Valentia Island Symposium on Subsea Cable Security and Resilience
Repair: Past, Present, Future

Valentia Island Transatlantic Cable Station, Valentia Island,
Co. Kerry, Ireland
22-24 April 2026



A Report of Proceedings



Preface

Subsea cable repair is a somewhat niche topic, but one which merits significant attention in these times of significant technological change and geopolitical tension. In April 2026, the second Valentia Island Symposium on Subsea Cable Security and Resilience brought together another excellent group of experts from across government, industry and academia to discuss the Past, Present and Future of Repair at the Valentia Island Transatlantic Cable Station. This detailed report is the result of those deliberations. We hope that its findings contribute to on-going policy discussions on the topic.

Amongst those who made it possible, we would like to express our gratitude to our hosts - the Valentia Island Transatlantic Cable Foundation – as well as to the Government of Ireland, Kerry County Council, the European Subsea Cables Association (ESCA), the International Cable Protection Committee (ICPC) and all the other Symposium sponsors listed below for their support and participation in the event. Keynote speeches by both Patrick O'Donovan, Minister for Climate, Communications and Sport and Helen McEntee, Minister for Foreign Affairs and Defence, as well as the attendance of officials from across government are a clear indication of the importance of the topic.

A huge thanks to all the speakers and moderators from across industry, government and academia who travelled from near and afar to discuss submarine cable repair from so many different angles. And hats off again to Professor Chris Morash for his memorable evening keynote address, and to the local musicians for their beautiful rendering of *Amhrán na Leabhar*.

To the staff at the Valentia Island Cable Station, the Royal Hotel at Valentia Island, the Heritage Centre, the Church of St John the Baptist and to the communities of Valentia Island and Portmagee - thank you once again for your exceptional hospitality.

Last, and certainly not least, we would like to dedicate this report to the memory of Derek Cassidy, a formidable engineer who was deeply passionate about the history of telecommunications cables and the Valentia Island Transatlantic Cable Station. We hope Derek's spirit of generosity and knowledge sharing will be carried forward by all those working in this area.

To each and every one of you, go raibh míle maith agaibh, thank you!

Camino Kavanagh, Symposium Chair
Leonard Hobbs, Chair, Valentia Transatlantic Cable Foundation
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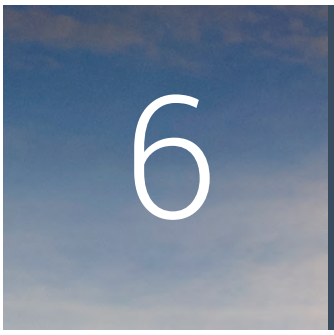

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Cumarsáide agus Spóirt
Department of Culture,
Communications and Sport

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Symposium Report



Introduction

The second multi-stakeholder Valentia Island Symposium on Subsea Cable Security and Resilience, was held from 22-24 April 2026. Hosted once again at the historic Valentia Island Transatlantic Cable Station, this year's Symposium focused on the topic of Restoration and Repair. Over three days, presentations focusing on the past, present and future of cable repair; an industry-led Table Top Exercise (TTX) centred on a multi-cable break scenario; and five thematic expert panels examined the resilience of the subsea cable repair ecosystem from complementary perspectives: government preparedness, public-private collaboration, geopolitical risk, structural changes in the maintenance market, and growing competition for seabed space.

The Symposium discussions were set against the most recent ICPC repair data covering more than 3,200 repairs since 2008.[1] The data set shows that the majority of cable faults continue to be caused by accidental commercial maritime activity, principally fishing gear and ships' anchors, rather than by deliberate interference. Measured against cable in service, the fault rate has roughly halved over the past decade, from around one repair per 5,000 km of cable in 2015 to approximately one per 10,500 km in 2025. Taken together, a consistent conclusion emerged across the proceedings: the existing industry-led repair model remains effective and should remain the foundation of the system, with the case for action resting on the growth of the installed base, an ageing repair fleet, and a much more complex operating environment. Any action to address these issues and ensure that the maintenance/repair ecosystem remains fit for purpose will require stronger industry-government coordination, greater investment and more deliberate planning for resilience.

Drawing from across the Symposium discussions, a series of key takeaways and practical actions emerged for strengthening the resilience of the subsea cable repair ecosystem. These are summarised as follows:

Key Takeaways

National preparedness Subsea cable repair can no longer be considered solely as a technical or commercial activity. Governments increasingly view the ability to restore traffic and repair damaged cables as a matter of national preparedness, economic security and societal resilience. This does not imply that governments should take over repair operations. Rather, participants repeatedly emphasised that the most effective role for governments is to enable and support industry response by reducing regulatory and administrative barriers, establishing clear crisis-management structures and points of contact, improving information sharing and situational awareness, facilitating access for vessels and specialist personnel, and preparing for scenarios that exceed the capacity of routine commercial arrangements. The TTX as well as lessons from recent major disruptions, including simultaneous faults and repairs in geopolitically difficult environments, demonstrated that existing maintenance arrangements can generally adapt under stress, but also highlighted the importance of trusted relationships and established coordination mechanisms.

Preparedness therefore depends as much on institutions, relationships and information as on physical repair assets**.** In this regard, participants supported moving from informal or personality-dependent relationships towards more durable government-industry structures, backed by exercises, clear responsibilities, two-way sharing of information, and post-incident learning. Since governments, operators, maintenance providers and security organisations each hold different parts of the operational and security picture; trusted mechanisms for sharing relevant information are essential to developing situational awareness during significant incidents. Similar considerations apply internationally. Subsea cable systems are inherently cross-border, making bilateral, regional and multilateral cooperation important for permitting, crisis coordination, information sharing and the exchange of good practice, including with regard to repair. At the same time, approaches need to reflect differing regional circumstances rather than assuming that models can be transferred directly elsewhere. Exchanges of lessons across regions are nonetheless useful.

[1] ICPC's Annual MTTR Analysis (2025) was presented during the Symposium framing session. It is available upon request via the following link: [placeholder for link]



A more complex geopolitical operating environment The current geopolitical context adds a further layer of complexity. Conflict, sanctions, insurance constraints, supply-chain disruption, cabotage and permitting restrictions, and declining trust between states can all impede repairs. Participants also identified the possibility of deliberate interference via physical or cyber means with cables and the wider repair ecosystem**,** including vessels, navigation systems, equipment, service providers and supply chains. Maritime domain awareness and information sharing between governments, industry and security organisations are consequently becoming more important. Navies may have a supporting role in higher-risk environments through surveillance, intelligence sharing, deterrence and, where circumstances require it, accompanying or protecting repair vessels. However, repair should remain fundamentally commercial, with military involvement calibrated to the circumstances so that it does not unnecessarily increase tensions.

In addition, while recognising the significant political, legal and enforcement obstacles to establishing a formal norm, speakers supported the principle of strengthening international expectations of non-interference with repair capabilities and operations, be it through physical, cyber or other means.[2]

The economics of maintenance and fleet renewal Alongside these preparedness and security challenges, the economics of the maintenance sector are approaching an inflection point**.** The installed cable base is forecast to grow substantially just as a significant share of the existing repair fleet approaches retirement. Around 15 maintenance vessels may require replacement by 2040, involving investment estimated at approximately US$3 billion. Yet thin margins, uncertain repair demand and the cost of maintaining vessels during periods of low utilisation make new purpose-built ships difficult to finance. Existing consortium and private maintenance arrangements have served the

[2] In the context of this report, and building on existing UNCLOS provisions relevant to criminalising wilful damage to submarine cables (Articles 113-115), which States have been repeatedly exhorted to implement and enforce, this would entail an expectation that State actors should refrain from conducting or knowingly supporting activity that obstructs or intentionally interferes with subsea cable repair vessels, personnel, equipment and operations.



industry well, but participants considered whether different investment vehicles and public-private partnerships could provide greater certainty for fleet renewal. Targeted public intervention may have a role where the market does not deliver strategically important capacity but should be designed carefully to avoid undermining functioning commercial structures.

Changing ownership patterns add uncertainty. Hyperscalers are increasingly important investors in new cable systems and may ultimately exercise greater influence over maintenance arrangements, potentially through bespoke solutions or greater control over or access to vessel capacity. To date, however, there is little concrete evidence of a fundamental change in operational requirements: rapid restoration remains important despite increased network redundancy. The direction of future maintenance models is therefore uncertain, reinforcing the need for transparency and flexibility rather than premature assumptions about any future structure.

People, skills and surge capacity As in other critical infrastructure sectors, people remain just as important as capability. Across the proceedings, participants repeatedly identified shortages of experienced engineers, jointers, ROV operators and marine crews, alongside retention challenges and dilution of experience. Training, apprenticeships, university partnerships and clearer career pathways can help expand the talent pool, while greater movement between telecommunications, power, offshore energy and other maritime sectors could improve utilisation and maintain competence. Beyond expanding the permanent workforce, participants also saw merit in exploring reserve-style and secondment models that could provide access to specialist industry expertise during severe disruptions. Such arrangements could strengthen contingency capacity, particularly where governments are considering sovereign repair capabilities, but would need to ensure that personnel remain operationally current and account for the international and commercial nature of cable repair. Governments considering sovereign or contingency repair capabilities should therefore ensure a focus on access to expertise and skills as well as physical assets.

Planning for repairability The Symposium discussions also demonstrated that repair resilience begins long before a fault occurs. Growing competition for seabed space, particularly around landfalls and congested nearshore areas, can constrain future maintenance and repair. Marine spatial planning should therefore preserve not only routes and landing sites but sufficient corridor widths, access rights and operational space for cable recovery and repair. Requirements intended to protect cables, including constrained routing and deep burial, can themselves increase repair costs and restoration times if repairability is not considered at the planning stage. Emerging technologies such as ROVs, AUVs and advanced fault-detection systems can assist in difficult environments, but do not remove the need for adequate space and access. Planning should consequently consider the entire infrastructure lifecycle — installation, operation, repair and eventual decommissioning — while increasingly accounting for climate-related changes affecting landfalls, coastal erosion and maritime activity.



Key action points for government and industry

Cross-cutting enabler:	
Ensure greater transparency and reciprocal information sharing within appropriate commercial, security and confidentiality constraints so that government policy and industry decision-making can draw on the fullest available evidence rather than on only one part of the picture. To this end, industry, either directly or through the ICPC, ESCA and equivalent bodies, should continue to make anonymised fault, cause and repair-time data available to governments who can use it to target barriers that demonstrably delay repair (e.g., permitting, customs, cabotage and vessel access) and test proposed interventions against it before committing public funds. Governments, through appropriate, secure channels, should ensure that vetted industry players have access to relevant government-held information and analysis that can inform operational risk and preparedness. *(Ref: Panels 1, 3, 4. See also footnote 2 above)*	
For immediate action	
1.	*Reduce regulatory and administrative barriers to repair.* Review permitting, licensing, customs, immigration, cabotage and related requirements, and establish expedited arrangements for emergency repairs and rapid deployment of specialist personnel and vessels. In view of the cross-jurisdictional character of the subsea telecommunications cables, these issues could also be taken up within the broader cable diplomacy toolbox. *(Ref: Panels 1, 2, 3; see also Panel 5)*
2.	*Institutionalise government-industry coordination before crises occur*. Establish clear lead authorities, 24/7 points of contact, trusted information-sharing mechanisms, joint exercises and post-incident reviews. (*Ref: Panels 1, 2; see also Panel 3)*
3.	*Strengthen international and security cooperation around repair operations*. Bolster maritime domain awareness, intelligence sharing and attribution capabilities, and determine the criteria and thresholds for appropriately calibrated naval support in higher-risk environments.
4.	*Promote a shared global expectation* that cable repair vessels, personnel and operations should not be obstructed or interfered with. *(Ref: Panel 3; see also Panel 1)*
5.	*Prepare for severe and simultaneous disruption, including how scarce repair capacity would be prioritised under non-business-as-usual conditions.* Establish the circumstances, authorities, information requirements and decision-making arrangements that would apply where available repair capacity is insufficient or commercial repair priorities and national resilience objectives diverge, including the threshold at which targeted government action might become necessary. *(Ref: Panels 1, 2; see also Panels 3 and 4)*
5.	*Assess and protect critical dependencies across the repair ecosystem*. Ensure that resilience planning extends beyond cable systems and repair vessels to the wider ecosystem on which restoration depends, and identify critical dependencies, geographic concentrations and single points of failure that could constrain repair capacity during crisis or conflict. *(Ref: Panel 3; see also Panels 2, 4)*
6.	*Explore reserve and contingency models for specialist repair expertise*, including whether reserve-style arrangements, secondments and structured public-private partnerships could provide access to specialist expertise during severe disruptions. Such models would need to maintain operational competence through regular industry exposure and exercises, and address the legal, jurisdictional and practical constraints associated with deploying personnel within an international commercial repair ecosystem. *(Ref: Panels 1, 2; see also Panel 4)*

Building resilience into the future	
7.	*Create the commercial conditions for fleet renewal and sufficient repair capacity*. Acknowledging the tension between the need for investment and the risk that poorly designed state intervention could distort a small and specialised market, industry and governments should continue to explore alternative investment mechanisms, including targeted public-private financing to address identified challenges such as ageing vessels and surge capacity. Where appropriate, such support should focus on demand-side measures and de-risking long-lived assets rather than state-owned tonnage, be designed with existing maintenance zones, and avoid displacing existing commercial commitments. (*Ref. Panel 4; see also Panel 2)*
8.	*Invest in people alongside physical assets*. Apprenticeships, training, clearer career pathways, cross-sector multi-skilling and carefully designed public-private initiatives should expand and sustain the pool of experienced engineers, ROV operators, splicers, jointers, marine and other specialised crew. *(Ref: Panels 1, 2, 4)*
9.	*Plan for repairability across the full infrastructure lifecycle*. Marine spatial planning, leasing and consenting should preserve routes, landing sites, repair corridors, operational access and sufficient seabed space, while considering the long-term implications of burial, congestion, climate change and eventual decommissioning. *(Ref: Panel 5; see also Panels 1, 2)*
10.	*Maintain flexibility as the repair ecosystem evolves*. Hyperscaler investment, sovereign repair initiatives, new technologies and changing commercial structures will continue to reshape the sector. Government and industry should use shared data, experimentation and sustained dialogue to adapt while preserving the commercial viability, interoperability and responsiveness of the wider repair ecosystem. (*Ref: Panels 2, 4; see also Panels 1, 5)*

In short, the existing repair ecosystem is at a strategic inflection point. Industry should continue to lead operational repair, while governments can provide the enabling regulatory, security, coordination and policy environment around it. Long-term resilience will depend on combining commercial viability with national preparedness: maintaining sufficient vessels and skilled personnel; reducing barriers to rapid repair; strengthening redundancy and contingency arrangements; preserving near-shore repairability through spatial planning; improving government-industry and international coordination; and preparing collectively for severe scenarios that may exceed the assumptions on which existing maintenance arrangements were designed.







Panel 1: Government preparedness and repair

Prepare for beyond BaU repairs

- multiple, simultaneous faults
- prolonged disruption
- constrained repair capacity
- repair prioritisation

Build resilience

- route diversity
- redundancy
- alternative redundancy options
- critical service dependencies
- business continuity

Strengthen coordination

- clear roles, PoCs
- trusted info sharing
- reduced regulatory barriers
- rapid vessel and personnel deployment

Institutionalise and test

- formal structures
- crisis coordination & comms
- exercises
- post-incident learning
- cross-border response

Adapt to challenges

- new repair models
- targeted public intervention
- geopolitical risks
- climate-related risks
- changing maritime activity
- evolving regulation

The panel focused on government preparedness for subsea cable disruption and repair, examining current repair and response capabilities, future challenges and the evolving relationship between governments and industry for enhancing broader subsea cable security and resilience. The overall conclusion was that effective preparedness and resilience depend as much on relationships, trust, governance and coordination as they do on physical repair capacity and infrastructure. Strong and increasingly structured partnerships between governments, operators, maintenance providers, critical service users and international partners were identified as the foundation for effective response and long-term resilience, particularly in scenarios that extend beyond routine industry-led repair arrangements.







Main discussion points

- The Irish Department of Climate, Communications and Sport (DCCS) highlighted a significant shift in preparedness and resilience across digital infrastructure, driven by new national and European regulatory frameworks. Ireland's 2026 National Strategy on the Resilience of Critical Entities[3] implements the Critical Entities Resilience (CER) Directive, requiring designated critical entities to identify risks, develop resilience plans and prepare for threats including malicious activity, climate risks and other hazards. For digital infrastructure, including subsea cables, the NIS2 Directive and forthcoming National Cyber Security legislation will further strengthen oversight and place greater responsibility on senior management and boards for resilience and risk management.

- The EU's Digital Operational Resilience Act (DORA) complements NIS2 and CER by requiring critical sectors, particularly financial institutions, to assess operational risks and the resilience of third-party providers, thereby increasing scrutiny of dependencies on underlying digital infrastructure, including subsea cable systems. This reinforces the principle that resilience is also the responsibility of users of critical services, which may need sufficient diversity across telecommunications providers and cable systems, alongside alternative communications such as satellite services. Ireland has also participated in the EU subsea cable Expert Group process that contributed to the EU Subsea Cable Security Toolbox, while supporting international connectivity through efforts to address regulatory barriers and facilitate new routes, including the Pisces cable system linking Ireland with France, Spain and Portugal.

- DCCS emphasised closer and more structured government-industry engagement. Work is underway to establish a formal subsea infrastructure stakeholder group drawing inspiration partly on arrangements emerging in the EU and in the UK, to provide a proactive forum for government, cable developers, operators and maintenance providers to share information, identify issues earlier and improve preparedness.

- The UK Department for Science, Innovation and Technology (DSIT) described its preparedness approach as combining cross-government coordination with industry engagement.[4] Following lessons from the 2022 Shetland Islands outages, the UK established the Government Subsea Infrastructure Response Group (HMG-SERG) to coordinate information, intelligence and policy responses. Industry engagement is supported

[3] See National Strategy on the Resilience of Critical Entities, March 2026, https://www.gov.ie/en/department-of-defence/publications/national-strategy-on-the-resilience-of-critical-entities-20262029/

[4] Following the July 2026 machinery-of-government changes, responsibilities for subsea telecommunications cable policy moved to the Department for Digital, Culture, Media and Sport (DCMS). https://www.gov.uk/government/news/machinery-of-government-changes-fact-sheet

through the Subsea Communications Cables Industry Group (SCCIG), its incident response working group and the National Emergency Plan for Subsea Cables. Participants also highlighted established bodies such as the International Cable Protection Committee (ICPC) and European Subsea Cables Association (ESCA) as effective channels for government engagement with the sector.

- Recognition of subsea cables as critical infrastructure was considered important but insufficient without practical attention to repair operations, permitting and regulation. Participants contrasted Europe's relatively developed policy and coordination frameworks with Southeast Asia and the South Pacific, where resilience arrangements are generally at an earlier stage. Maritime spatial planning and repair permitting were identified as regional priorities, alongside growing cooperation involving Australia, Singapore, ASEAN and QUAD members. European experience can provide useful lessons, but approaches must reflect local geography, budgets and governance structures, particularly in archipelagic states.





On coordination

- Coordination was identified as a central challenge because subsea incidents involve numerous stakeholders, overlapping responsibilities and potentially cascading impacts across telecommunications, energy, finance and government. Participants stressed the importance of establishing mechanisms before crises occur and institutionalising preparedness rather than relying on individual relationships. Durable structures, clear points of contact and governance arrangements are particularly important given personnel turnover.

- Joint communications are a key objective of the developing Ireland–UK collaboration framework, including coordination before, during and after incidents to counter misinformation, provide reassurance and maintain public confidence. This has become increasingly important as awareness of subsea cables has grown following media attention and incidents in the Baltic region.

- While operators' approaches to public communications vary because of commercial sensitivities, participants broadly supported timely and coordinated government-industry messaging. Prompt acknowledgement that significant incidents are being investigated was viewed as particularly valuable for limiting speculation, improving public understanding and maintaining confidence during periods of uncertainty.

- Cross-government and cross-jurisdictional coordination were viewed as fundamental. Ireland's National Maritime Security Strategy[5] and UK coordination structures were cited as examples of whole-of-government approaches. Ireland and the UK are also developing closer bilateral cooperation on information sharing, crisis coordination, joint response planning and scenario-based exercises relevant to subsea cables. Participants supported designated lead departments acting as coordinating hubs for industry and highlighted the value of joint exercises. The long-established cooperation between the Commissioners of Irish Lights, Trinity House and Northern Lighthouse Board was also cited as a useful precedent for durable cross-jurisdictional arrangements.[6]

[5] National Maritime Security Strategy 2026-2030, February 2026, https://www.gov.ie/en/department-of-defence/publications/national-maritime-security-strategy-20262030/

6 EXPLAIN

- Industry participants identified information sharing and situational awareness as areas where closer government-operator collaboration could significantly improve incident response. Maintenance providers may understand faults within their contractual arrangements but lack visibility of wider national consequences, while governments may possess information about outage impacts, maritime activity or security concerns unavailable to operators. Although repairs are generally prioritised through contractual agreements, major disruptions may introduce wider public-interest considerations, making better information sharing valuable for informed prioritisation.

- Operators stressed the importance of clear and responsive government contacts, particularly when assessing cable faults or suspicious maritime activity. While governments cannot always disclose sensitive intelligence and operators must protect commercial information, participants supported mechanisms for timely exchange of operationally relevant information. A layered model was suggested, combining confidential sharing between relevant parties with broader dissemination of lessons through workshops, industry groups and sector-wide forums.

- Iceland was highlighted as an example of preparedness tailored to national circumstances. With only three international subsea cables, Iceland has considered severe scenarios in which all three become unavailable simultaneously. Satellite communications could support a limited range of critical government, emergency and financial services, although not replace full cable capacity. More broadly, participants stressed that resilience and redundancy are responsibilities not only of cable operators but also of organisations dependent on subsea connectivity, which should plan for continuity through alternative communications channels.

On post-incident assessment and adaptation

- Participants emphasised post-incident analysis and lessons learned as important mechanisms for improving resilience. The ICPC provides industry information on faults, repairs and trends, while operators and repair providers conduct detailed incident reviews. Government approaches are also becoming more structured and may be further improved through NIS2 incident-reporting requirements and the use of lessons from previous incidents to refine crisis procedures and exercises. Greater joint government-industry review could strengthen preparedness while avoiding duplication of established industry reporting.

On market structures and public intervention

- The discussion considered how market structures, investment and ownership affect resilience, including the growing role of hyperscalers. While the latter remain important investors, market-led investment may not deliver every strategically important route or capability, potentially creating a role for targeted public support. Resilience therefore depends on the interaction of ownership, investment, route diversity and public policy rather than hyperscaler involvement alone.

- European initiatives discussed included Connecting Europe Facility funding and measures arising from the EU Cable Security Toolbox, including support for cable deployment, distributed acoustic sensing, vessels of opportunity and modular repair capabilities. Views differed on government intervention: some participants cautioned against disrupting established commercial structures, while others saw targeted experimentation as a means of addressing market gaps and stimulating innovation. The longer-term impact will depend on implementation.



On broader resilience issues

- Specialist workforce capability was identified as an important component of preparedness. Physical assets such as repair vessels are insufficient without the technical expertise needed to understand, protect and support cable repairs. Participants considered reserve units and industry secondments as possible ways of building surge capacity. They also discussed the viability of deploying military personnel on commercial vessels across jurisdictions, concluding that the latter would be challenging since it would interfere with their defence and national security remits, and that the practicalities of such a role would not be realistic.

- Workforce mobility and permitting were also identified as challenges, particularly for near-shore repairs requiring specialist multinational teams. Participants questioned whether streamlined procedures or exemptions could facilitate rapid cross-border deployment of personnel involved in critical infrastructure repairs.

- Climate adaptation is emerging as a resilience consideration for national preparedness. In Ireland, attention has focused on coastal erosion around landing stations and near-shore infrastructure, with updated datasets being developed to inform routing, landing-site selection and engineering decisions. The ICPC is also examining how climate change may alter fish stocks and fishing activity, which remain major causes of cable faults. Shifting fishing grounds could expose cables previously considered adequately protected or buried, requiring changing environmental conditions to be incorporated into long-term vulnerability assessments.

- Participants highlighted societal preparedness and responsible public communication as components of broader resilience. Although existing initiatives encourage practical preparation for disruptions, subsea cable communications should be proportionate and carefully managed to avoid unnecessary alarm, with emphasis on accurate, timely and coordinated messaging rather than cable-specific public preparedness measures.

Panel 2: Public private collaboration for repair

Strengthen industry-led maintenance model

- effectiveness of established arrangements
- repair coordination and capacity sharing
- prepare for constrained repair capacity scenarios

Reduce barriers to rapid repair

- permitting and licensing
- customs and immigration
- understanding repair requirements
- timely deployment of vessels and crew

Institutionalise public-private coordination

- trusted relations
- clear roles and PoCs
- info sharing
- crisis coordination

Strengthen work-force and surge capacity

- recruitment and retention
- training and apprentices
- specialist *competences*
- multi-skilling
- flexible workforce models

Address longer-term capacity and investment needs

- ageing repair fleet
- replacement investment
- limited surge capacity
- targeted public investment
- evolving hyperscaler role

The panel examined how public–private collaboration can strengthen the resilience of the subsea cable repair ecosystem. The overall conclusion was that established industry-led maintenance and repair arrangements function effectively under normal and even stressed conditions, and that public-private collaboration can complement these arrangements, particularly in preparing for more stressed scenarios. Priorities include reducing regulatory and operational barriers to rapid repair, strengthening coordination and preparedness for more severe disruption scenarios, and addressing longer-term challenges around workforce skills, repair capacity and structural challenges such as ageing assets and investment affecting the repair ecosystem.



Main discussion points

- Collaboration between the public and private sectors in subsea cable repair is becoming more visible and important, even though repair operations themselves remain largely industry-led. Governments have historically played a role in supporting cable infrastructure investment and connectivity development, but in most regions, direct involvement in fibre optic cable maintenance and repair has been relatively limited. As subsea cables are increasingly recognised as critical infrastructure, governments are taking a more active interest in understanding and supporting repair arrangements, particularly where disruptions could have wider economic or societal consequences.

- Industry representatives stressed that the existing repair ecosystem is a mature and largely effective commercial system that has managed cable faults for decades through cooperation between cable owners, maintenance authorities, repair contractors and vessel operators. They emphasised that public-sector involvement should complement rather than disrupt these established arrangements. Industry associations were identified as a practical route to that outcome. For example, ESCA and the ICPC already provide standing mechanisms for engagement with regulators and seabed managers and involving them early in the design of any public intervention was seen as a reliable way to avoid unintended market effects.

- Participants cautioned that poorly designed subsidies or government-led structures could unintentionally distort a decently functioning market. Workforce development was highlighted as one area where partnerships between industry and government can deliver tangible benefits, particularly through training, apprenticeships and initiatives to address emerging skills shortages within the sector.

- From the perspective of repair vessel operators, government collaboration is often most relevant at the operational and regulatory interface rather than in decisions over repair itself. As noted in the previous panel, repair priorities remain driven by contractual arrangements between customers and maintenance providers, but governments can significantly influence response times through permitting, licensing, customs and immigration processes, as well as by helping industry navigate sanctions regimes and cross-border approvals. Even minor administrative requirements or delays in obtaining approvals can slow repair operations, particularly when faults occur during weekends, holidays or outside normal working hours. Examples were cited where routine procedures created unnecessary delays despite broad agreement that repairs should proceed, as well as instances where government assistance helped resolve issues outside normal commercial arrangements.





- Participants also emphasised that subsea infrastructure resilience cannot be achieved through isolated government action or by individual government departments acting independently. Effective preparedness requires a whole-of-government approach bringing together defence, security, communications, infrastructure and regulatory stakeholders, alongside industry, which owns and operates most critical maritime infrastructure. National maritime security frameworks, including the one recently launched in Ireland, were presented as a means of moving beyond fragmented approaches by establishing common objectives, coordination mechanisms and shared responsibilities. More broadly, this reflects a shift from ad hoc relationships towards more structured public-private arrangements capable of providing continuity, shared understanding and preparedness over time.

On whether current maintenance arrangements are fit for purpose

- The panel reinforced the view that the existing industry-led repair model remains largely effective, but that targeted improvements could strengthen the ability of governments and industry to respond when conditions move beyond business as usual. Recent incidents in West Africa and the Red Sea were cited as examples where maintenance authorities, cable owners, repair operators and governments worked together to manage disruptions, share assets and coordinate responses, while striving to maintain continuity of service for users. These examples demonstrated the resilience of existing arrangements during multiple simultaneous faults and complex geopolitical conditions.

- At the same time, speakers stressed that resilience depends not only on technical repair capability, but also on effective coordination across governments, agencies and industries. Regulatory changes, permitting requirements and administrative processes can create unintended barriers to repair operations, particularly where responsibilities are fragmented or implementation does not fully reflect operational realities. Examples of ambiguity in legislation, licensing requirements or approval procedures, which can cause delays, reinforced the importance of translating policy objectives into clear operational arrangements.



- Coordination also extends beyond government and the cable sector. Subsea cables share an increasingly congested maritime space with a growing number of other seabed users, including offshore energy and other infrastructure making maritime spatial planning and visibility of future activity important to anticipating potential friction or conflicts. Participants also stressed that resilience planning must encompass the coastal and terrestrial assets that support cable repair operations, and not just offshore assets at sea.

- A recurring theme of the session was the value of information sharing and trusted relationships. Participants highlighted coordination as a recognised risk area within ongoing EU work on subsea cable resilience and emphasised the importance of clearly identified government points of contact that are available when incidents occur. During emergency repairs, operators, governments and security agencies may each hold only part of the overall picture. Trusted networks, regular engagement and established communication channels can therefore improve situational awareness and allow issues to be resolved quickly. Norway's experience was cited as an example where strong relationships between government, military and industry have improved situational awareness and mutual understanding without relying solely on formal processes.

- While the existing repair model was generally considered effective, participants recognised that more severe scenarios could place it under greater strain. In the short- to medium-term, governments might support the existing system through improved regulatory and administrative processes, stronger inter-governmental coordination, workforce development, joint exercises and stress-testing. There was also discussion of potential support for addressing structural challenges such as ageing repair vessels, limited surge capacity and difficulties financing replacement assets. Targeted measures, such as underwriting demand or supporting contingency capabilities, could strengthen resilience without fundamentally altering market structures.

- A longer-term question concerns the potential tension between commercial repair priorities and national resilience objectives. Repair priorities are largely determined through established commercial arrangements, but participants identified an unresolved question as to whether, and under what circumstances, governments might require powers to intervene where available repair capacity is insufficient to meet critical national requirements.

On hyperscalers and the evolution of maintenance arrangements

- The discussion considered whether the growing influence of hyperscalers could fundamentally alter existing marine maintenance arrangements. Given the scale and redundancy of their global networks, participants questioned whether hyperscalers might eventually adopt a different approach to cable repairs, for example, accepting longer restoration times, consolidating repairs into fewer vessel deployments, or placing greater emphasis on cost efficiency. Such changes could affect the economics of maintenance agreements and potentially increase the need for public intervention or public-private partnerships to preserve repair capability.

- Industry representatives acknowledged that such outcomes are possible but emphasised that the direction of maintenance models remains uncertain. While repair numbers may be declining in some regions and increasing in others, the capacity carried by the new generation of systems is increasing significantly, raising the operational and commercial consequences of a major cable outage. Rapid repair capability is therefore likely to remain important, even as maintenance models evolve.

- Participants also highlighted a tension between the global perspective of hyperscalers and the regional structure of existing maintenance zones and agreements. Hyperscalers increasingly assess maintenance requirements through their global network architectures and business priorities, while operators and maintenance providers must ensure that regional repair ecosystems remain commercially viable. Participants described the current maintenance ecosystem as effective but relatively delicate, requiring a balance between the interests of hyperscalers, traditional operators and maintenance providers.

- For now, there is little evidence of a fundamental change in operational practice. Hyperscalers continue to seek rapid restoration following outages, and suppliers reported no significant change in contractual requirements. At the same time, some hyperscalers are actively exploring more bespoke maintenance approaches focused on specific cable types, water depths or geographic regions, potentially involving different vessel configurations and repair solutions. None has yet emerged as a dominant model, but participants viewed the willingness to test established assumptions as a potentially positive source of innovation.



On workforce resilience

- Workforce capability emerged as another important challenge that can be addressed, in part, through closer public-private collaboration. Cable ship crews are typically composed of a mix of permanent employees, contractors and agency personnel from multiple nationalities, drawing on an already limited pool of suitably qualified people. Operators reported difficulties finding experienced personnel when required, alongside broader concerns about retention and the dilution of experience as individuals move between employers, roles and adjacent maritime sectors.

- Training and apprenticeships were widely regarded as part of the solution. Participants discussed the value of state-supported training schemes, apprenticeship programmes, university partnerships and industry outreach as ways to expand the pool of existing personnel. However, training alone does not guarantee long-term capacity: newly trained personnel often move to wherever demand and remuneration are highest. Participants therefore stressed both the value of expanding the overall industry talent pool and the need for clearer career pathways that help potential recruits move from initial interest into employment.

- Maintaining competence was considered as important as initial training. Marine maintenance skills require regular operational exposure across a range of vessel activities, with personnel often developing through construction and installation work before progressing into maintenance roles. This reflects the specialised nature of the skillsets required and reinforces the importance of maintaining a broad and active operational ecosystem to sustain workforce competence. The challenge is therefore not simply creating capacity but ensuring that skills remain current through ongoing participation, exercises and engagement with industry.

- Participants suggested looking beyond traditional recruitment pools and supported greater multi-skilling across telecommunications, power cables, offshore energy, marine construction and other maritime disciplines. Such an approach would allow personnel to move between sectors as demand fluctuates, while creating a larger pool of workers with relevant skills available to support critical infrastructure. For instance, former submariners have been recruited into subsea cable operations and successfully transitioned into roles such as jointers, ROV pilots and engineering specialists. Their technical backgrounds and experience operating in multidisciplinary environments made them particularly valuable recruits.

- The same principle of flexibility was extended to vessels. As fleets are renewed, participants suggested there may be opportunities to design more adaptable vessels capable of supporting activities across telecommunications and power cable sectors. Greater collaboration and planning across industries could improve the utilisation of both workforce and vessel capacity, reducing the risks associated with operating in isolated sectoral silos.

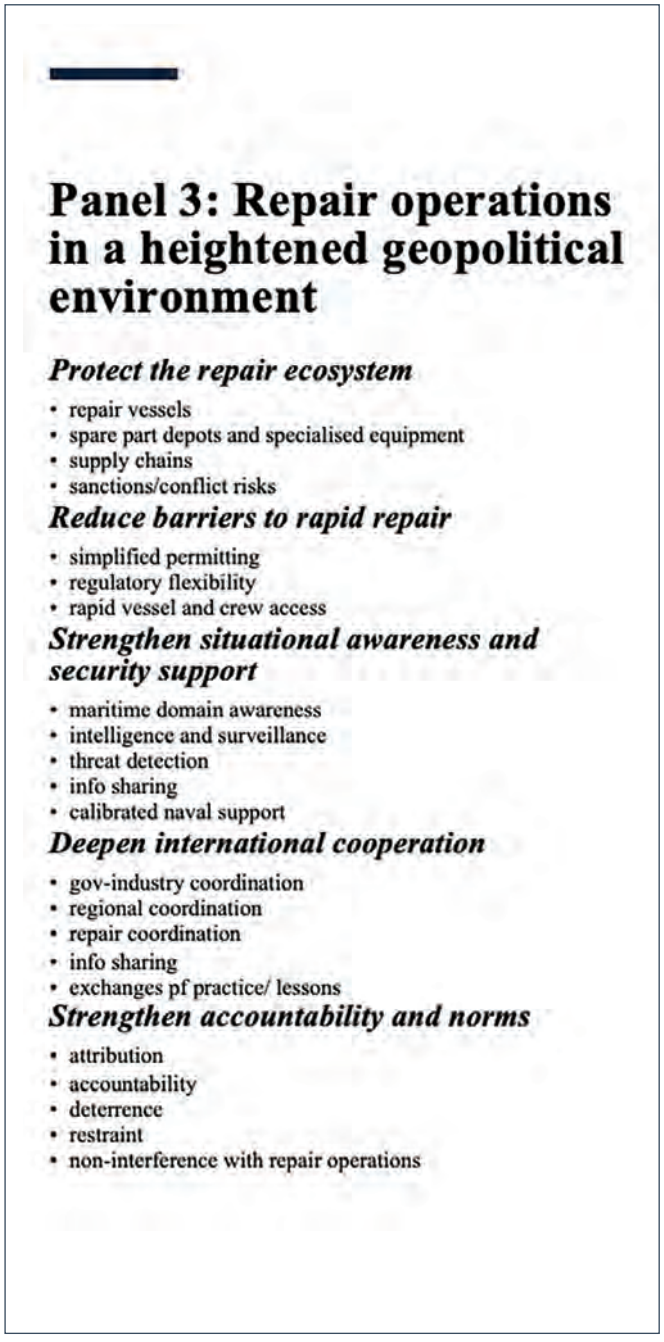
- Industry representatives highlighted ongoing efforts to address workforce shortages through apprenticeships, graduate programmes, university partnerships and outreach activities. While organisations recognised that not all trainees would remain with their original employer, there was broad agreement that growing the overall pool of skilled personnel benefits the wider industry. Several participants emphasised the importance of fostering long-term interest and enthusiasm for the sector, even if individuals ultimately move between employers, suppliers and operators. Attracting new talent is only part of the challenge. Industry outreach initiatives are increasingly succeeding in generating interest among students and early-career professionals, but participants identified a gap between raising awareness of the sector and helping potential recruits navigate available employment opportunities. Improving the visibility of career pathways and making job

opportunities easier to find was highlighted as an important complement to ongoing efforts to address the sector's skills shortage.

- Participants also explored whether apprenticeship-style or reserve models could strengthen access to specialist skills. Potential precedents included reserve-force structures such as the US Air National Guard, historical reserved occupations within the Merchant Navy and state-sponsored technical training programmes such as Ireland's former Defence Forces Apprentice School. Vodafone's apprenticeship model was also cited as an example of how government can help define training requirements, accredit providers and oversee delivery while industry provides practical employment and experience. Participants considered whether similar apprenticeship arrangements could potentially incorporate elements of reserve service or partnerships with defence organisations, particularly in engineering and technical disciplines. However, participants also identified significant practical constraints. Maintaining specialist competence requires continuing operational experience, while military and government personnel often rotate through roles in ways that can make deep technical expertise difficult to retain. Commercial cable fleets are also highly international: deploying serving military personnel, security teams or military equipment aboard commercial vessels can complicate access to certain jurisdictions, crew movements and regulatory compliance, and could interfere with the security and defence priorities of these military service members. These considerations would need to be addressed in any reserve-style model.

- Overall, apprenticeship-based and possible reserve approaches were viewed as potentially useful components of workforce resilience, but not simple substitutes for a strong commercial skills base. Any model would need to account for the specialised, international and operationally intensive nature of cable repair, while supporting a sufficiently broad and active workforce to sustain competence over time.





Panel 3: Repair operations in a heightened geopolitical environment

Protect the repair ecosystem

- repair vessels
- spare part depots and specialised equipment
- supply chains
- sanctions/conflict risks

Reduce barriers to rapid repair

- simplified permitting
- regulatory flexibility
- rapid vessel and crew access

Strengthen situational awareness and security support

- maritime domain awareness
- intelligence and surveillance
- threat detection
- info sharing
- calibrated naval support

Deepen international cooperation

- gov-industry coordination
- regional coordination
- repair coordination
- info sharing
- exchanges pf practice/ lessons

Strengthen accountability and norms

- attribution
- accountability
- deterrence
- restraint
- non-interference with repair operations

The panel examined how a more contested and uncertain geopolitical environment is affecting subsea cable repair, including through conflict, sanctions, regulatory restrictions, supply chain disruption and the potential for deliberate interference with repair operations. The overall conclusion was that while repair should remain fundamentally industry-led, geopolitical risks are increasing the importance of government and security support in reducing barriers to repair, strengthening situational awareness and protecting repair capability. Closer international cooperation, information sharing and stronger normative expectations against interference with repair capabilities and operations were identified as important to ensuring that repairs can continue safely and effectively in increasingly complex operating environments.

Main discussion points

- The discussion highlighted how geopolitical developments are increasingly affecting not only subsea cable security but also the ability to conduct repairs. Speakers identified a range of risks, including armed conflict, sanctions, permitting restrictions, supply chain disruptions, insurance constraints and declining trust between states, all of which can delay or complicate repair operations.

- Industry representatives noted that operating in conflict zones presents significant practical challenges, including crew safety, insurance requirements, security arrangements and legal compliance. Even outside active conflict areas, sanctions regimes and growing regulatory barriers can restrict access to repair locations or delay repairs. Many cable repair vessels can mobilise rapidly, but this responsiveness can be undermined by lengthy permitting processes, cabotage requirements and other regulatory and administrative obstacles. In some jurisdictions, tensions were identified between recognising cables as strategic infrastructure and maintaining regulatory frameworks that inadvertently delay repairs.

- The wider geopolitical context has become more volatile, complex and uncertain. Ongoing conflicts, strategic competition between states, reduced trust in international relations and pressures on multilateral institutions are creating new challenges for infrastructure resilience. These developments can affect freedom of navigation, increase insurance and operating costs, disrupt supply chains and make international cooperation on standards, permitting and incident response more difficult. Particular concern was expressed about the growth of shadow fleets, the impact of sanctions regimes and the increasing scrutiny applied to foreign-owned infrastructure and service providers. Participants also identified the potential for more deliberate forms of interference with repair capability, including through surveillance, satellite navigation disruption, cyber and electronic warfare, and sabotage of or interference with repair assets or equipment.

- Lessons-learned reviews following cable repairs provide evidence of how permitting delays and regulatory barriers affect repair timelines and costs. While responsibility for pursuing regulatory improvements generally rests with cable owners and maintenance agreement participants, repair providers can support these efforts by sharing operational experience and identifying shortcomings in existing frameworks.

- For industry representatives, governments should focus on reducing practical barriers to repair operations rather than attempting to redesign the existing repair ecosystem. Emphasis was placed on simplifying permitting processes, reducing unnecessary administrative burdens and facilitating rapid access for repair vessels and personnel. Greater regulatory flexibility for emergency repairs was seen as a realistic and achievable objective that would benefit operators, cable owners, governments and consumers alike.

On international coordination, attribution and engagement

- Preparedness and maritime security were framed as increasingly international issues requiring strong engagement with partners at bilateral, regional and multilateral levels. Priorities for Ireland, for instance, include supporting cooperation across government, advancing initiatives through the EU, strengthening relationships with key partners such as the UK and other Atlantic states, and engaging with international organisations including the UN and NATO. Closer coordination was seen as a means of avoiding duplication, strengthening collective resilience and ensuring that efforts are focused on protecting shared infrastructure.



- The discussion emphasised attribution as an important component of subsea infrastructure protection and of deterrence. Participants argued that governments, industry and security organisations should work together to improve the ability to identify and attribute malicious activity through technology, intelligence and information sharing. Successful attribution would also need to be accompanied by appropriate legal mechanisms, policy tools and political will, all of which are necessary to hold actors accountable. While recognising the practical difficulties involved, credible attribution and accountability were seen as important to increasing the costs and risks associated with hostile activity.

- Participants highlighted the important role that industry organisations such as the ICPC, ESCA and NASCA already play as bodies through which technical expertise, fault data and operational experience are aggregated across the sector, in promoting best practice and facilitating dialogue between industry and governments. Engagement by government representatives in these forums was seen as a valuable way to understand operational realities and identify effective approaches to issues such as permitting, regulation and cable protection.

- In response to a question about government–industry cooperation in China, the discussion highlighted significant differences in decision-making culture and regulatory processes compared with Europe and the United States. Some regulatory challenges in the region, particularly in relation to permitting, may be driven as much by uncertainty and caution as by strategic intent. While acknowledging that perceptions of China vary internationally, the view expressed was that China has a strong interest in maintaining and protecting subsea cable infrastructure given its own dependence on international connectivity. Overall, the discussion suggested that while China's approach is shaped by different institutional and cultural dynamics, there remains a willingness to engage internationally and participate in efforts to improve the resilience of subsea telecommunications cables.

On the role of navies in safeguarding repair operations

- The panel examined the evolving role of navies in supporting subsea cable repair operations in an increasingly contested and uncertain maritime environment. Participants agreed that the primary military contribution is likely to be in maritime domain awareness, information sharing, surveillance and deterrence, rather than direct involvement in repair activities. The protection of critical underwater infrastructure has become a strategic priority, requiring clear roles, protocols and communication channels to be established between governments, operators, repair providers and security organisations before incidents occur.

- NATO representatives similarly emphasised the value of maritime domain awareness and intelligence sharing. While most navies have limited resources and may not be able to routinely escort repair vessels, military organisations can support repair operations by monitoring activity around critical infrastructure, identifying suspicious behaviour and providing operators with timely information. A visible naval presence may also contribute to deterrence by demonstrating that activities around critical infrastructure are being monitored. Examples were also highlighted where security forces have supported infrastructure operations through measures such as enforcing exclusion zones and providing protection when requested by civilian authorities.

- Industry participants generally welcomed the availability of naval support in higher-risk environments, particularly where piracy, conflict or security threats are present. However, they noted that the existing cable repair system is largely commercial in nature and has historically operated effectively without routine military involvement. Military support is not typically required for standard repair operations, and some participants cautioned that overt military involvement in certain circumstances could potentially increase tensions rather than reduce them.

- The discussion also identified a potential information gap between security assessments conducted by governments and the operational realities of cable repair. Repair operators may sometimes have indications of the likely cause of a cable fault but would not normally know whether an incident is being assessed by governments as potential sabotage or grey-zone activity unless that information was explicitly shared. This reinforced the importance of mechanisms for sharing operationally relevant security information where it may affect the safety or conduct of repair operations.

On an emerging norm of non-interference with repair operations

- Panellists considered whether subsea cable repair operations should be recognised as a neutral or humanitarian function under international law and therefore protected from interference during crises or conflicts. While the panel broadly supported the objective of ensuring that repairs can proceed safely and without obstruction, there was significant scepticism about the practicality of establishing or enforcing such a norm in the current geopolitical environment. Already, existing navigational warnings around repair operations are frequently ignored. Furthermore, if a hostile actor were to deliberately target a cable, the repair vessel or operation itself could subsequently become a target.

- Panellists noted that for a range of reasons it would be difficult to classify cable repairs as purely humanitarian or neutral activities. They also questioned whether hostile actors would respect any designated status for repair operations, particularly if they do not adhere to broader international norms or legal frameworks.



- From a diplomatic perspective, participants noted that the language used in international discussions can help shape norms and expectations of State behaviour regarding subsea cable protection. While agreement on classifying subsea cables as “humanitarian” or “neutral” infrastructure may be difficult, there was support for promoting greater international recognition of their importance to societies, economies and essential services. While recognising the political and practical challenges involved, the aim would be to build on existing efforts and strengthen norms that discourage interference with cable infrastructure and repair operations

- Industry representatives supported the idea of a norm of non-interference with cable repair operations, arguing that restoring damaged cables serves the public interest in much the same way as repairing power networks, transport infrastructure or other essential services. Furthermore, while widespread acceptance of a formal norm may be difficult to achieve, strengthening international expectations against State or State-backed interference with repair operations, and supporting the rapid restoration of critical connectivity should remain desirable objectives.

- More broadly, participants emphasised that the subsea cable industry has a long history of effective international cooperation in cable deployment and maintenance, built on shared technical objectives and common operational interests that transcend national boundaries. While geopolitical tensions present growing challenges, preserving this tradition of cooperation was seen as a priority.



The panel examined how growth in subsea cable infrastructure, an ageing vessel fleet, changing ownership patterns, and increasing government interest are placing pressure on the existing repair and maintenance ecosystem. The overall conclusion was that established commercial models have served the industry well but will need to evolve to support timely investment in vessels, skills and repair capacity while preserving the flexibility and efficiency of an industry-led system. More adaptable financing and contracting models, closer government-industry collaboration, improved data sharing and sustained investment in training and workforce development were identified as important to ensuring that repair capacity remains commercially viable, operationally effective and resilient as demand continues to grow.



Main discussion points

- The panel examined how structural shifts in the subsea cable market are reshaping the repair and maintenance sector. Drawing on a recently published maintenance study, participants framed the sector as being at an inflection point: bandwidth demand is driving a large volume of new, high-capacity cable deployments at the same time as a significant share of the legacy maintenance fleet approaches retirement. The result is a forecast 48% net increase in cable kilometres by 2040, which is expected to increase the overall volume of faults requiring repair even if underlying fault rates remain stable or continue to decline. This raised questions about whether the existing maintenance fleet will be able to maintain current service levels as the installed cable base continues to grow.

- A dominant theme of the discussion was vessel investment and fleet ageing. By 2040, a large proportion of maintenance vessels will be near the end of their 40-year service life, yet investment in replacements has been sporadic. Speakers attributed this to the sector's difficult economics, including thin repair margins, market uncertainty and the high cost of maintaining vessels that may spend significant periods idle between repairs. This contrasts sharply with the substantial capital flowing into new cable infrastructure itself. The prevailing reliance on used or converted vessels was presented as both a symptom of these underlying economics and a potential risk to the long-term sustainability of the repair ecosystem.

- Participants noted that the investment challenge is not simply one of identifying a future need for vessels, but of creating sufficient commercial certainty to make new vessel construction bankable. New vessels require significant upfront capital and long lead times, while future repair demand and revenue can be difficult to predict with sufficient certainty to support investment decisions. This creates a structural tension between the need to maintain sufficient repair capacity for resilience purposes and a commercial model in which vessels must remain economically viable over long operating lives.

On commercial models and financing future repair capacity

- Against this background, the discussion turned to how existing commercial arrangements might adapt. Participants explored how the traditional consortium or "club" model and private maintenance agreements allocate risk differently and questioned whether existing approaches will remain sufficient for the coming period of market growth and fleet renewal. Alternative structures discussed included hybrid commercial models combining features of both approaches and collaborative tender processes that place greater emphasis on service quality and long-term capability rather than price alone. Greater flexibility in maintenance arrangements was seen as one potential means of providing operators with the commercial certainty needed to sustain and renew repair capacity.

- Financing models were considered separately as an important part of this challenge. Participants discussed co-investment vehicles using special purpose vehicles and long-term charters to make vessel financing more bankable, alongside public-private partnerships, blended finance, development bank participation (e.g., the World Bank), venture capital and other forms of capex support. Participants noted that different contractual approaches may be required for emergency and non-emergency repairs, and that longer-term commitments could help address the mismatch between the substantial capital required for new vessels and the uncertain or intermittent revenues associated with repair activity.

On changing ownership and government involvement

- Market power and ownership transition also featured prominently in the discussions. As legacy telecom-owned systems are decommissioned, voting power within consortia is expected to shift toward the largest investors, increasingly the content providers or hyperscalers. Speakers noted genuine uncertainty over how these players may use their growing influence within maintenance arrangements, including whether they might seek greater control over vessel supply or operations, or commission bespoke maintenance solutions tailored to their own networks. Such developments could materially alter the balance between existing agreements and create new pressures on maintenance providers and traditional operators.

- At the same time, participants noted that greater hyperscaler involvement does not necessarily imply a move away from established maintenance arrangements. The direction of travel remains uncertain, and future models may involve a combination of existing regional maintenance structures and more bespoke solutions. The discussion therefore focused less on predicting a single future model than on the need for the repair ecosystem to remain sufficiently flexible to accommodate changing ownership patterns, customer requirements and approaches to risk allocation.

- Government and regulatory interest in the repair ecosystem are also evolving. Participants observed that scrutiny is broadening from cable installation and ownership to the resilience and security of maintenance and repair capacity itself. Concrete examples included a recent U.S. requirement to verify the depth of burial of U.S. cables, the potential risk of cabotage-style restrictions on foreign-flagged vessels, and growing expectations around cyber security for the repair fleet. Some governments are actively exploring sovereign repair capabilities to reduce reliance on foreign operators, a move that could supplement the market but also disrupt established structures.

- As with previous sessions, the panel focused heavily on workforce resilience, specifically on human capacity and skills**.** A recurring message was that governments should invest in people and talent, not vessels alone. Participants pointed once again to a constrained pool of experienced engineers, ROV operators and marine crews, diluted experience across the market, and persistent retention challenges. Apprenticeships and training pathways (including SubOptic- and operator-led schemes) were highlighted as practical responses, alongside a need for greater movement of skilled personnel between telecoms, power and energy marine work.

- Speakers underlined that the operational realities of repair remain stubbornly unchanged. There is still essentially one methodology for repairing a cable, and the post-splice sequence (splice, wrap, mould and final test) is the principal reason repairs remain time-consuming. Complexity increases with multiple fibre pairs and combined power-and-fibre systems. Power cables, in particular, take longer to repair and have much larger bend radii. Crew requirements also vary significantly by function (illustratively, at around 45 on a maintenance vessel, 65 on an installation vessel and 70 on a power-cable vessel). Anecdotes, including one system discovered some 50 km from its intended route, reinforced the importance of accurate data and trusted operators.

- The session concluded that the maintenance and repair sector is in a period of genuine structural transition, driven by cable growth, an ageing fleet, shifting ownership toward content providers, and intensifying government interest. Existing commercial models have served the industry well but may need to become more flexible, transparent and collaborative, potentially through hybrid agreements, joint tenders, co-investment and public-private partnerships so as to unlock timely investment in new vessels. Resilience also depends as much on people as on capabilities, making sustained investment in skills and training essential. Continued government-industry engagement, better data sharing, and adaptable financing structures will be critical to maintaining commercial viability while safeguarding the long-term resilience and repairability of critical subsea cable infrastructure.

Panel 5: Marine Spatial Planning & Cable Repair

Plan for resilience & security

- strategic cable routes
- landing site protections
- spatial diversity
- avoid concentration risk
- redundancy

Manage competition for seabed space

- pipelines & power cables
- offshore renewables
- shipping & ports
- coastal infrastructure
- congested nearshore environments

Design for repairability

- sufficient corridoors
- operational space
- repair access
- flexible permitting
- burial implications
- repair time & cost

Plan for the full life-cycle & future risks

- installation and decommissioning
- maintenance & repair
- legacy infrastructure
- climate-related risks
- technology as an enabler

Invest in people & technical capability

- engineers/jointers /ROV operators/ other specialised functions
- training and apprenticeships
- new skills pathways
- adapting to new cable complexities
- repair/testing limits

Strengthen coordination across sectors & borders

- regulators & planners
- subsea cable industry
- other seabed users
- operational understanding
- tronsboundary coordination
- regulatory alignment

The panel examined how increasing competition for seabed space is affecting the deployment, maintenance and repair of subsea cables, particularly in congested nearshore areas and where cables must coexist with offshore energy, shipping and other maritime infrastructure. The overall conclusion was that marine spatial planning should incorporate repairability and resilience from the outset, preserving not only cable routes and landing sites but also the space, access rights and regulatory flexibility needed for future maintenance and emergency repairs. More strategic and lifecycle-based planning, closer coordination between regulators and industry, improved cross-border cooperation and greater consideration of emerging climate and technology challenges were identified as important to ensuring that increasingly congested seabed space can support the long-term resilience, maintainability and repairability of subsea cable infrastructure.

Main discussion points

- Increasing competition for seabed space is affecting subsea cable deployment, maintenance and repair. Participants emphasised that marine spatial planning is not simply a technical or environmental issue, but increasingly a critical resilience and security concern. Well-planned cable routes, landing sites and repair access corridors can reduce fault risks and improve the ability to restore connectivity following incidents in a timely manner. These considerations are reflected in long-established ICPC Recommendations and ESCA Guidelines,[7] which emphasise route protection, separation distances and repairability as key components of cable system resilience.

- Regulators highlighted the growing challenge of managing competing demands within increasingly congested maritime areas. In Ireland, much new development activity is concentrated close to shore, where cables must compete for space with port expansion, coastal protection projects, tourism infrastructure and offshore renewable energy developments. Landing sites were identified as a particular pressure point, as multiple sectors increasingly seek access to the same nearshore areas. Representatives from the UK similarly described growing congestion on the continental shelf and outlined efforts to move away from project-by-project seabed management towards a more strategic, long-term planning approach. Initiatives such as the Crown Estate's Marine Delivery Routemap[8] aim to identify suitable areas for future telecommunications infrastructure, safeguard access routes to the coastline and maintain spatial diversity so that cables do not become concentrated in a limited number of corridors. This is intended to strengthen resilience and repairability by reducing the risk that a single incident could affect multiple systems and by preserving options for future cable development.

- Climate considerations are not yet fully integrated into current planning models but are increasingly recognised as an important area for future work. Reference was made to research examining the potential impacts of climate change on subsea cable infrastructure, particularly at landfalls and coastal areas vulnerable to erosion, sea-level rise and other climate-related hazards. These risks could have implications not only for the location and design of future infrastructure but also for the long-term viability of existing landing points. Future iterations of planning frameworks are expected to explore how climate risk can be incorporated into seabed suitability assessments and longer-term infrastructure planning.

- The discussion also highlighted the challenges of operating in highly congested maritime environments such as Singapore, where subsea cables must coexist with shipping lanes, anchorages, pipelines, power cables, military training areas, land reclamation projects and major port operations. In such environments, cable routing is often driven as much by competing uses of the seabed as by engineering preferences, requiring complex route design, deep burial and specialised installation techniques. While permitting may be relatively efficient, extensive notification requirements and coordination with multiple stakeholders can still create delays and operational constraints. Repairs can be particularly challenging, often requiring specialised dynamically positioned vessels, support craft and additional safety measures because conventional anchoring techniques may not be feasible. The Singapore example illustrated how seabed congestion can affect the entire cable lifecycle, from route selection and installation through to maintenance and emergency repair.

[7] For ICPC Recommendations, see https://iscpc.org/publications/recommendations/; for ESCA Guidelines, see: https://www.escaeu.org/guidelines/

[8] See: https://www.thecrownestate.co.uk/our-business/marine/Marine-Delivery-Routemap

On planning for repairability, and the role of technology

- A central theme throughout the session was the importance of incorporating repair considerations into marine planning from the outset. Participants argued that effective repair capability depends on a broader "repair ecosystem" encompassing seabed space, permitting arrangements, lease conditions, access rights and sufficient operational flexibility. UK Crown Estate representatives described ongoing work to refine leasing arrangements and planning frameworks to ensure that maintenance and repair activities, including emergency interventions, can be undertaken without unnecessary restrictions. Ireland's maritime planning regime similarly seeks to account for maintenance and emergency repairs within initial approvals, reducing the need for additional authorisations when repairs are required. Representatives from Ireland's Maritime Area Regulatory Authority (MARA) emphasised that this extends beyond simply identifying or protecting cable routes: sufficient corridor widths and operational space must also be preserved to enable future repair operations, recognising that vessels, equipment and cable recovery activities often require access well beyond the immediate cable footprint. This approach depends in part on developers identifying credible repair scenarios during the planning stage so that operational requirements can be understood and reflected in consent and leasing decisions.

- Industry representatives stressed that planning decisions made during installation can have significant long-term consequences for maintenance and repair. Measures intended to reduce immediate risks, such as routing cables through constrained corridors or requiring deep burial, can make future repairs more difficult, costly and time-consuming. Spatial constraints may require operators to relocate repaired cable sections away from existing infrastructure, increasing the amount of spare cable required, extending repair durations and adding significant costs. Several speakers cautioned that if sufficient space is not reserved around cable routes, future repairs may become operationally challenging and, in some circumstances, potentially impracticable. This reinforces the need to assess route protection and repairability together rather than treating them as separate objectives.

- Technology offers some potential to mitigate these constraints, although participants cautioned that it does not remove the need to preserve sufficient space and operational flexibility for repairs. ROVs, AUVs, specialised recovery tools and advanced fault-detection systems provide additional options for working in congested or otherwise difficult environments, but many of the fundamental repair processes remain unchanged. These technologies can also be more expensive, weather-sensitive and operationally complex than traditional repair methods. Participants noted that greater automation, including robotic fibre splicing, may offer future efficiencies and reduce some operational constraints. At the same time, emerging cable technologies may introduce additional complexity; multi-core fibre, for example, could create new technical challenges for fault identification, splicing and repair. Technological innovation was therefore seen as an important part of the solution, but not a substitute for effective spatial planning and access.

On planning across the infrastructure lifecycle

- The discussion also addressed the full lifecycle of subsea infrastructure. Participants highlighted growing challenges associated with decommissioning legacy assets, particularly in congested areas where infrastructure such as horizontal directional drilling (HDD) ducts may be considerably more difficult and expensive to remove than to install. Decisions taken at the planning and installation stages can therefore create obligations and constraints decades later. This reinforced the importance of considering installation, operation, maintenance, repair and eventual decommissioning within a single lifecycle planning framework, rather than treating each stage independently. Greater consideration of decommissioning requirements at the outset could also help avoid creating additional seabed congestion and constraints for future infrastructure.

- International coordination emerged as another important theme. Both MARA and the Crown Estate recognised the value of closer cooperation across jurisdictions, particularly for transboundary cable systems that require permits, environmental assessments and regulatory approvals from multiple authorities. Differences in regulatory processes, timelines and requirements can complicate both deployment and subsequent maintenance or repair. While cooperation is already developing in some sectors, particularly around energy infrastructure, participants acknowledged that more coordinated approaches to telecommunications infrastructure planning and permitting would be beneficial. MARA and the Crown Estate also stressed that regulators and seabed managers rely heavily on industry expertise to understand technical and operational requirements, including the space required for installation and repair. Industry representatives, in turn, highlighted the benefits of clear, predictable and sufficiently flexible planning and regulatory frameworks. Continued dialogue between authorities and industry was therefore seen as important both for improving regulatory understanding and for ensuring that technical requirements are incorporated into planning decisions at an early stage. ESCA's established work with marine regulators, seabed managers and the offshore renewables sector on consenting, crossing agreements and separation distances was cited as a model for this kind of engagement, alongside the ICPC's published Recommendations and Government Best Practices[9] on route protection and repairability.

The session concluded that effective marine spatial planning requires continuous dialogue, shared data and collaboration between regulators, planners, industry and other seabed users. As competition for increasingly congested seabed space intensifies, planning frameworks will need to balance the requirements of telecommunications infrastructure with offshore energy, shipping, ports, coastal development and other maritime activities. Critically, this means protecting not only the routes and landing sites required to deploy cables, but also the space, access rights and regulatory flexibility needed to maintain, repair and ultimately decommission them. Embedding repairability and lifecycle considerations into planning decisions from the outset, supported by closer cross-border coordination and continued government-industry engagement, will be essential to ensuring long-term resilience, including where the maintainability and repairability of critical subsea infrastructure is concerned.

[9] ICPC Government Best Practices: https://iscpc.org/publications/icpc-best-practices/

Annex 1
Symposium Agenda



Valentia Island Symposium on Subsea Cable Security and Resilience Repair: Past, Present, Future

Valentia Island Transatlantic Cable Station, Valentia Island,
Co. Kerry, Ireland
22-24 April 2026

AGENDA		
TUESDAY 21 APRIL		
Time	**Topic**	**Location**
18:00 – 20:00	**Earlybird Reception**	The Valentia Heritage Museum
WEDNESDAY 22 APRIL		
Time	**Topic**	**Location**
08:30 – 09:00	Registration	Transatlantic Cable Station
09:00 – 09:30	**Symposium Opening and Welcome Keynote** Minister for Culture, Communications and Sport, Mr. Patrick O'Donovan.	
A Call for Presentations (CfP) was issued earlier this year with the aim of attracting innovative and diverse thinking on security and resilience of subsea telecommunications cables, with a focus on repair as the theme of the Symposium. The first morning will showcase the selected abstracts and serve as an important segue into the following 2 days of proceedings		
09:30-10:30	**CfP Stream 1** - The challenges involved in laying, operating and repairing submarine cables in the Arctic, both today and in the future. - You Can't Always Get What You Want (But Sometimes, You Get What You Need): Governments, Reality Checks, and the Geopolitics of Repairs Under Fire - Repair Delay as Systemic Risk: Subsea Cables and the Limits of Digital Resilience	Transatlantic Cable Station
10:45 – 11:45	**CfP Stream 2** - How emerging threats, vulnerabilities and dependencies are impacting the maintenance of submarine cables. - Regulating for Resilience: The Evolution of U.S. Subsea Cable Mitigation Agreements - Global Networks: is Sovereignty and Outdated theories of Defence holding back Resilience and Security in Subsea Infrastructure?	
12:00 – 13:00	**CfP Stream 3** - Strengthening Subsea Cable Resilience Through Protection and Restoration: From reactive repair to proactive resilience - Past the Taxi Queue: Cable Repair Prioritization in Large-Scale, Parallel Outage Scenarios - From Grapnel to…Grapnel - The Historic Evolution of Subsea Cable Repair.	
13:00 – 14:00	Lunch	
14:00 – 18:00	TTX (closed)	Guided Tour of Valentia Island
18:30 – 21:00	**Symposium Welcome Reception** **Introduction** Mr. Micheál Lyne, Ms. Gemma Musgrave and Ms. Iseult Ní Chonchúir **Keynote ''Is our relationship with technology broken?'**	John the Baptist Church & The Royal Hotel Professor Chris Morash, Trinity College Dublin

THURSDAY 23 APRIL		
Time	Topic	Location
08:30–09:00	Registration	Transatlantic Cable Station
09:00 – 09:15	**Welcome**	
09:15 – 10:15	**Scene Setting**	
10:15–11:00	Break	
11:00–11:30	**Keynote** Minister for Foreign Affairs and Defence, Ms. Helen McEntee	
11.30–13.00	**Panel 1 Government Preparedness and Repair**	Transatlantic Cable Station
13:00–14:00	Lunch	
14:00–15:30	**Panel 2 Public-Private Collaboration for Repai**	Transatlantic Cable Station
15.30 – 16.00	Break	
16.00 – 17.30	**Panel 3 Ensuring Repair Operations in a Heightened Geopolitical Context**	Transatlantic Cable Station
17:30 – 17:45	**Wrap-up**	
19:00 – 22:00	**Quayside Chat** 'If it Happens Tomorrow …"**Symposium Dinner**	The Royal Hotel

FRIDAY 24 APRIL		
Time	Topic	Location
08:30 – 08:45	Opening/ Welcome Day 2	Transatlantic Cable Station
08:45 – 10:15	**Panel 4** Adaptation in Repair: Market Shifts and Structural Changes	
10:15 – 10:30	Break	
10:30 – 12:00	**Panel 5** Repair in a Crowded Seabed: Navigating the Spatial Squeeze	Transatlantic Cable Station
12:00 – 12:15	**Chair Sum-Up and Symposium Closing**	
12:15 – 14:00	Light lunch	

Glossary of Key Terms

Term / Acronym	Definition
ACMA — Atlantic Cable Maintenance Agreement	A consortium-based maintenance arrangement providing submarine cable maintenance and repair services across the Atlantic region. Participating cable owners share access to repair vessels, depots, specialist personnel and associated maintenance services.
Ad hoc repair	A cable repair arranged outside an established consortium or private maintenance agreement. Operators relying on ad hoc arrangements must secure suitable vessels, personnel and services when a fault occurs and may face longer mobilisation times when repair capacity is constrained.
AIS — Automatic Identification System	A maritime tracking system through which vessels transmit information including their identity, position, course and speed. AIS supports cable protection and maritime domain awareness and can assist investigations into fault causation, including identifying anchor-drag incidents.
Anchor drag	The unintended movement of a vessel's anchor across the seabed while the vessel is underway or drifting. A dragging anchor can travel significant distances and damage submarine cables and other seabed infrastructure.
Anchor management	Operational practices intended to ensure vessel anchors are properly secured, monitored and deployed to reduce the risk of accidental anchor drag and damage to submarine infrastructure.
AUV — Autonomous Underwater Vehicle	An unmanned underwater vehicle capable of operating with a degree of autonomy from a surface vessel. AUVs can support cable route surveys, inspection, monitoring and fault-localisation activities.
Cable depot / storage depot	A strategically located facility where spare submarine cable, repeaters, joints and repair equipment are stored and maintained for deployment during repairs. The location and availability of suitable spares can materially affect repair mobilisation times.
Cable fault	Damage or deterioration affecting the electrical or optical performance of a submarine cable. Faults range from electrical insulation or shunt faults to partial or complete optical fibre breaks and may or may not immediately interrupt traffic.
Cable maintenance agreement	A commercial arrangement through which cable owners secure access to repair vessels, specialist personnel, spare cable, depots, equipment and related services. Agreements may take the form of regional consortia or private contracts. In the telecommunications sector, they also function as a form of collective self-insurance by sharing the costs of standby repair capability and fault response.
Cable maintenance zone	A defined geographic region within which a maintenance arrangement provides participating cable owners with access to designated repair vessels, depots and associated repair services.
Cable recovery	The process of locating, accessing and retrieving a damaged submarine cable from the seabed so that the affected section can be repaired or replaced.
Cable repair vessel	A specialised vessel equipped to locate, recover, repair, test and redeploy submarine cables. Repair vessels typically carry cable-handling equipment, grapnels and specialist personnel and may also carry ROVs and other subsea equipment.
Cabotage	National rules restricting or regulating the use of foreign-flagged vessels for activities within a state's maritime jurisdiction. Cabotage requirements can affect the ability of repair vessels to mobilise and conduct repairs rapidly.

Term / Acronym	Definition
Connecting Europe Facility (CEF)	An EU funding instrument supporting strategic infrastructure in areas including transport, energy and digital connectivity.
Critical Entities Resilience Directive (CER)	EU legislation requiring designated critical entities to assess risks and take measures to strengthen their resilience against natural and human-induced threats.
Coherent OTDR / coherent reflectometry	An advanced optical fault-localisation technique used on long repeatered submarine cable systems. It enables faults to be identified over distances of thousands of kilometres where conventional OTDR techniques cannot operate effectively.
Consortium maintenance agreement / “club” model	A cooperative maintenance arrangement in which multiple cable owners share the costs and resources required to maintain access to repair vessels, depots, equipment and specialist services within a defined geographic area.
Critical underwater infrastructure (CUI)	Infrastructure located on or beneath the seabed that performs functions important to national security, economic activity or essential services, including telecommunications cables, electricity interconnectors and pipelines.
Cutting and holding grapnels	Specialised grappling equipment deployed from a repair vessel to locate, cut, grip and recover submarine cable from the seabed. Grapnel-based recovery remains an important technique for deep-water repair.
Distributed Acoustic Sensing (DAS)	A technology that uses optical fibre to detect vibrations and acoustic signals along a cable and can potentially support monitoring and situational awareness around subsea infrastructure.
Dielectric breakdown / incipient insulation fault	A developing failure in the insulating material surrounding a cable’s electrical conductor. Degradation can allow electrical leakage and may eventually develop into a more serious cable fault.
Digital Operational Resilience Act (DORA)	An EU regulatory framework designed to strengthen the ability of financial entities to withstand, respond to and recover from information and communications technology-related disruption.
Exclusive Economic Zone (EEZ)	A maritime zone extending up to 200 nautical miles from a coastal state’s baselines in which the state has specified sovereign rights and jurisdiction under international law.
Electroding	A technique used to assist with locating an electrically detectable submarine cable or fault by towing electrodes from a vessel while a low-frequency signal is transmitted through the cable.
Emergency repair exemption	A regulatory provision allowing urgent cable repair operations to proceed under expedited or simplified permitting and approval requirements.
Fault localisation	The process of determining the geographic position of a submarine cable fault before recovery operations begin. Accurate localisation is important because uncertainty of even several kilometres can significantly increase the difficulty and duration of deep-water repairs.
Fault rate	The frequency at which cable faults or repairs occur over a defined period or relative to the amount of cable in service. Expressing faults relative to cable kilometres provides a useful measure of reliability as the global network expands.
Fibre pair	Two optical fibres used together to provide bidirectional transmission through a submarine cable system. Modern systems can contain many fibre pairs, increasing jointing and testing complexity during repair.
Full optical fibre break	A fault in which the optical fibre is completely severed, resulting in loss of signal transmission through the affected fibre or cable section.
Grapnel	A specialised device deployed from a cable repair vessel to locate, cut, grip or recover a submarine cable from the seabed, particularly during deep-water repairs.

Term / Acronym	Definition
Horizontal Directional Drilling (HDD)	A trenchless construction technique used to install cable ducts beneath coastlines, beaches and other sensitive areas.
High seas	Areas of the ocean beyond national jurisdiction. Only a small proportion of submarine cable repairs occurs on the high seas; most take place within areas subject to coastal-state jurisdiction.
Hyperscaler	A large-scale technology or cloud-services company operating extensive global digital infrastructure. Hyperscalers have become major investors and owners in international submarine cable systems and increasingly influential participants in maintenance arrangements.
International Cable Protection Committee (ICPC)	An international industry organisation promoting the protection and resilience of submarine telecommunications and power cables through technical guidance, recommended practices, research and engagement with governments and maritime stakeholders.
Jointers	Specialist technicians trained to connect and repair submarine cable sections. Cable jointing requires highly specialised skills and is a critical component of repair operations.
Liquidated Damages (LDs)	Pre-agreed contractual payments that may become payable when specified performance obligations or service levels are not met, subject to the terms of the maintenance agreement.
Maintenance and Improvement (M&I) work	Planned activity undertaken outside emergency fault response, including inspection, cable protection improvements, reburial and other work intended to maintain or enhance cable resilience.
Marine spatial planning (MSP)	The process through which governments and regulators manage the spatial and temporal use of marine areas. For cables, MSP can affect route selection, landing sites, separation from other infrastructure and the space and access available for future repair.
Maritime domain awareness (MDA)	Understanding activities, conditions and threats within the maritime environment that may affect security, safety, economic activity or infrastructure. In the cable context, MDA supports situational awareness and identification of potentially threatening vessel activity.
Mean Time to Repair (MTTR)	A measure used to assess the time associated with restoring or repairing infrastructure following a fault. Cable-repair analysis may break this into stages including notification to vessel departure, transit and repair activity to identify operational, regulatory and geographic sources of delay.
Modular repair capability	An approach in which specialist cable-repair equipment and systems can be deployed on a suitable non-dedicated vessel rather than relying exclusively on a purpose-built cable repair ship.
NIS2 Directive	EU legislation establishing cybersecurity risk-management and incident-reporting requirements for essential and important entities, including organisations involved in digital infrastructure.
Network Operations Centre (NOC)	A facility responsible for monitoring the operation and performance of a telecommunications network. Cable faults are typically first detected through alarms or monitoring systems overseen by a NOC.
Optical Time-Domain Reflectometer (OTDR)	An instrument used to identify and locate faults in optical fibre by transmitting a light pulse through the fibre and measuring reflected or scattered light.
Partial optical fibre break	Damage in which an optical fibre is impaired but not completely severed. Traffic may continue, but the fault can cause signal attenuation, reduced performance or intermittent communications and may develop into a complete break.

Term / Acronym	Definition
Private maintenance agreement	A maintenance arrangement contracted outside the traditional consortium or club structure, typically between a cable owner or group of owners and a commercial marine maintenance provider.
Repair ecosystem	The wider network of capabilities and dependencies required to restore damaged submarine cables. It includes repair vessels, specialist personnel, spare cable and depots, equipment, ports, suppliers, insurers, supply chains, permitting arrangements, navigation and communications systems and other supporting services.
Repair authority	The organisation or entity responsible under a maintenance arrangement for coordinating and authorising the mobilisation of repair resources following a cable fault.
Restoration	The recovery of telecommunications connectivity following an outage. Restoration may occur through traffic rerouting before physical repair of the damaged cable has been completed.
Remotely Operated Vehicle (ROV)	An underwater vehicle controlled from a surface vessel and used for subsea inspection, cable recovery, burial and intervention where divers or conventional equipment may be impractical.
Service-affecting fault	A cable fault that causes degradation or interruption of telecommunications service. Not all physical cable faults are service-affecting because redundancy or traffic rerouting may allow services to continue.
Shadow fleet	A term commonly used for vessels operating through opaque ownership, registration, insurance or trading arrangements, often in connection with efforts to circumvent sanctions or regulatory restrictions. Such activity can complicate maritime domain awareness and risk assessment around subsea infrastructure.
Shallow-water repair	Repair undertaken in nearshore or shallow waters where conventional cable vessels may be unable to operate safely. Such operations can require divers, barges, shallow-draft vessels, ROVs or other specialised assets.
Shunt fault	An electrical fault occurring when a cable's conductor becomes electrically connected to seawater, allowing current to leak to earth. Optical fibres may initially remain operational even though the cable's power-feeding system has been compromised.
Sovereign repair capability	Repair vessels, personnel, equipment or other capacity maintained or controlled by a national government to provide an independent or contingency ability to support submarine cable repairs.
Spare cable	Replacement submarine cable held at a depot for use during repairs. Its availability, compatibility and location can materially affect mobilisation and repair times.
Supply-chain resilience	The ability of the repair ecosystem to maintain access to materials, equipment, components, vessels, specialist services and personnel despite disruptions to manufacturing, trade, transport or geopolitical conditions.
Surge capacity	Additional vessels, specialist personnel, equipment or other repair capability that can be mobilised when demand exceeds normal operating requirements, including during multiple simultaneous faults or major regional disruption.
Traffic rerouting	The transfer of communications traffic from a damaged or unavailable cable onto alternative cable systems or network paths, allowing service to be restored before physical repair is completed.
Vessel of opportunity	A vessel not permanently dedicated to submarine cable maintenance but capable of being adapted, equipped or contracted to perform specified repair or support functions when required.
War-risk insurance	Specialised insurance covering risks associated with war, conflict and related security threats that may be excluded from ordinary marine insurance. Its availability, conditions and cost can determine whether repair vessels can operate in high-risk areas.



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