applicable technologies. In developing legislation, clarify liability standards (intentionality, negligence) and penalty amounts.
	Co-existence with other Maritime Sectors

(continued)

7	Include navigating in proximity to submarine cables within the standard syllabus for the Basic Safety Training mandated by the International Maritime Organisation (IMO) under their International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW).
8	Require adequate stowage and securing of anchors on vessels to be inspected under the Flag State and regular Port State Control Inspection to avoid anchor dragging against submarine cables.
9	Recognize the spatial requirements of existing and future submarine cables, including their avoidance of manmade and natural hazards, chokepoints, and coexistence with regulated uses of (or protective measures for) the seabed and marine environment, consistent with the jurisdictional provisions of UNCLOS and customary international law.
10	Consider expanding the remit of nautical charting agencies to require them to regularly update the plotting of cables based on latest information from industry. Promote the maintenance of up-to-date cable system position records by cable owners, and encourage clear data flows where relevant from cable installers, owners and recovery companies to government and charting agencies to ensure accuracy, consistency and accountability.
	Strengthening Security & Resilience
11	<u>Audits and Stress Tests</u>: Encourage relevant entities to conduct routine stress tests to verify submarine cable system robustness, assess network risks from choke points and/or route congestion/clustered landings, and disaster response. Regularly audit cable resilience and maintenance provisions to ensure adequate spares, repair agreements, and test the robustness of cable station and digital access security.
12	<u>Decommissioning and redundancy</u>: Promote information sharing and/or notification regarding submarine cable decommissioning to address any resilience gaps, particularly for Small Island Developing States (SIDS) reliant upon few international links.
13	Enhance and expand industry guidance on hardening the security and surveillance of cable stations, fronthaul cables and outside plant and digital access portals (command and control systems).
14	Evaluate the benefit of higher upfront Investment to reduce the risk of future outages. Industry is encouraged to share detailed recommendations on survey, route planning, engineering and installation (including burial) to enhance cable protection.

WORKING GROUP 3 RECOMMENDATIONS
FOSTERING CONNECTIVITY AND GEOGRAPHICAL DIVERSITY

1	Promote the establishment of blended-finance platforms and initiatives for submarine cable investments, with emphasis on Small Island Developing States ("SIDS"), Landlocked Developing Countries ("LLDCs"), and underserved remote coastal regions, de-risking projects which may deliver high development impact but may not be commercially viable.
2	Encourage engagement among financing institutions, governments[197] and operators early in the submarine cable design process to promote potential investments benefiting SIDS, LLDCs and other underserved regions.
3	Support the design and implementation of partnership structures, including public-private partnerships, for marine cables to underserved regions, enabling routes that would not achieve commercial viability through purely private consortiums alone.
4	Encourage the development of insurance mechanisms to 1) improve project bankability for SIDS, LDCs and other underserved regions and (2) reduce insurance costs for all systems.
5	Encourage governments to develop clear, predictable policy and regulatory frameworks for submarine cable licensing and permitting to reduce costs and project implementation delays resulting from uncertain regulatory environments, and improve project bankability.
6	Encourage non-discriminatory access to cable landing stations, consistent with national regulations and national security requirements, in underserved regions, enabling competing carriers to secure capacity for domestic and international terrestrial service driving wholesale price reductions benefiting end-users, digital economy development and landlocked neighboring countries.
7	Promote the integration of branching units into the initial design of major trunk submarine cable routes, creating opportunities for concessional financing to promote cost-effective connectivity for SIDS, LDCs and other underserved regions.
8	Encourage governments to consider options to develop anchor-tenancy on systems designed for underserved regions by purchasing minimum bandwidth capacity on new submarine cable systems de-risking private sector and public investment.
9	Support the implementation of good practices from new and existing toolkits, where feasible, with the intention to enable rapid national submarine cable project deployments, with emphasis on SIDS, LDCs and other underserved regions, to reduce costs and time to develop and deploy submarine cable systems and backup arrangements.

[197] Any reference to "national" or "government" is understood to extend to Regional Economic Integration Organizations (REIOs) within their respective area of competence.

(continued)

10	Encourage, through industry best practice, the use of guidelines for assessing and fulfilling route diversity and resiliency needs of SIDS, LDCs and other underserved regions, to prevent disruptions resulting from environmental and human-made hazards.
11	Support capacity-building and technical assistance for regulators and policy makers in developing countries, to enable countries to adopt good practices for submarine cable deployment, adapted to local contexts.
12	Encourage comprehensive hazard vulnerability assessments for new submarine cable deployments and recommissioning projects to SIDS, LDCs and underserved regions to mitigate identified hazards when possible.
13	Encourage the implementation of regulatory frameworks which incentivize shared landing infrastructure in underserved regions, reducing duplication of vulnerable facilities while maintaining the benefits of competition and diverse routing.
14	Develop and adopt, where feasible, technical and operational protocols enabling seamless failover to satellite, microwave, or other backup systems during extended submarine cable outages.

*Any reference to "national" or "government" is understood to extend to regional economic integration organisations (REIOs) within their respective area of competence.

ABUJA DECLARATION[198]

The International Advisory Body on Submarine Cable Resilience Declaration (agreed by the International Advisory Body on Submarine Cable Resilience on 26 February 2025) Abuja, Nigeria

We, the members of the International Advisory Body on Submarine Cable Resilience, recognize the vital role of submarine telecommunications cables in enabling global connectivity, empowering economic growth, and supporting digital transformation. They are critical infrastructure and should be respected in accordance with international law.

In the spirit of collaboration and shared understanding, we adopt this Declaration as a framework for fostering resilience and encouraging cooperative efforts to support this vital infrastructure.

1. Acknowledging Vital Infrastructure

We recognize the essential role that submarine telecommunications cables play as critical infrastructure in enabling global economic, social, and governmental activity through interconnected communication systems by carrying over 99% of intercontinental data traffic.

[198] See The International Advisory Body on Submarine Cable Resilience Declaration, Abuja, Nigeria, 26 February 2025, https://www.itu.int/digital-resilience/submarine-cables/wp-content/uploads/sites/2/2025/02/summit-declaration-nigeria-2025.pdf

2. Strengthening Cable Protection Through Risk Mitigation

We underscore the importance of identifying and mitigating a range of risks to submarine cable systems, including natural events and accidental maritime damage, through the timely exchange of pertinent information, knowledge and best practices as well as enhanced cooperation between government agencies and all relevant stakeholders. We encourage promotion of sufficient and necessary mitigation and recovery measures to reduce the scale and scope of cable damage.

3. Promoting Diverse Routes and Landings to Enhance Resilience and Continuity

Considering that submarine telecommunications cables are crucial to the digital ecosystem from strategic, economic, safety, security, and strategic autonomy perspectives, we encourage the development of geographically diversified infrastructure, through all possible funding approaches including Public-Private-Partnerships, to mitigate potential disruptions, increase resilience, maintain connectivity, and ensure no region is left isolated.

4. Facilitating Timely Deployment and Repair

We encourage the development of government policies and practices to expedite the deployment of new submarine cable systems, ensure the maintenance and timely repair of damaged cables, to promote streamlined permits processes, maintain stockpiles/spares, and further support the development of the submarine cable installation and repair ecosystem.

5. Promoting Global Cooperation

We encourage international cooperation among governments, national regulatory authorities, research centres, universities, industry stakeholders, international organizations and other stakeholders to address shared challenges and support the continuous operation of submarine cable networks.

6. Advancing Sustainable Approaches

We uphold international law, and promote best practice principles and multistakeholder coordination on submarine communication cables. We support the adoption of physical risk based planning and environmentally sustainable practices informed by the best available science in the planning, deployment, and maintenance of submarine cables, ensuring the responsible management of natural and marine environments.

7. Fostering Technological Innovation

We highlight the value of innovative technologies and solutions that can mitigate the risks of damage to and enhance the resilience and efficiency of submarine cable systems, to ensure they remain operational, robust and reliable.

8. Facilitating Capacity Building

We advocate for the development of knowledge-sharing platforms and training programs to enhance the ability of all nations, particularly developing countries, to manage protect and repair submarine cable systems effectively and efficiently.

9. Preparing for Future and Present Connectivity Needs

Recognizing the rapid growth in global data transmission and the reliance of the entire digital ecosystem on such connectivity, we support efforts to ensure that submarine cable infrastructure can meet the demands of an accessible, stable and open digital future, and address the current digital divide, inter alia, through investment in new cable systems, upgrades to existing routes, and improved capacity planning.

10. Encouraging Proactive Risk Awareness

We encourage regular risk assessments and cooperative approaches among all relevant stakeholders, including governments, cable operators, system suppliers, and maintenance providers, to identify and address risks and challenges in submarine cable systems, contributing to greater resilience and preparedness for the long-term.

11. Using Data for Informed Decisions

We underline the importance of using data-driven and evidence-based approaches, including the analysis of cable routes, natural hazard risks, maritime activities and resources, to develop repair capabilities, guide decision-making and prioritize areas requiring additional focus.

Through this Declaration, we reaffirm our shared vision of collaboration, innovation, and sustainability, ensuring that submarine cables continue to play a vital role in global connectivity and development.

PORTO DECLARATION[199]

The Porto Declaration on Submarine Cable Resilience (affirmed by the International Advisory Body on Submarine Cable Resilience, on 3 February 2026) Porto, Portugal

We, the members of the International Advisory Body on Submarine Cable Resilience (IAB), reaffirm the vital role that submarine telecommunications cables have for global connectivity, economic development, social inclusion, and digital transformation.

Following the adoption of the Abuja Declaration in February 2025, which affirmed principles and priorities for submarine telecommunications cables as critical infrastructure, the IAB has convened Working Groups to engage on those priorities.

Building on this progress, non-binding recommendations are expected to further inform international cooperation and resilience building efforts.

These recommendations are meant to provide overarching guidance on how States and regions may harmonise and create enabling policy and regulatory environments that support and enable development, operation, and resilience of submarine cable systems, including by addressing barriers that may delay deployment or restoration of those systems. These

[199] See The Porto Declaration on Submarine Cable Resilience, Porto, 2-3 February 2026, https://www.itu.int/digital-resilience/submarine-cables/wp-content/uploads/sites/2/2026/02/Porto-Summit-Declaration.pdf

recommendations should also underscore the importance of coordination and cooperation among relevant authorities, the submarine cable industry, and marine stakeholders to support the protection of existing infrastructure and the development of future networks, alongside continued efforts to build institutional capacity and expertise.

We further recognize the value of the work of this International Advisory Body on Submarine Cable Resilience in its 2024-2026 mandate that have brought together specific industry, governments, academia, and other stakeholders. Through this collaboration, we have established constructive lines of communication, advanced awareness of the strategic importance of submarine cables, and developed practical suggestions to inform policy, operational practice, and investment decisions.

We welcome the recommendations that have been produced through constructive work in the International Advisory Body and encourage participants to take them forward as relevant and appropriate.

On the basis of this shared understanding, we affirm the following guidance to strengthen international cooperation and resilience:

1. Streamline submarine cable permitting, maintenance, and repair processes through clear, transparent, and predictable regulatory frameworks and designate a single government contact point to facilitate timely cable deployment and repair.
2. Improve legal framework and regulatory procedures while reducing legal and regulatory barriers, including in areas such as cabotage, customs, and marine spatial planning and management.
3. Encourage cable geographic diversity and redundancy, by supporting investment, through partnerships, including public–private partnerships, supporting varied routes, redundant landing points, and resilient infrastructure, especially for Small Island Developing States, Least Developed Countries, Landlocked Developing Countries, and underserved regions.
4. Encourage the adoption of industry best practices for assessing, mitigating and responding to risks to submarine cable infrastructure.
5. Encourage enhanced cable protection through better planning and across relevant marine sectors.
6. Build cable capacity and support innovation through training and use of technologies that enhance monitoring, route design, redundancy, and climate-resilient infrastructure.

We invite governments to consider reflecting this guidance, as appropriate, when developing or reviewing relevant policies, regulatory approaches, and operational frameworks and we encourage industry to strengthen and expand existing initiatives that support cable protection and resilience.

Through this Porto Declaration, we reaffirm our shared commitment to cooperation to help ensure that submarine cables serve as a resilient foundation of open, reliable, and interoperable global connectivity for all.

5. ANNEXES

ANNEX A: LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation	Definition
ACE	Africa Coast to Europe
ACMA	Atlantic Cable Maintenance Agreement
ADB	Asian Development Bank
ADGMIN	ASEAN Digital Ministers Meeting
ADREP	accident/incident data reporting
AI	artificial intelligence
AIS	automatic identification system
APMA	Atlantic Private Maintenance Agreement
APMMSA	Asia Pacific Marine Maintenance Service Agreement
ASEAN	Association of Southeast Asian Nations
ASPI	Australian Strategic Policy Institute
BMH	beach manhole
CARCIP	Caribbean Regional Communications Infrastructure Project
CARICOM	Caribbean Community
CBPC	Brazilian Submarine Cable Protection Committee
CCPL	Center for Cybersecurity Policy and Law
CIRF	Caribbean ICT Regulators Forum
CLS	cable landing station
CMA	contract management agreement
CPC	cable protection committee
CPEI	Cable Project of European Interest
CPZ	cable protection zone
CTU	Caribbean Telecommunications Union
DAH	double armour heavy
DA/MDA	double armour/medium double armour
DAS	distributed acoustic sensing
DKCPC	Danish Cable Protection Committee

(continued)

Abbreviation	Definition
DFI	development finance institution
DFOS	distributed fibre-optic sensing
DSIT	Department for Science, Innovation and Technology
EASSy	Eastern Africa Submarine System
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EEZ	exclusive economic zone
ENISA	European Union Agency for Cybersecurity
ERP	emergency response plan
ESCA	European Subsea Cables Association
EU	European Union
FAD	fish aggregating device
FCC	Federal Communications Commission
FSM	Federated States of Micronesia
GDIP	Global Digital Inclusion Partnership
GDP	gross domestic product
GIS	geographical information system
GRAOF	Global Repair Optimization Framework
HDD	horizontal directional drilling
HFC	high fibre count
HIPCAR	Harmonization of ICT Policies, Legislation and Regulatory Procedures
HSE	health, safety and environment
HTW	Human Element, Training and Watchkeeping
IAB	International Advisory Body on Submarine Cable Resilience
ICPC	International Cable Protection Committee
ICT	information and communications technology
IMCA	International Marine Contractors Association
IMDA	Infocomm Media Development Authority
IHO	International Hydrographic Organization
IMO	International Maritime Organization

(continued)

Abbreviation	Definition
ISA	International Seabed Authority
ISAC	information sharing and analysis centre
IT	information technology
ITU	International Telecommunication Union
JMA	joint maintenance agreement
JMSC	Joint Maritime Security Centre
KIS	Kingfisher Information Service
KPI	key performance indicator
LAC	Latin America and the Caribbean
LDC	least-developed country
LLDC	landlocked developing country
LW	light weight
MARA	Maritime Area Regulatory Authority
Mbps	megabytes per second
MCA	Maritime and Coastguard Agency
MDB	multilateral development bank
MECMA	Mediterranean Cable Maintenance Agreement
MIC	Ministry of Internal Affairs and Communications
MMO	Marine Management Organization
MOP	method of procedure
MPA	Maritime and Port Authority
MSP	maritime special planning
MTTR	mean time to repair
NAZ	North America Zone
NCA	National Coastal Administration
Nkom	Norwegian Communications Authority
NMPi	National Marine Plan Interactive
NOAA	National Oceanic and Atmospheric Administration
NOC	network operations centre
NORS	Network Outage Reporting System

(continued)

Abbreviation	Definition
OECD	Organisation for Economic Co-operation and Development
OEID	Observatory of Digital Ecosystems and Infrastructure
OFCOM	Office of Communications
OPEX	operating expenditure
ORCA	Offshore Renewables and Cables Awareness
OTDR	optical time domain reflectometer
PCRIC	Pacific Catastrophe Risk Insurance Company
PIDA	Programme for Infrastructure Development in Africa
PMA	private maintenance agreement
POW	plan of work
PPP	public-private partnership
PRCP	Pacific Regional Connectivity Programme
RAH	rock armour heavy
REIO	regional economic integration organization
RMA	repair and maintenance agreement
ROV	remotely-operated vehicle
RRU	rapid response unit
SEIOCMA	South East Asia and Indian Ocean Cable Maintenance Agreement
SIDS	small island developing States
SMART	Science Monitoring and Reliable Telecommunications
SPDA	special purpose double armour
SPMA	South Pacific Maintenance Agreement
SPOC	single point of contact
STCW	Standards of Training, Certification and Watchkeeping for Seafarers
STRAITREP	Ship Reporting System in the Straits of Malacca and Singapore
TSS	Traffic Separation Scheme
2OCMA	Two Oceans Cable Maintenance Agreement
UJ	Universal Joint
UK	United Kingdom
UNCLOS	United Nations Convention on the Law of the Sea

(continued)

Abbreviation	Definition
UNIDIR	United Nations Institute for Disarmament Research
UQJ	Universal Qualified Joint
US	United States
USD	United States dollar
VLCC	very large crude carrier
VMS	vessel monitoring system
VTS	vessel traffic services
WACC	weighted-average cost of capital
WARCIP	West Africa Regional Communications Infrastructure Project
WD	water depth
YZ	Yokohama Zone

ANNEX B: LIST OF IAB MEMBERS

Co-Chairs

- H.E. Minister Bosun Tijani, Minister of Communications, Innovation and Digital Economy, Federal Republic of Nigeria
- Prof. Sandra Maximiano, Chairwoman of ANACOM's Board of Directors, Portugal

Members

1. Mr Kevin **Adams**, Director, Digital Infrastructure, Department of Science, Innovation and Technology (United Kingdom).
2. H.E. Mr. Amit **Agrawal,** Secretary, Department of Telecommunications, Ministry of Communications, Government of India (India).
3. H.E Eng. Majed Sultan **Al Mesmar**, Director General of Telecommunications and Digital Government Regulatory Authority (United Arab Emirates).
4. H.E. Mr. Abdullah **Al-Mubadal**, Deputy Governor of the Telecommunication Sector of Communications, Space and Technology Commission (CST) (Saudi Arabia).
5. H.E. Ms. Deemah **AlYahya**, Secretary-General of Digital Cooperation Organization.
6. Mr Gustavo Santana **Borges**, Executive Superintendent, Anatel – National Telecommunication Agency (Brazil).
7. Mr Jesmond **Bugeja**, Chief Executive Officer of Malta Communications Authority (Malta).
8. Ms Jo **Conroy**, Technical Programme Manager of Google.
9. Mr Michael **Cunningham**, CEO of Crosslake Fibre.
10. Mr Carlos **Dasi**, (CTIO) Chief Technology Innovation Officer of Telxius a Telefónica Company.
11. Ms Kelly **Donohue**, Global Head of Network Infrastructure Policy of Meta Platforms, Inc.
12. Mr Rui **Faria**, Executive Director of Angola Cables.
13. H.E. Dr Ömer **Fatih Sayan**, Deputy Minister of Turkish Ministry of Transportation and Infrastructure (Turkiye).
14. Dr Youssouf **Hamidou Issoufa**, Director General of Comores Cables.
15. Mr Peter **Jamieson,** Vice Chair European Subsea Cables Association (ESCA).
16. Mr Sangbu **Kim, VP** Digital & AI at The World Bank.
17. Ms Nadia **Krivetz**, Director of Cable Connectivity and Resilience Centre, Department of Foreign Affairs & Trade, Australian Government.
18. Mr Xiaowei **Luan**, Executive Vice President of China Telecommunications Co., Ltd.
19. Mr John **Mills,** Deputy Assistant Secretary, U.S. Department of State (United States).
20. Mr Mick **McGovern**, General Manager Marine Operations of Alcatel Submarine Networks.
21. H.E. Mr. Miguel **Marques Gonçalves Manetelu**, Minister of Ministry of Transport and Communications (Timor-Leste).
22. Dr Eduardo **Mateo**, Chief Strategy Officer, Submarine Network Division, NEC Corporation.
23. Mr Károly **Mátrai**, CEO of MVM Group.
24. Dr Jane **Munga**, Fellow of Carnegie Endowment for International Peace.
25. Ms Nomsa **Muswai Mwayenga**, Co-Founder of Africa Subsea Ecosystem Forum- ASEF-Africa.

26. Mr Mohamed **Nasr**, CEO & Managing Director of Telecom Egypt.
27. Mr Cher Pong **Ng**, Chief Executive (CE) of Infocomm Media Development Authority (IMDA) (Singapore).
28. H.E. Amb. Ernst **Noorman**, Ambassador-at-Large for Cyber Affairs of Ministry of Foreign Affairs (Netherlands).
29. Mr Koji **Ono**, Company Executive Director, Submarine Cable Networks of KDDI.
30. Mr Andy **Palmer-Felgate**, Vice President of North American Submarine Cable Association-NASCA.
31. Mr Semisi (James) **Panuve**, Chief Executive Officer of Tonga Cable Limited.
32. Mr Jarkko **Saarimäki**, Director General of Finnish Transport and Communications Agency-Traficom (Finland).
33. H.E. Mr. Mohamed **Shamroukh**, Executive President, National Telecom Regulatory Authority (NTRA) (Egypt).
34. Mr Rodney **Taylor**, Secretary-General - Caribbean Telecommunications Union (CTU).
35. Ms Nonkqubela **Thathakahle Jordan-Dyani**, Director-General of Department of Communications and Digital Technologies (South Africa).
36. Mr Mustafa **Yaasin Sheik**, Director General of National Communications Authority of Somalia (Somalia).
37. Mr Aliyu **Yusuf Aboki**, Executive Secretary of West Africa Telecommunications Regulators Assembly (WATRA).
38. Mr Zhiguo **Zhao**, Leading Expert on Submarine Cables, Ministry of Industry and Information Technology, (China).
39. Mr Sigurd **Zhang**, Executive Vice President of HMN Tech Co. Ltd.
40. Mr Hanwu **Zhu**, Senior Vice President, China United Network Communications Group Company Limited.

Secretariat

- Tomas Lamanauskas, Deputy Secretary-General, International Telecommunication Union (ITU)
- Kent Bressie, Legal Adviser, International Cable Protection Committee (ICPC)

ANNEX C: LIST OF WORKING GROUP MEMBERS

WG1: Timely deployment and repair			
Working Group Members:	**59**		
First name	**Surname**	**Organization**	**Country**
Co-facilitators:			
Zhiguo	**Zhao**	**Leading Expert on Submarine Cables, Ministry of Industry and Information Technology, China**	**China**
Kevin	**Adams**	**Director, Digital Infrastructure, Department of Science, Innovation and Technology (United Kingdom)**	**United Kingdom**
Technical Focal Points			
Maosheng	Zhai	China Academy of Information and Communications Technology	China
Matthew	James	Digital Infrastructure, Department of Science, Innovation and Technology	United Kingdom
Members			
Suyanto		Directorate of Digital Infrastructure Acceleration, Ministry of Communication and Digital Affairs	Indonesia
Liban	Abdulkahdir	National Communications Authority	Somalia
Abayomi	Adebanjo	MainOne	Nigeria
Norhani	Adzhar	MCMC	Malaysia
Uzoamaka	Okenna -Aguneche	NCC-Nigeria	Nigeria
Omar	Al Nemer	Telecommunications and Digital Government Regulatory Authority, UAE	United Arab Emirates
Ibrahim	Al Owais	e-Marine	United Arab Emirates
Aliana	Aziz	MCMC	Malaysia
João	Beleza Vaz	Anacom	Portugal
Santos	Bobai	NCC-Nigeria	Nigeria

(continued)

WG1: Timely deployment and repair			
Afşin	Büyükbaş	Information and Communication Technologies Authority (BTK) of Türkiye	Türkiye
Domingos	Cahoji	Angola Cables	Angola
Pijia	Cao	HMN Technologies Co., Limited	China
Olufunke	Damola-Sokunbi	NCC-Nigeria	Nigeria
Stephen	Dawe	ESCA	United Kingdom
Kossivi	Dokoue	ARCEP-Togo	Togo
Kelly	Donohue	Meta	United States of America
Junshi	Gao	China Mobile Group Design Institute Co., Ltd.	China
James	Ghatinga	Nokia	Kenya
Heather	Goethert	U.S. Department of State	United States of America
Darren	Griffiths	Optic Marine (OMS)	Malaysia
Agustin	Gutiérrez	Telxius	Spain
Ellis	Harkins	AWS	United Kingdom
Sven	Homan	Belgian Institute for Postal Services and Telecommunication	Belgium
Tom	Janssen-Manning	Google	Kingdom of the Netherlands
Ljupcho	Jovanovski	Google	Switzerland
Dzikrul Insanul	Kamila	Directorate of Digital Infrastructure Acceleration, Ministry of Communication and Digital Affairs	Indonesia
Liesa	Korolkow	Federal Ministry for Digital and Transport	Germany
Marko	Kotilainen	Finnish Transport and Communications Agency Traficom	Finland
Ashish	Kushwaha	Department of Telecommunications, Government of India	India
Mick	McGovern	ASN	France
Woon Sien	Loh	Infocomm Media Development Authority ("IMDA") (Singapore)	Singapore

(continued)

WG1: Timely deployment and repair			
Mamoudou	Magassouba	ARPT-Guinea	Guinea
Doug	May	U.S. Department of State	United States of America
Daniel	Marchi	National Telecommunication Agency (Anatel)	Brazil
Mick	McGovern	ASN (Alcatel Submarine Networks)	United Kingdom
Soumaïla	Minkailou	AMRTP-Mali	Mali
Philip	Murphy	Marine Operations, International Networks - Telstra	Australia
Xuechao	Niu	Zhongtian Technology Submarine Cable Co. Ltd	China
Sören	Nübel	Federal Ministry for Digital and Transport	Germany
Semisi	Panuve	Tonga Cable Limited	Tonga
Michael	Paul	MTN Digital Infrastructure - Bayobab	United Arab Emirates
Robert	Pepper	Global Digital Inclusion Partnership	United States of America
Sergey	Popkov	PJSC «Rostelecom»	Russian Federation
Romualdo	Rocha	Blue Marine Telecom	Brazil
Robert	Schumann	Cybastion Institute of Technology	United Kingdom
Timothy	Scoltock	Cable Connectivity and Resilience Centre - Department of Foreign Affairs and Trade	Australia
Zhenyu	Shao	China Submarine Cable Construction Co. Ltd	China
Andrey	Shustov	PJSC «Rostelecom»	Russian Federation
Verne	Steyn	OATS	South Africa
Alexey	Strelchenko	JSC «Management of Advanced Technologies»	Russian Federation
Tom	Sullivan	U.S. Federal Communications Commission	United States of America
Georgios	Tselentis	European Commission	
Mahalmadane Sidi	Toure	AMRTP-Mali	Mali
Rong	Xu	S.B. Submarine Systems Co. Ltd.	China

(continued)

WG1: Timely deployment and repair			
Hongbo	Yang	China Unicom	China
Xing	Zheng	China Information Communication Technologies Group	China
Miaozhuang	Zheng	China institute for marine affairs	China

WG2: Risk identification, monitoring and mitigation			
Working Group Members:	**62**		
First name	**Surname**	**Organization**	**Country**
Co-facilitators			
Nonkqubela	**Thathakahle Jordan-Dyani**	**Director-General of Department of Communications and Digital Technologies (South Africa)**	**South Africa**
Andy	**Palmer-Felgate**	**Vice President of North American Submarine Cable Association-NASCA**	**United States of America**
Technical Focal Point			
Sagren	Naidoo	Broadband Infraco SOC Ltd., Department of Communications and Digital Technologies	South Africa
Members			
Amr	Abbas	NTRA	Egypt
Priscilla	Adjei Dorsese	MTN Digital Infrastructure - Bayobab	Ghana
Norhani	Adzhar	MCMC	Malaysia
Uzoamaka	Okenna - Aguneche	NCC-Nigeria	Nigeria
Omar	Al Nemer	Telecommunications and Digital Government Regulatory Authority, UAE	United Arab Emirates
Ibrahim	Al Owais	e-Marine	United Arab Emirates
João	Alves	Anacom	Portugal
Arif	Arısoy	Information and Communication Technologies Authority (BTK) of Türkiye	Türkiye

(continued)

WG2: Risk identification, monitoring and mitigation			
Aliana	Aziz	MCMC	Malaysia
Theophilus A	Benson	Carnegie Mellon University	United States of America
Santos	Bobai	NCC-Nigeria	Nigeria
Cheng	Chang	China Mobile Limited	China
Sergey	Chuvashev	FSUE «Morsvyazsputnik»	Russia
Michael	Cuddington	Meta	United Kingdom
Kristine	Dalaker	Australian National Centre for Ocean Resources and Security, University of Wollongong	Australia
Olufunke	Damola-Sokunbi	NCC-Nigeria	Nigeria
Kossivi	Dokoue	ARCEP-Togo	Togo
Zhang	Fang	HMN Technologies Co. Ltd	China
Wale	Fayose	MainOne	Nigeria
Clementino	Fernando	Angola Cables	Angola
Alina	Filippova	FSUE «Morsvyazsputnik»	Russia
James	Ghatinga	Nokia	Kenya
Heather	Goethert	U.S. Department of State	United States of America
Maoyou	He	China Information Communication Technologies Group	China
Douglas Njenga	Irungu	WIOCC Group	Kenya
Sander	Isendoorn	Ministry of the Interior and Kingdom Relations	Kingdom of the Netherlands
Peter	Jamieson	Virgin Media	United Kingdom
Mohamed Ousmane	Kaba	ARPT-Guinea	Guinea
Arto	Laikari	VTT Technical Research Centre of Finland Ltd	Finland
Patrícia	Leal Coutiho	National Telecommunication Agency (Anatel)	Brazil
Lei	Lei	China Unicom	China
Mick	McGovern	ASN	France
Yanfeng	Ma	HMN Technologies Co., Limited	China

(continued)

WG2: Risk identification, monitoring and mitigation			
Doug	May	U.S. Department of State	United States of America
Bambang	Marwoto	Indonesian Navy Hydro-Oceanographic Center (PUSHIDROSAL)	Indonesia
Eduardo	Mateo	NEC	Japan
Soumaïla	Minkailou	AMRTP-Mali	Mali
Aldo	Monaca	Società Italiana di Idrografia / Italian Hydrographic Society (Member of IFHS)	Italy
Philip	Murphy	Marine Operations, International Networks - Telstra	Australia
Sagren	Naidoo	Department of Communications and Digital Technologies	South Africa
Maria	Novikova	FSUE «Morsvyazsputnik»	Russian Federation
Daniel	Obam	Convergant Kenya Ltd.	Kenya
Robert	Pepper	Global Digital Inclusion Partnership	United States of America
Juan Pablo	Rosati	Telxius	Uruguay
Elhad Kassim	Said Ahmed	Comores Cables	Comoros
David	Scerri	MCA	Malta
Timothy	Simmons	U.S. Department of Homeland Security	United States of America
Robert	Schumann	Cybastion Institute of Technology	United Kingdom
Antoine	Sciberras	MCA	Malta
Mustafa	Sheik	National Communications Authority	Somalia
Indra	Siswoyo	Directorate of Digital Infrastructure Acceleration, Ministry of Communication and Digital Affairs	Indonesia
Nick	Smith	Google	United Kingdom
Rajesh Kumar	Soni	Department of Telecommunications, Government of India	India
Verne	Steyn	OATS	South Africa
Chris	Sturgeon	Red Penguin	United Kingdom

(continued)

WG2: Risk identification, monitoring and mitigation			
Göran	Swistek	Federal Ministry of Defense	Germany
Harapan	Takaryawan	Directorate of Digital Infrastructure Acceleration, Ministry of Communication and Digital Affairs	Indonesia
Johannes	Theiss	European Commission	
Mahalmadane Sidi	Toure	AMRTP-Mali	Mali
Jeroen	Van Overloop	Federal Service Mobility	Belgium
Sophie	Wright	Google	Singapore
Qi	Zang	National Marine Data and Information Service	China
Hong	Zhebin	China Telecom Group Co., Ltd.	China

WG3: Fostering connectivity and geographical diversity Working Group			
Total Members:	**63**		
First name	**Surname**	**Organization**	**Country**
Co-facilitators			
Sangbu	**Kim**	**VP Digital & AI at The World Bank**	**Global**
Rodney	**Taylor**	**Secretary-General - Caribbean Telecommunications Union (CTU)**	**Regional**
Technical Focal Points			
John	Garrity	World Bank	World Bank
Tariq	Mohammed	Caribbean Telecommunications Union	Regional
Members			
Oluwakemi	Adeyanju	Aetheris Consult Ltd & ASEF	United Kingdom
Norhani	Adzhar	MCMC	Malaysia
Uzoamaka	Okenna -Aguneche	NCC-Nigeria	Nigeria
Dewole	Ajao	Google	Nigeria

(continued)

WG3: Fostering connectivity and geographical diversity Working Group			
Omar	Al Nemer	Telecommunications and Digital Government Regulatory Authority, UAE	United Arab Emirates
Tawfeeq	AL-Momany	Ministry of Digital Economy & Entrepreneurship	Jordan
Mohamed	Alnoaimi	TRA	Bahrain
Aliana	Aziz	MCMC	Malaysia
Samia	Bahsoun	Subsea System Consultant	United States of America
Santos	Bobai	NCC-Nigeria	Nigeria
Julien	Bollati	European Commission	
Tullio	Carne Bertini	National Telecommunication Agency (Anatel)	Brazil
Rodrigo	Carvalho	Angola Cables	Brasil
Thomas	Chalumeau	World Bank	Global
Samba Khonte	Coulibaly	SONATEL	Senegal
Mike	Cunningham	Crosslake Fibre	Canada
Olufunke	Damola-Sokunbi	NCC-Nigeria	Nigeria
Alhassane	Diallo	ARPT-Guinea	Guinea
Kossivi	Dokoue	ARCEP-Togo	Togo
Bartek	Drzewiczak	Google	United States of America
Augusto	Fragoso	Anacom	Portugal
Michael	Francois	Google	Switzerland
Heather	Goethert	U.S. Department of State	United States of America
Naima	Hassan	National Communications Authority	Somalia
Hengky	Iriawan	Indonesian Navy Hydro-Oceanographic Center (PUSHIDROSAL)	Indonesia
Douglas Njenga	Irungu	WIOCC Group	Kenya
Michael	Kennett	Google	United Kingdom
Liesa	Korolkow	Federal Ministry for Digital and Transport	Germany

(continued)

WG3: Fostering connectivity and geographical diversity Working Group			
Nadia	Krivetz	Director of Cable Connectivity and Resilience Centre (Connectivity Branch)	Australia
Beytullah	Kuşcu	Information and Communication Technologies Authority (BTK) of Türkiye	Türkiye
Jose	Lay	National Communications Authority of Timor-Leste	Timor-Leste
Yongfeng Neal	Li	S. B. Submarine Systems Co., Ltd.	China
Tong	Li	China Mobile Limited	China
Eng Soon	Lim	Singapore Telecommunications Limited ("Singtel")	Singapore
Liang	Ma	China Telecom Group Co., Ltd.	China
Doug	May	U.S. Department of State	United States of America
Patrick	Mbogo	London Internet Exchange	Kenya
Jane	Munga	Carnegie Endowment for International Peace	Kenya
Nomsa	Mwayenga	ASEF	South Africa
Sören	Nübel	Federal Ministry for Digital and Transport	Germany
Daniel	Obam	Convergant Kenya Ltd.	Kenya
Koji	Ono	KDDI	Japan
Oluwasayo	Oshadami	Mainone	Nigeria
George	Pantos	Ministry of Digital Governance in Greece	Greece
Robert	Pepper	Global Digital Inclusion Partnership	United States of America
Elaine	Reed	Vodafone	United Kingdom
Alex	Riddell	Pelagian	United Kingdom
Ben	Roberts	Digital Economy Advisors	Kenya
El-sadate	Said Omar	Comores Cables	Comoros
Munir	Salau	MainOne	Nigeria
Steve	Song	Internet Society	Canada

(continued)

WG3: Fostering connectivity and geographical diversity Working Group			
Wenguo	Sun	China Information Communication Technologies Group	China
Michal	Szczesny	EXATEL	Poland
Evgeny	Tonkikh	The M.I. Krivosheev National Research Centre for Telecommunication (NRCT)	Russian Federation
Cheikh Ahmadoul Khadim	Touré	SONATEL	Senegal
Alexander	Van den Hil	SURF	Kingdom of the Netherlands
Rahul	Vatts	Bharti Airtel	India
David	Wahome	Seacom	Kenya
Kai	Wang	China Unicom	China
Jason	Woodrow	MTN Digital Infrastructure - Bayobab	United Arab Emirates
Jiantao	Xu	HMN Technologies Co., Limited	China
Meng Fai	Yue	Singapore Telecommunications Limited ("Singtel")	Singapore
Kwok	Yau Ho	HMN Technologies Co. Ltd.	China
Ye	Yin	Guangdong planning and designing institute of telecommunication Co. Ltd.	China
He	Yongtao	China Post and Telecommunications Consulting and Design Institute (CITC)	China

ANNEX D: IAB TERMS OF REFERENCE[200]

International Advisory Body for Submarine Cable Resilience
Terms of Reference

1. OBJECTIVES

The International Telecommunication Union (ITU), in partnership with the International Cable Protection Committee (ICPC), establishes the International Advisory Body for Submarine Cable Resilience (hereinafter the "Advisory Body") to enhance submarine telecommunications cables, which provide more than 99 percent of the world's intercontinental connectivity, support a range of human activities in developed and developing states, including electronic commerce, financial transactions, government services, tele-health and tele-education, social and cultural exchanges, and scientific inquiry. This Advisory Body will serve as a platform for international multistakeholder collaboration to identify, develop, and promote government and industry best practices for submarine cable resilience, focusing on, *inter alia*:

- Timely licensing, deployment and repair of submarine cables
- Mitigation of the risks of physical damage to submarine cables
- Enhancement of submarine cable resilience and the continuity of communications over such cables, and
- International cooperation in the aforementioned areas.

2. COMPOSITION

2.1 The Advisory Body's members should consist of leaders and representatives from a mix of: international and regional organisations (including those focused on cable protection); government policymakers and regulators; submarine cable operators (including telecommunications carriers and hyperscalers), system suppliers, cable ship operators, and survey companies; and academia.

2.2 Additional criteria include ensuring diversity and inclusion across genders, regions, and economies, a demonstrated commitment to the Advisory Body's mission, and the capacity for sustained engagement to promote a comprehensive and coordinated approach to enhancing submarine cable resilience.

2.3 Potential members satisfying the criteria identified above will be solicited through a public call for nominations. The ITU and the ICPC may solicit additional nominations to ensure effective and diverse representation consistent with the criteria identified above. The ITU and the ICPC will jointly propose members to be selected with the concurrence of the co-chairs.

2.4. Intergovernmental organizations may be invited to join in a consultative role to offer expert insights that will complement the discussions of the formal membership of the Advisory Body

3. OPERATING GUIDELINES

3.1 The Advisory Body will have two co-chairs. Representatives of the ITU and ICPC will serve as co-executive secretaries of the Advisory Body.

[200] See ITU, IAB, "Terms of reference", ITU, Geneva, https://www.itu.int/digital-resilience/submarine-cables/advisory-body/terms-of-reference/ (accessed 7 July 2026).

3.2 The Advisory Body will foster a collaborative and inclusive environment, encouraging diverse perspectives, open dialogue, and equal participation. Members will uphold integrity and impartiality, making decisions based on expert knowledge and commit to the highest standards of governance and probity.

3.3 A vision, plan and time deliverables will be agreed based on the objectives and scope. The Advisory Body will meet at least twice per year, one convening in person during the annual Submarine Cable Resilience Summit (the “Submarine Cable Resilience Summit") and the others virtually.

3.4 A quorum for the Advisory Body meetings will be at least two thirds of the Members.

3.5 Advisory Body's decision-making process will be consensus based.

3.6 The agenda for Advisory Body meetings shall be agreed by the co-chairs.

3.7 The Advisory Body Members must fully commit to, and always observe and in all contexts, the values and standards of the United Nations, adhere to UN principles including those for human rights, labour, environment, anti-corruption, and the rule of law.

3.8 In its work, the Advisory Body members will adhere to the United Nations Code of Conduct. The Office of the ITU Secretary-General will provide operational support. In cases of alleged misconduct or inability to fulfil duties, including failure to comply with applicable laws and/or the UN operational guidance in force at the time, the continued participation of such member(s) in the work of the Advisory Board may be reconsidered.

3.9 The Advisory Body is constituted for an initial period of two years.

3.10 The Advisory Body’s co-chairs and members will serve for a period of two years.

3.11 Advisory Body position is purely voluntary and non-remunerated.

3.12 The ITU and ICPC Secretariat team will perform the functions of secretariat for the Advisory Body.

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Place des Nations
CH-1211 Geneva 20
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ISBN 978-92-61-40561-8

Published in Switzerland
Geneva, 2026

Photo credits: ITU