An Agenda for

Accessible Communications @ Sea Solutions for Small-Scale Fishers

Interim Report
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About the Smart Seas Toolkit (SST) for Disaster Resilience ("Smart Seas") Project: The Smart Seas Project is a joint project among the International Telecommunication Union (ITU), Caribbean Telecommunications Union (CTU) and Telecommunications Authority of Trinidad and Tobago (TATT). It sets out to preserve the lives of vulnerable small-scale fishers (SSF) in the Caribbean and increase their resilience through information and communications technologies (ICTs), with emphasis on the associated *enabling environment*. The project is instantiated in Trinidad and Tobago, the Maritime Rescue Co-ordination Centre (MRCC) for Grenada, Barbados and St. Vincent and the Grenadines.

The project's outputs focus on strengthening, among other things, the compliance with policy and regulation, operations, capacity and the use of technology in maritime communications ecosystem. It will also facilitate a global partnership to report on technological, service and market innovations to address the perennial problem of accessible emergency communications for small-scale fishermen. Stakeholder engagement is critical in ensuring the effectiveness and the viability of the project's outputs and impacts.

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Executive Summary

A number of digital inclusion initiatives have been undertaken by Administrations around the world to connect the unconnected, particularly marginalized communities and those with specific needs, including persons with disabilities, and indigenous people.

This report recognizes that there still exist marginalized communities, with specific needs, which remain underserved. Small-scale fishers (SSF), who comprise 94% of the world's fisheries fleet, are one such community that has traditionally faced socioeconomic and digital exclusion. Plying their trade in small, undecked crafts at sea, SSF are highly vulnerable to risks including piracy and adverse weather. They require special attention from Administrations on account of the compounding issues of exclusion and disaster vulnerability.

The *ITU/CTU/TATT Smart Seas Toolkit for Disaster Resilience Project* has investigated and identified barriers to accessible communications at sea for SSF in four Caribbean countries. Findings reveal gaps in the enabling environment; and recommendations have been made to facilitate and encourage adoption of best practice, as specified in UN Conventions and related artefacts. Compliance has been seeded in all countries through multi-stakeholder coordination and supporting resources. Tangible contributions to maritime operations have been made through the purchase of essential VHF radio equipment, while the Project looks to the future at complementary technologies.

This report makes the case to recognize SSF as an underserved community, and dimensions accessible comms@sea into devices, services, adoption, capacity and the enabling environment. Furthermore, it provides baseline multi-sectoral, multi-stakeholder priorities, to ensure inclusion of vulnerable communities who earn their living at sea.

1 Introduction

1.1 Connectivity and Digital Inclusion

The *digital divide* was one of the first concepts used to describe the gaps between those who have access to information and communications technologies (ICTs) and can use the internet, from those that do not; those falling within the gap were referred to as the *underserved* (TATT 2013[1]). As ICTs advanced over the years, so too did the concept of the *digital divide*, into those of ICT accessibility[2], digital inclusion[3] and connectivity[4].

International organizations such as the United Nations, through its Sustainable Development Goals (SDGs), and the International Telecommunication Union (ITU), through its Connect 2030 Agenda, have been working with its Member States around the world, to bridge these gaps and ensuring that everyone, regardless of their location or background, has access to the benefits that digital technologies can provide. Each of these initiatives identify the current state and the envisioned states and the gaps between them, identifying key actions to be taken, in order to reach the envisioned state.

1.2 The Small-Scale Fisher

Among the underserved lie a unique community who, in addition to facing digital and socioeconomic exclusion, are highly exposed and otherwise vulnerable to risks while plying their daily trade. Small-scale fishers (SSF) comprise approximately 94% of the world fisheries fleet (IYAYA 2022[5]), and are responsible for securing approximately 40% of the daily fish consumed (FAO 2022[6]). The definition of SSF[7], while varying by community, country and region, are defined in this context through a synthesis of desk research and consultations, as those who:

1. operate in wooden, undecked, motor-powered vessels less than 12 m, termed *pirogues*
2. ply their trade within their country's exclusive economic zones (EEZs), typically 40 km from shore or less
3. have low ICT adoption and digital literacy levels

These pirogues offer little protection to fishers, leaving them highly vulnerable to risks at sea, such as piracy and adverse weather conditions, feeding into the global consideration of fishing being one of the world's most dangerous jobs, in which thousands lose their lives, annually. ICTs have potential to strengthen the resilience of SSF through all phases of the disaster management cycle: mitigation, preparation, response and recovery, but the low ICT adoption rates of SSF to standard ICTs suggest gaps to its accessibility.

The compounding threats of digital and socioeconomic exclusion, as well as high risk while plying their trade should warrant the need for SSF to be recognized as a marginalized, underserved population, yet many administrations around the world do not recognize this community. The continued neglect for the digital inclusion of SSF will, in turn, result in the continued widening of the gaps to accessible ICTs and hence, continued loss of life at sea.

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[1] Telecommunications Authority of Trinidad and Tobago (TATT). 2013. *The Digital Divide Survey Report in Trinidad and Tobago, 2013*. Available at: https://tatt.org.tt/DesktopModules/Bring2mind/DMX/API/Entries/Download?Command=Core_Download&EntryId =340&PortalId=0&TabId=222

[2] ensuring inclusive access to marginalized groups, such as persons with disabilities (PWDs)

[3] the foundation for ensuring that everyone, regardless of their background or location, has equitable, meaningful and safe access to services, opportunities and digital resources (UN n.d.)

[4] *Connectivity*: a two-dimensional scale in terms of being *universal* - connectivity for all, across people, households, communities, and businesses; and *meaningful* – allow users to have a safe, satisfying, productive online experience at an affordable cost (ITU 2023)

[5] Sustainable Small-Scale Fisheries." Food and Agriculture Organization of the United Nations. https://fao.org/policy-support/policy-themes/sustainable-small-scale-fisheries/en/ .

[6] FAO. 2022. The State of World Fisheries and Aquaculture 2022: Towards Blue Transformation. Available at: https://www.fao.org/publications/home/fao-flagship-publications/the-state-of-world-fisheries-and-aquaculture/2022/en

[7] FAO defines SSF or *artisanal* fishers, as those who make short trips close to shore in small vessels; and utilize low levels of technology and capital investment

1.3 Objectives

This Report sets out to:

1. Propose a multi-dimensional framework for accessible comms@sea for SSF
2. Define, across the dimensions identified, accessible comms@sea for SSF
3. Frame the current state of comms@sea for SSF
4. Identify the gaps between accessible comms@sea for SSF and the current state
5. Recommend multi-dimensional, multi-stakeholder priorities to fill the gaps identified:
    a. To efficiently and effectively utilize the standard comms@sea solutions, prescribed under applicable UN Conventions and Recommendations; and
    b. Through emerging technologies, as a means of supplementing standard solutions

1.4 Methods

This Report was developed through a synthesis of desktop research and stakeholder consultations. Consultations were held both in-person as well as virtually, and used both synchronous and asynchronous means over the period December 2023 - Feb 2025.

1.5 Structure of the Report

The report contains a number of chapters and applicable appendices. **Chapter 2** is centred around developing an analytical framework to assess accessible comms@sea solutions for SSF. **Chapter 3** defined requirements for accessible comms@sea for SSF, while **Chapter 4** identifies the current state of comms@sea. The differences between the envisioned accessible comms@sea, and that which exists, is captured in **Chapter 5**, from which a number of key recommendations arise; these are found in **Chapter 6**. Quite apart from filling the gaps which exist, there is also opportunity in looking forward at emerging technologies, to support the standard suite of comms@sea solutions, while also identifying opportunities and areas for further research and innovation.

2 Communications @ Sea

2.1 Communications at Sea for All Seafarers

ICTs play a vital role across all four phases of the disaster management cycle: preparedness, mitigation, response and recovery. International treaties developed by the International Maritime Organization (IMO) such as the *International Convention on Safety of Life at Sea* (SOLAS Convention; IMO 1974[8]), and the *International Convention on Maritime Search and Rescue* (SAR Convention; IMO 1979[9]), and the (ITU 2024[10]) set global standards for communications at sea and their associated enabling environments. According to the Radio Regulations (2024) and SOLAS Convention (1974), communications at sea (comms@sea) can be classified into four categories, identified, defined and prioritized as shown below.

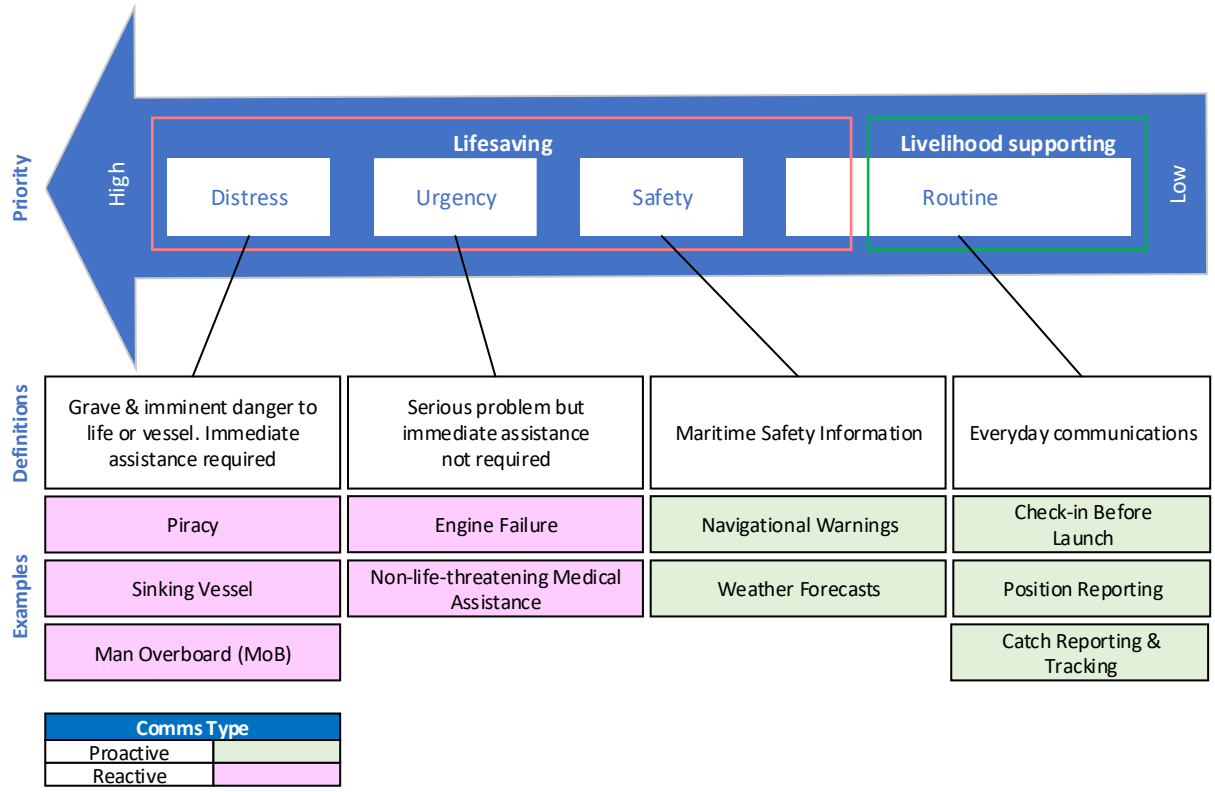


Figure 1 Comms@Sea Priorities, Definitions & Examples

The Global Maritime Distress and Safety System (GMDSS) is a set of internationally established technical, operational and administrative resources, which set the standards for emergency communications at sea (IMO 1974). It was originally derived from studies conducted by the IMO and ITU in the mid-1970s (ITU 2020[11]) and officially instantiated through the SOLAS Convention. The GMDSS sets the foundations for communications at sea by vessels over 300 GT, through its 9 functional requirements; every ship, while at sea, shall be capable of:

[8] International Maritime Organization (IMO). *International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended*. London: IMO, 2024
[9] International Maritime Organization (IMO). *International Convention on Maritime Search and Rescue (SAR), 1979, as amended*. London: IMO, 2016
[10] International Telecommunication Union (ITU). *Radio Regulations, Edition of 2024*. Geneva: ITU, 2024
[11] International Telecommunication Union (ITU). *Manual for Use by the Maritime Mobile and Maritime Mobile-Satellite Services*. Geneva: ITU, 2020

Table 1 GMDSS' 9 Technical Requirements and their Applicability to SSF (Adapted from IMO 1974)

#	TX	RX	Requirement	Applicable to SSF?
1	✓		ship-to-shore distress alerts by at least two separate and independent means, each using a different radiocomm service	✓
2		✓	shore-to-ship distress alerts	✓
3	✓	✓	ship-to-ship distress alerts	✓
4	✓	✓	search and rescue co-ordinating communications	✓
5	✓	✓	on-scene communications	✓
6	✓	✓	signals for locating	✓
7	✓	✓	maritime safety information	✓
8	✓	✓	general radiocomms to & from shore-based radio systems or networks	✓
9	✓	✓	bridge-to-bridge communication	X

Chapter IV of the SOLAS Convention mandates the carriage of radiocommunications equipment[12], by SOLAS-compliant vessels (those over 300 GT, and is *not* applicable to fishing vessels), and is used to define various sea areas, A1 - A4, shown below.

Table 2 Sea Areas, their Ranges and Applicability to SSF (Source: IMO 1974, ITU 2020[11] and FAO, ILO and IMO 2012[13])

Sea Area	Within Coverage of at least one...	Range from shore	Applicable to SSF?
VHF	VHF coast station	20 - 30 nmi	✓
A1	VHF-DSC coast station	20 - 30 nmi	✓
A2	1 MF-DSC coast station	100 - 400 nmi	✓
A3	Inmarsat geostationary satellite	> 400 nmi	X
A4	HF-DSC coast station	All other areas	X

In addition to the SOLAS and SAR Conventions, the ITU Radio Regulations (ITU 2024[14]), is a key UN treaty that outlines emergency radiocommunications procedures and channels for emergency and routine communications at sea. It is through these key treaties that member states which are signatory to the convention, are obligated to perform a number of operational and administrative activities, listed in **Appendix A**: Extracts from Key UN Conventions.

2.2 Comms@Sea for SSF

Currently, no international regulations or UN conventions exist that *mandate the carriage* of comms@sea solutions by SSF; instead recommendations exist in the form of the *Safety Recommendations for Decked Fishing Vessels of Less than 12 metres in Length and Undecked Fishing Vessels* (FAO/ILO/IMO 2012[15]). These include some of the comms@sea provisions from the GMDSS, such as VHF-DSC radios, as well as other, non-GMDSS communications solutions such as cellular phones. It is the responsibility of countries to include comms@sea provisions under national policies, regulations and legislation, yet very few countries around the world have done so.

Instead, the adoption and routine use of comms@sea solutions by SSF is, dependant on the availability and affordability of devices and services, as well as the attitudes and digital skills capacity of SSF to effectively and routinely use them. Many such devices, such as MF/HF and VHF-DSC radios are outside the purchasing power of SSF, which create an affordability barrier; these devices in particular are also dependent on having the required knowledge and skills to operate maritime radios, which require

[12] SOLAS Chapter IV, Regulations 7-11 mandate the carriage of VHF-DSC radios, a search and rescue locating device, a NAVTEX receiver, a recognized mobile satellite service enhanced group calling system, and a satellite EPIRB capable of floating free if the ship sinks
[13] FAO, ILO and IMO. *Safety Recommendations for Decked Fishing Vessels of Less than 12 metres in Length and Undecked Fishing Vessels, 2012*. Rome: FAO. http://www.fao.org/3/a-i3108e.pdf
[14] International Telecommunication Union (ITU). *Radio Regulations, Edition of 2024*. Geneva: ITU, 2024.
[15] Food and Agriculture Organization (FAO), International Labour Organization (ILO), and International Maritime Organization (IMO). *Safety Recommendations for Decked Fishing Vessels of Less than 12 Metres in Length and Undecked Fishing Vessels*. Rome: FAO, 2012. Available at: http://www.fao.org/3/a-i3108e.pdf

specialized training and licensing. SSF, who often have low literacy as well as digital literacy, are at increased risk of exclusion from using these solutions.

2.3 Analytical Framework

Existing comms@sea solutions are often designed for larger vessels, and UN Conventions and Recommendations do not mandate the carriage of comms@sea by SSF. Furthermore, Accessible comms@sea is dependent on the affordability and availability of devices and services, the adequate digital skills of end users, an enabling environment, and positive and responsible attitudes to support the carriage and routine use of comms@sea solutions by SSF. It is therefore proposed that accessible comms@sea be viewed as a multi-dimensional problem for which gaps exist, requiring examination and analysis across three dimensions:

1. **Devices**: end user comms@sea devices used by SSF and other mariners
2. **Services**: telecommunications services accessed by SSF on applicable comms@sea devices
3. **Enabling Environment**: all applicable UN Conventions and Recommendations, the ecosystem, policy and regulatory environments, operations and capacity

The analytical framework for this Agenda, therefore considers the current state of comms@sea (supply), the envisioned state of accessible comms@sea for SSF (demand), the multi-dimensional gaps which may exist, and the multi-dimensional, multi-sectoral gap-filling priorities.

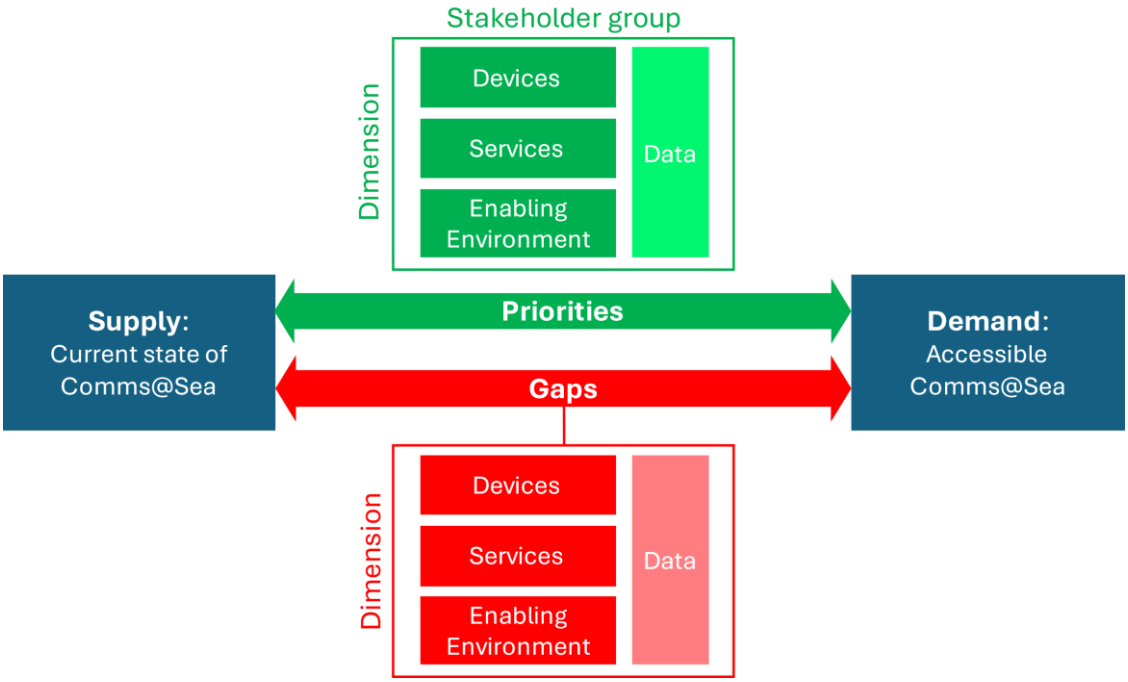


Figure 2: Analytical Framework for Accessible Comms@Sea for SSF

3 Demand: Accessible Comms@Sea for SSF

The demand side focuses on scoping what is meant by accessible, affordable comms@sea for SSF. In alignment with the analytical framework, it is structured in terms of:

1. Devices & Services
2. Enabling Environment
3. Data

3.1 Devices & Services

Accessible devices focus on the *affordability* of the device, as well as its *ease of use*, *seaworthiness* and *availability of lifesaving and livelihood-supporting features*. These are critical in ensuring that the devices are within the purchasing power of SSF, are capable of being operated easily during life-threatening situations, and can withstand the maritime elements while being used in small, undecked vessels with no power supply. The proposed requirements for devices and services are as follows:

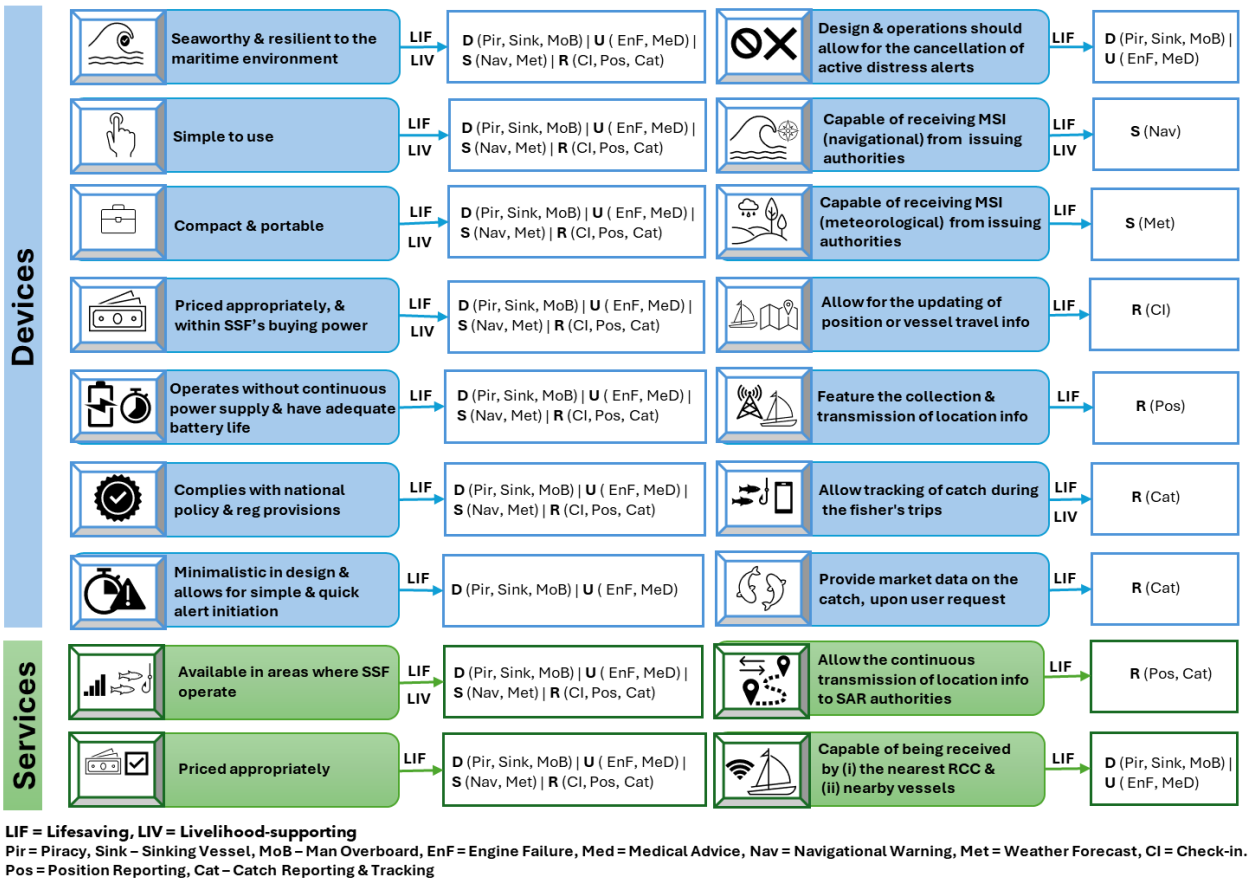


Figure 3 Device and Service Requirements

3.2 Enabling Environment

The enabling environment, as defined under the Project's Gap Analysis, includes compliance with UN conventions and recommendations, the ecosystem, policy and regulatory environments, operations and capacity. Enabling environment requirements for accessible comms@sea for SSF are as follows.

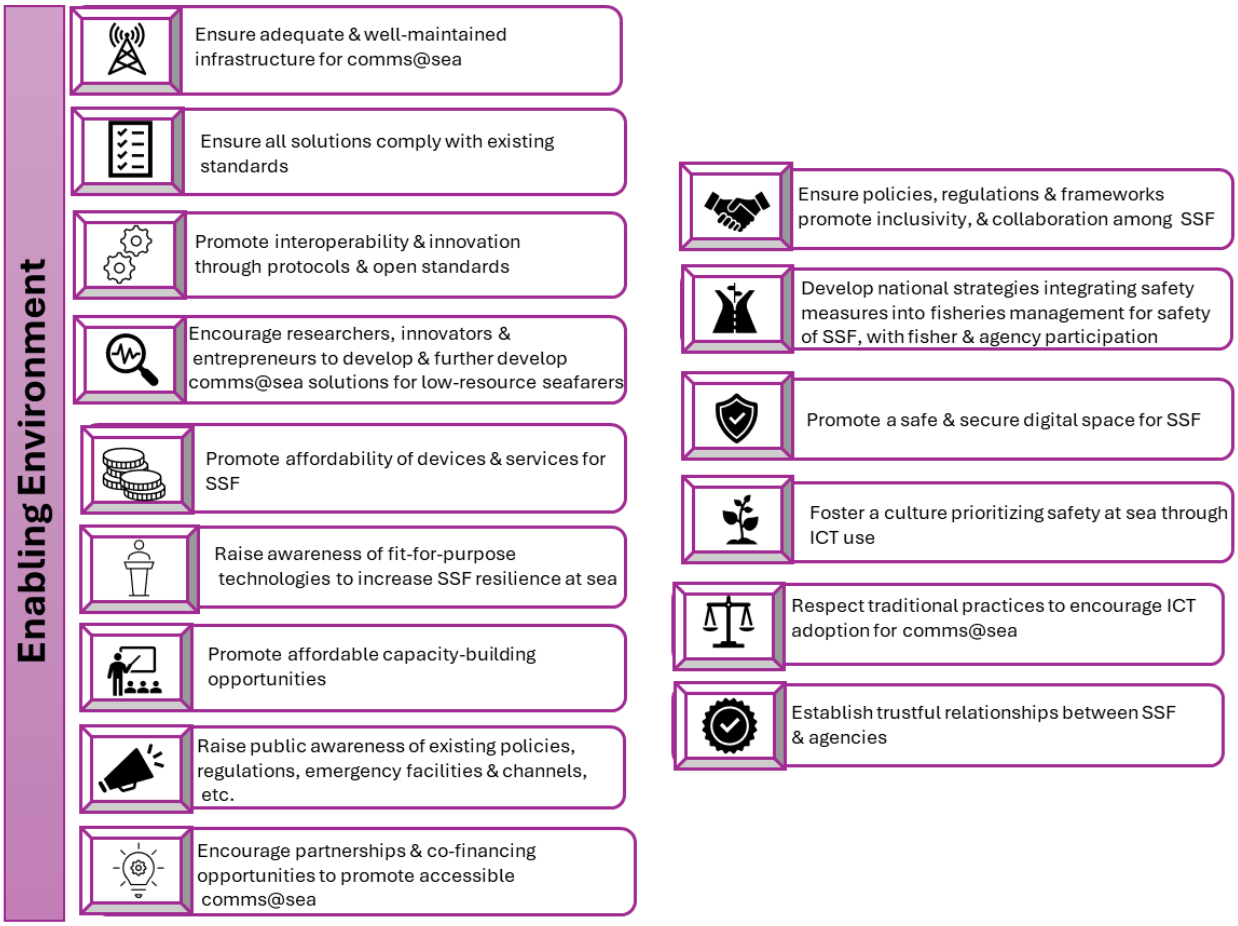


Figure 4 Enabling Environment Requirements

3.3 Data

Data plays a key role in all four phases of disaster management. Effective and efficient data collection and dissemination systems have the potential to save lives and support the livelihoods of all seafarers. UN Agencies, through their relevant conventions, specify the data required to be made available to all mariners, which are applicable to distress, urgency, safety and routine situations. These form the baseline for the current state of comms@sea data, as many countries are signatory to these conventions. A list of the required data is provided in Table 3.

Table 3 SSF-related Lifesaving & Livelihood-supporting Data Required by the UN

Data	Particulars	Class[16]		Formats[17]			Artefact	Source
		LF	LS	V	T	G		
Distress	name of the vessel in distress	✓		✓			Radio Regulations, Edition of 2020	ITU
	call sign or other identification	✓		✓				
	MMSI	✓		✓				
	the position (latitude & longitude) or in relation to a known geographical location	✓		✓				

[16] LF = Lifesaving, LS = Livelihood-supporting
[17] V = Voice, T = Text, G = Graphical

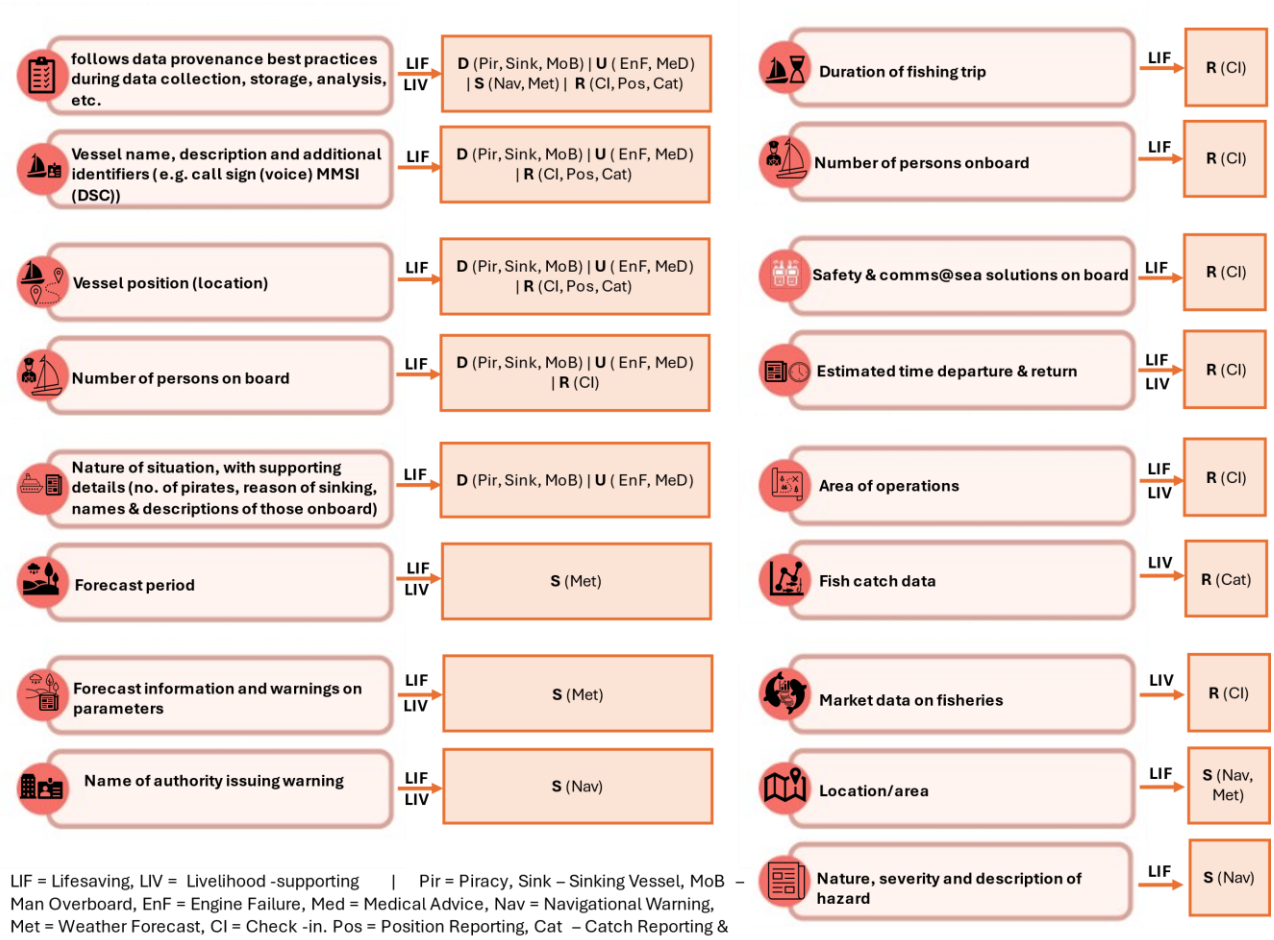
Data	Particulars	Class[16]		Formats[17]			Artefact	Source
		LF	LS	V	T	G		
	nature of the distress	✓		✓				
	kind of assistance required	✓		✓				
	other useful information	✓		✓				
Urgency	name of the station TX urgency message	✓		✓				
	call sign or other identification	✓		✓				
	MMSI	✓		✓				
	the text of the urgency message	✓		✓				
Location data (AIS)	MMSI	✓			✓		Resolution A.1106(29) [18]	IMO
	call sign and name	✓			✓			
	IMO Number	✓			✓			
	length and beam	✓			✓			
	type of ship	✓			✓			
	location of electronic position fixing system (EPFS) antenna	✓			✓			
	ship's position with accuracy indication and integrity status	✓			✓			
	position time stamp in UTC	✓			✓			
	course over ground (COG)	✓			✓			
	speed over ground (SOG)	✓			✓			
	heading	✓			✓			
	navigational status	✓			✓			
	rate of turn (ROT)	✓			✓			
	ship's draught	✓			✓			
	hazardous cargo (type)	✓			✓			
	destination and ETA	✓			✓			
	route plan (waypoints)	✓			✓			
	short safety-related messages	✓			✓			
Navigational Warnings[19]	casualties to lights, fog signals, buoys and other aids to navigation	✓			✓		Resolution MSC.469 (101)	IMO
	presence of dangerous wrecks	✓			✓			
	establishment of major new aids to navigation or significant changes to existing ones	✓			✓			
	presence of large unwieldy tows in congested waters	✓			✓			
	drifting hazards	✓			✓			
	areas where Search and Rescue (SAR) and anti-pollution operations are being carried out	✓			✓			
	the presence of newly discovered rocks, shoals, reefs and wrecks likely to constitute a danger to shipping, and, if relevant, their marking;	✓			✓			
	unexpected alteration or suspension of established routes;	✓			✓			
	cable or pipe-laying activities, the towing of large submerged objects for research or exploration purposes, the employment of manned or unmanned submersibles, or other underwater operations constituting potential dangers in or near shipping lanes;	✓			✓			
	establishment of research or scientific instruments in or near shipping lanes	✓			✓			
	the establishment of offshore structures in or near shipping lanes	✓			✓			
	significant malfunctioning of radionavigation services and shore-based Maritime Safety Information radio or satellite services	✓			✓			
	information concerning events which might affect the safety of shipping, sometimes over wide areas	✓			✓			

[18] IMO. 2015. Resolution A.1106(29). Revised Guidelines For The Onboard Operational Use Of Shipborne Automatic Identification Systems (AIS). Available at: https://wwwcdn.imo.org/localresources/en/OurWork/Safety/Documents/AIS/Resolution%20A.1106(29).pdf

[19] IMO. 2019. Resolution MSC.469(101). Amendments to World-Wide Navigational Warning Service. Available at: https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MSCResolutions/MSC.469(101).pdf

Data	Particulars	Class[16]		Formats[17]			Artefact	Source
		LF	LS	V	T	G		
	operating anomalies identified within Electronic Chart Display and Information System (ECDIS) including Electronic Navigational Chart (ENC) issues	✓			✓			
	acts of piracy and armed robbery against ships	✓			✓			
	tsunamis and other natural phenomena, such as abnormal changes to sea level	✓			✓			
	World Health Organization (WHO) health advisory information	✓			✓			
	security-related requirements	✓			✓			
Marine Forecasts	date and time of issue	✓			✓		Manual on Marine Meteorological Services (WMO 2012)[55]	WMO
	valid period of the forecast	✓			✓			
	name and designation of forecast area(s)	✓			✓			
	warning status	✓			✓			
	synopses	✓			✓			
	wind speed or force and direction	✓	✓		✓			
	visibility, when less than 6 nautical miles (10 kilometres) visibility is forecast	✓			✓			
	phenomena that may restrict visibility.	✓			✓			
	ice accretion, where applicable	✓			✓			
	waves (sea and swell)	✓	✓		✓	✓		
Marine MET Warning	synopses	✓			✓			
	type of warning	✓			✓			
	date and time of issue	✓			✓			
	location of disturbance in terms of latitude and longitude or with reference to well-known landmarks	✓			✓	✓		
	extent of affected area	✓			✓	✓		
	description of the phenomena	✓			✓			
	type of disturbance (for example, low, hurricane, front) with a statement of central pressure in hectopascals	✓			✓			
	direction and speed of movement of disturbances	✓			✓	✓		

These fields are further refined to those applicable to SSF, as shown below.



LIF = Lifesaving, LIV = Livelihood -supporting | Pir = Piracy, Sink – Sinking Vessel, MoB – Man Overboard, EnF = Engine Failure, Med = Medical Advice, Nav = Navigational Warning, Met = Weather Forecast, CI = Check -in. Pos = Position Reporting, Cat – Catch Reporting & Tracking

4 Supply: State of the Art

Existing comms@sea solutions can be classified as **essential** or **non-essential** (see Figure 5 for examples), based on their global recognition as lifesaving comms@sea, and inclusion in the GMDSS:

1. **Essential**: fall under the GMDSS, globally approved as key lifesaving comms@sea solutions
2. **Non-essential**: do not fall under the GMDSS, not globally approved as key lifesaving comms@sea solutions, *but have the potential to support comms@sea solutions within the GMDSS suite*

Figure 5 Examples of Essential and Non-Essential Comms@Sea Solutions

This chapter treats with the current state of **devices and services**, the **enabling environment** and **data**, considering primarily the four Smart Seas Countries, abstracted further to the 34 CITEL Member States.

4.1 Devices & Services

The current state of communications at sea considers comm@sea solutions captured in the GMDSS through the SOLAS Convention, as well as the Safety Recommendations (FAO, ILO and IMO 2012). Traditional tools such as *VHF, VHF-DSC and MF/HF radios*, and *NAVTEX* remain essential for short- and long-range comms@sea, particularly in distress and safety situations. Meanwhile devices such as *EPIRBs, AIS-SARTs*, and *IoT-enabled sensors* provide critical support for search and rescue operations, vessel tracking, and data-driven decision-making. These solutions are particularly of interest to SSF, enabling them to leverage comms@sea to save lives and support their livelihoods. The sample comms@sea solutions identified in [FIG ABOVE] were compared in terms of their applicability to SSF. These greatly align with the requirements provided in the previous chapter, and will be used in the subsequent chapter to assess the gaps which may exist among the existing devices and services.

The existing services is closely linked to the devices, and represents the types of communications used by each. The majority of comms@sea solutions use one of the services below.

Table 4 Comms@Sea Services and Example Devices

Service	Bands Used	Example Devices
Radio	VHF, MF/HF	AIS-SART, VHF radio, MF/HF Radio, VHF-DSC radio, MF-DSC radio, NAVTEX receiver, FM radio receiver
Satellite	L-Band, COSPAS-SARSAT, etc.	EPIRB, Satellite phones
Radar	X-Band radar	SART
Cellular	3G, 4G	Cellular phones

VHF-DSC Radio	MF-DSC Radio	Handheld VHF radio	EPIRB	SART/AIS-SART	NAVTEX receiver	Mobile Telephone	Satellite Phone	Radio Receiver
								
V2V V2S	V2V V2S	V2V V2S	V2V V2S	V2V V2S	RX only	C2C	C2C	RX only
TX/RX	RX	TX/RX	TX/RX	TX/RX	RX only	TX/RX	TX/RX	RX only
1:1 & 1:M	1:1 & 1:M	1:1 & 1:M	1:M	1:M	N/A	1:1	1:1	N/A
Not Seaworthy		Seaworthy	Seaworthy	Seaworthy	Not Seaworthy	Not Seaworthy	Not Seaworthy	Not Seaworthy
Requires live power		< 8 hours	> 24 hours	> 24 hours	Requires live power	<24 hours	<24 hours	> 24 hours
Requires specialized training			Simple to use	Simple to use	Somewhat simple to use	Simple to use	Simple to use	Simple to use
Neither compact nor portable	Neither compact nor portable	Compact & portable	Compact & portable	Compact & portable	Neither compact nor portable	Compact & portable	Compact & portable	Some are compact & portable
$$$	$$$$	$$	$$	$$	$$	$	$$	$
Can broadcast distress alerts					Cannot TX	Cannot broadcast		Cannot TX
Can send quick distress alerts					Cannot TX	Can send quick distress alerts		Cannot TX
Can cancel distress alerts					Cannot TX	Can cancel distress alerts		Cannot TX
Can RX NAV & MET MSI			Cannot RX NAV & MET MSI		Can RX NAV & MET MSI	May RX NAV & MET MSI through app		Yes
Some can log position			Can log position		No position logging	Can log position	No position logging	
Does not facilitate catch tracking						Apps may allow catch tracking	Does not facilitate catch tracking	
Does not provide market data						Apps may provide data	Does not provide market data	

Figure 6 Current State of Sample Essential and Non-essential Comms@Sea Devices

4.2 Enabling Environment

The enabling environment, in the context of this report, uses the case study of the 4 Smart Seas countries, and is further abstracted to cover the 34 Member States of the Inter-American Telecommunication Commission (CITEL)[20]. It leverages the *Smart Seas Gap Analysis of the Maritime Communications Enabling Environment (2022)*[21], which recognizes that the enabling environment primarily considers 5 dimensions:

1. **UN conventions and recommendations**: whether Smart Seas and CITEL countries are member states of relevant UN agencies, comply with the obligations under these conventions, and whether said conventions and recommendations consider SSF in their texts

2. **The ecosystem**: engagements among actors in the maritime communications ecosystem

3. **Policy and regulatory environment**: comms@sea-related policy and regulatory documents, such as frameworks, disaster management plans, etc; policy initiatives; enforcement measures; licensing; etc.

4. **Operations**: comms@sea infrastructure, and the roles of agencies within the sector

5. **Capacity**: knowledge and skills that lead to the utilization of communications at sea technologies

At an international level, many UN artefacts exist, including treaties, conventions and recommendations, which cover maritime communications and safety at sea. These primarily originate from the ITU, IMO, FAO

[20] Inter-American Telecommunication Commission (CITEL). *Member States*. Washington: CITEL, 2021. https://www.oas.org/en/member_states/default.asp
[21] International Telecommunication Union (ITU). *Smart Seas Gap Analysis of the Maritime Communications Enabling Environment*. ITU, 2022

ILO and WMO, and represent the baselines standards for comms@sea and safety at sea, along with its respective data. A list of relevant UN artefacts is provided in Table 5, and is classified in terms of regulations (Reg), recommendations (Rec) and frameworks (Fra).

Table 5 UN & International Artefacts related to SSF-related Maritime Communications

Agency	*Artefact(s)*	Latest Ed.	Type	Description
FAO	*Safety at Sea for Small-scale Fishers in the Caribbean*[22]	2020	Rec	Provides guidelines to enhance safety and reduce accidents at sea, particularly for the Caribbean region
	*Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries***Error! Bookmark not defined.**	2015	Rec	Provides practical advice for supporting sustainable development of SSF, covering different aspects such as resource management, social development, inclusivity and gender equality
FAO/ILO /IMO	*Safety Recommendations*[4]	2012	Rec	Lays out safety recommendations tailored for small fishing vessels including construction, equipment requirements, and operational procedures.
IMO	*IAMSAR Manual*[23]	2016	Rec	Provides guidelines for organizing and managing search and rescue operations at sea and general operations of SAR facilities
	*SAR Convention***Error! Bookmark not defined.**	2016	Reg	Establishes international standards and procedures for maritime search and rescue operations, defining the responsibilities of states and organizations involved in SAR organisation and operations
	*SOLAS Convention***Error! Bookmark not defined.**	2020	Reg	Sets minimum safety standards for construction, equipment, and operation of ships and other vessels. Instantiates the GMDSS, which stands as the leading international treaty for comms@sea, for vessels over 300 GT
ITU	*Radio Regulations, Edition of 2024***Error! Bookmark not defined.**	2024	Reg	Contains latest regulations and provisions related to radio communication including governance of allocation and use of radio frequencies for various communication services, including maritime communication
	ITU-R Recommendations	Ongoing	Rec	Series of recommendations published by the ITU-R sector based off study groups, which includes technical and performance standards for the operational procedures, technical characteristics and spectral use of comms solutions, including comms@sea solutions
WMO	*Manual on Marine Meteorological Services Guide to Marine Meteorological Services (WMO-NO. 558)*[24]	2012	Reg, Rec	Defines best practices for the exchange of marine meteorological information by authorities, and outlines key meteorological data to be collected and disseminated by WMO member states
	Early Warnings for All: Executive Action Plan 2023-2027	2022	Fra	Outlines strategies and initiatives for enhancing early warning systems for natural disasters and emergencies to enhance resilience

The multi-dimensional, multi-sectoral, maritime communications ecosystem can be viewed at a glance through FIGURE; it comprises a number of actors and agencies, as well as policies, regulations and other resources, at national, regional and international levels. A mapping of the nominal interactions in the case of Trinidad and Tobago, as an example, is provided in FIG. This reveals the engagements among actors ang agencies within the ecosystem.

[22] FAO. 2020. *Safety at Sea for Small-Scale Fishers in the Caribbean*. Rome. https://doi.org/10.4060/ca8626en

[23] IMO & ICAO. 2016. IAMSAR Manual: International Aeronautical and Maritime Search and Rescue Manual 2016 Ed. 7th ed. London

[24] WMO. 2012. Manual on Marine Meteorological Services. Volume I – Global Aspects. Annex VI to the WMO Technical Regulations Available at: https://library.wmo.int/doc_num.php?explnum_id=5442

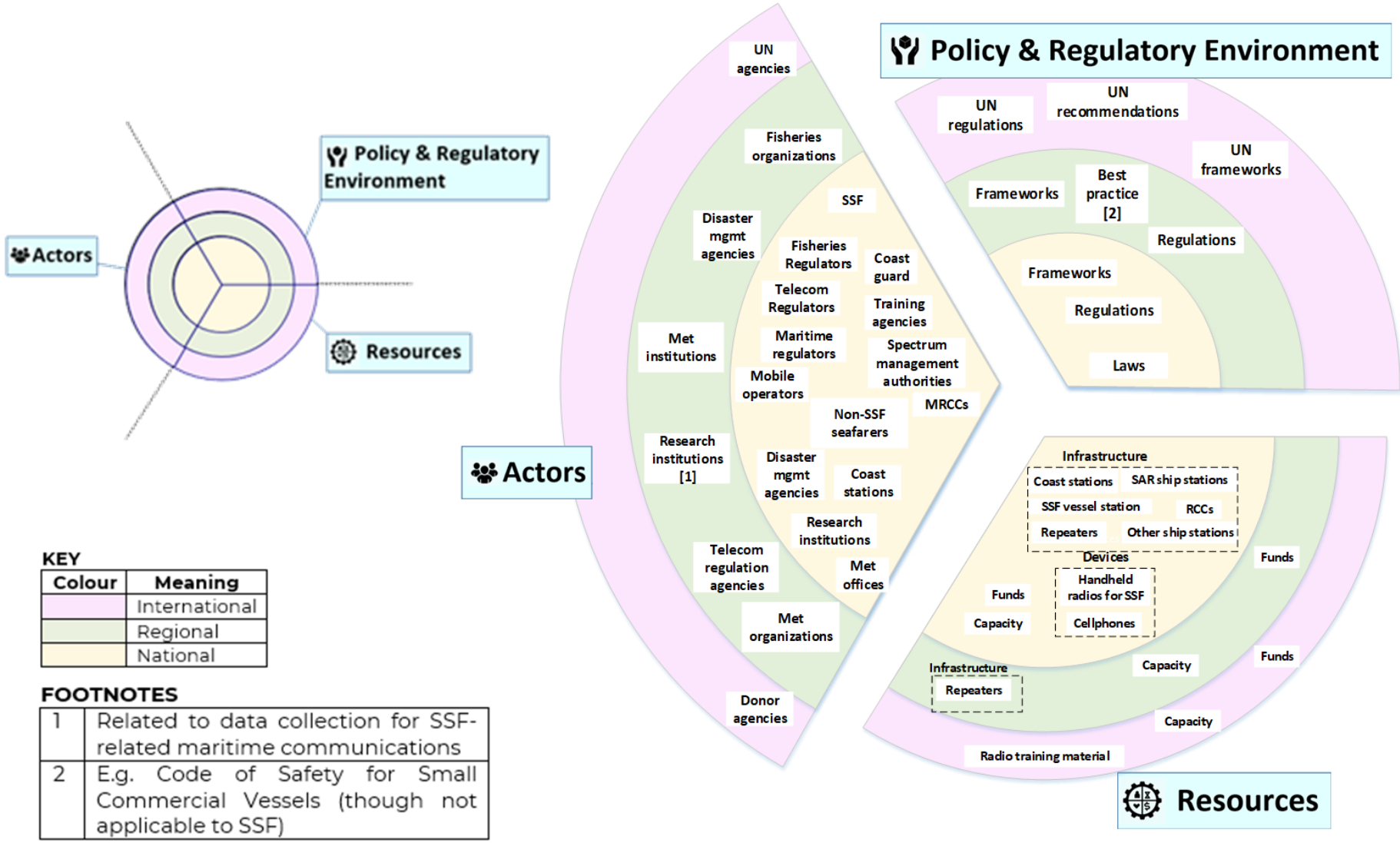
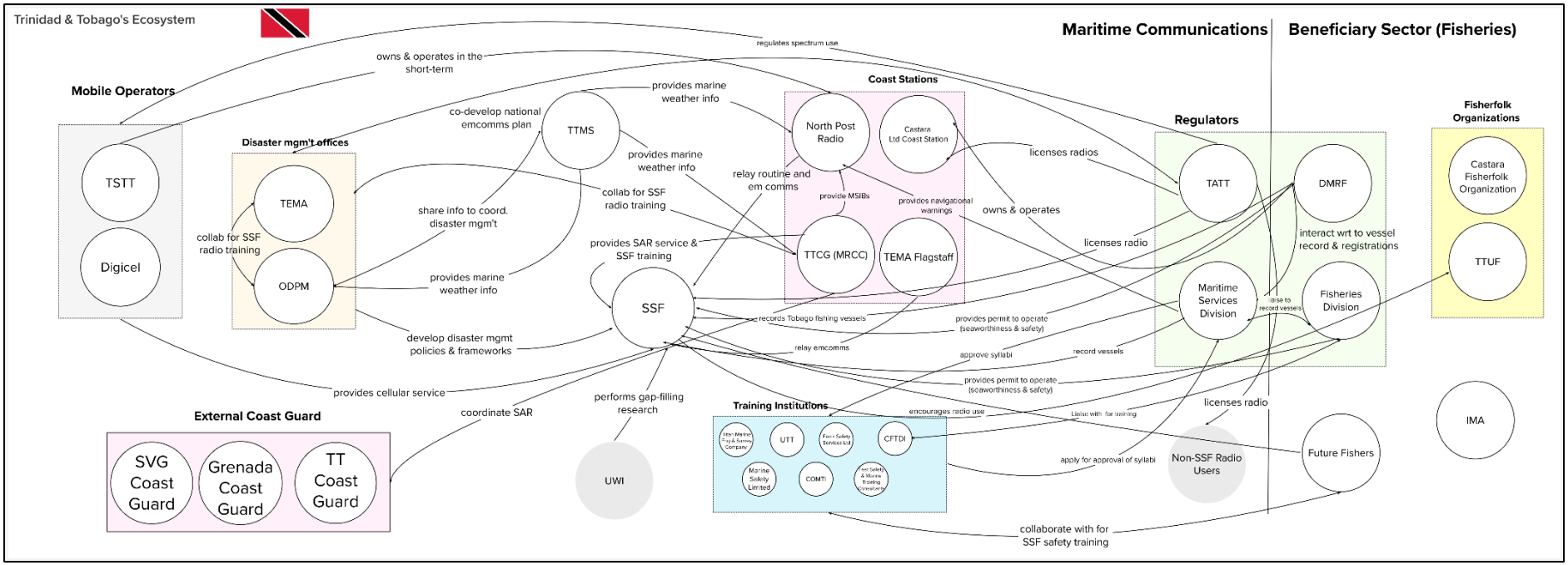


Figure 7 Maritime Communications Ecosystem - Multidimensional View



List of Acronyms

CFTDI - Caribbean Fisheries Training & Development
COMTI - Coastal & Offshore Marine Training Institute
DMRF - Department of Marine Resources and Fisheries
IMA - Institute of Marine Affairs
MRCC - Maritime Rescue Coordination Centre
MSIB - Maritime Safety Information Bulletin
NGO's - Non-governmental Organizations
ODPM - Office of Disaster Preparedness & Management
SAR - Search and Rescue
SSF - Small-scale Fishers
TATT - Telecommunications Authority of Trinidad and Tobago
TEMA - Tobago Emergency Management Agency
TSTT - Telecommunications Services of Trinidad and Tobago
TTCG - Trinidad and Tobago Coast Guard
TTMS - Trinidad & Tobago Meteorological Services
TTUF - Trinidad & Tobago United Fisherfolk
UTT - University of Trinidad & Tobago

Figure 8 Trinidad and Tobago Maritime Communications Ecosystem

Data was collected through desktop research on CITEL's 34 Member States' maritime communications enabling environment, which revealed a number of key findings across the 5 dimensions, shown in FIG. This includes CITEL Member States':

6. Membership with relevant UN Agencies
7. Compliance with applicable UN Conventions
8. Designation of national focal points to these UN Agencies
9. Designation of roles and responsibilities within the maritime communications ecosystem
10. Engagement levels among relevant agencies within the ecosystem
11. Data on the radio coverage and operations of, national shore-based facilities, which serve as rescue co-ordination centres
12. Inclusivity of policy and regulatory artefacts on comms@sea and SSF in universal service
13. Drafting and availability of official SAR agreements (bilateral or national agreements)
14. Policies, regulations and legislation on the carriage of comms@sea equipment by SSF
15. Availability of safety at sea and communications at sea training for SSF
16. Existence of localized curricula and certifications for SSF comms@sea use

A summary of the state is provided in FIG, and is used in the subsequent chapter to uncover key findings and gaps which may exist in the ecosystem.

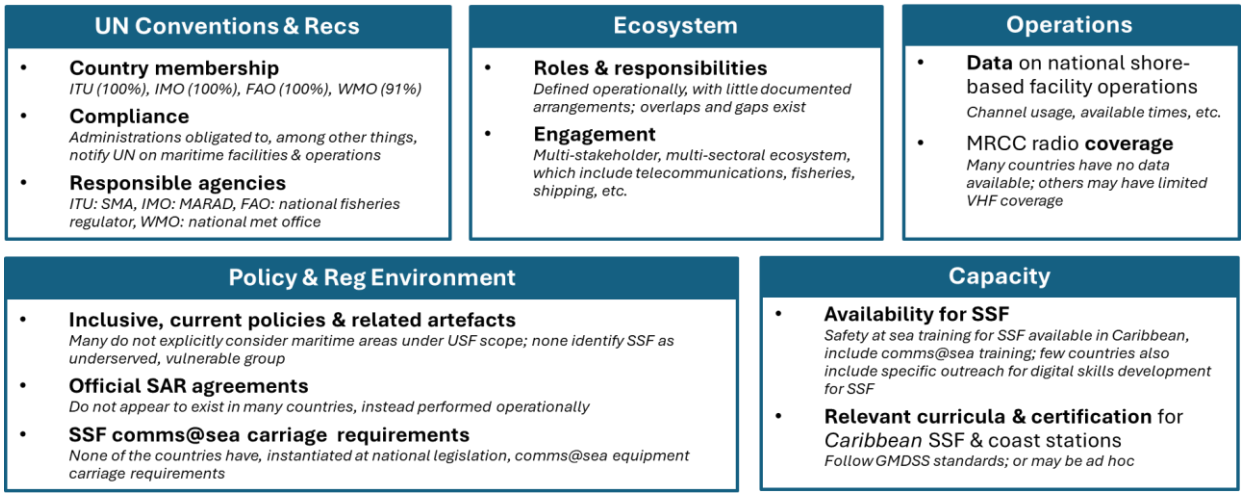


Figure 9 Current State of the Maritime Communications Enabling Environment among CITEL Member States

100% of CITEL Member States are also members of the ITU, IMO and FAO, yet only 91% are members of the WMO. Membership at UN organizations is critical in ensuring that all countries are equally represented at international discussions, and can benefit from regional and international expertise on matters related to the UN agency's specialization – in this case, marine meteorological topics.

Four key UN Conventions and Treaties were identified of interest in supporting comms@sea and safety for SSF. They included the ITU Radio Regulations, IMO SOLAS Convention, IMO SAT Convention and WMO Convention. Of the 34 CITEL Member States, 100% are signatory to the Radio Regulations, 97% are signatory to the SOLAS Convention and 68% are signatory to the SAR Convention. Furthermore, 91% of these countries are signatory to the WMO Convention, which matches the number of CITEL Member States that are also WMO Member States. The WMO Convention is of importance to the comms@sea as it obligates WMO Member States to notify the WMO on marine meteorological data and dissemination facilities, for inclusion in WMO No-9 Vol D, which is publicly available online.

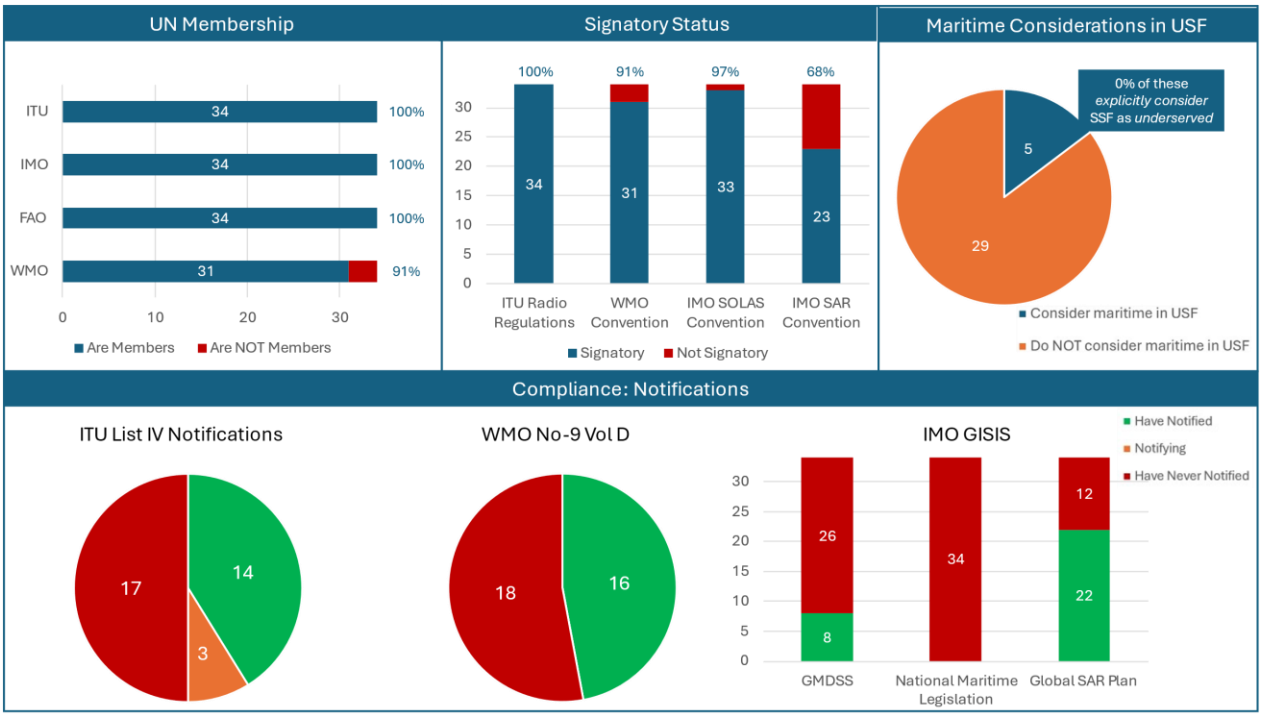


Figure 10 Data on Maritime Communications Enabling Environment among CITEL Member States

Of the 34 CITEL Member States (for which 2 are not part of WMO), only 16 of them have notified WMO on relevant data for inclusion in No-9 Vol D. ITU and IMO also collect data on coast stations (IMO terms as shore-based facilities) which are involved in comms@sea. These are collected through the ITU MARS database, which is published biannually as part of List IV: Coast Stations and Special Service Stations. The most recent List IV publication was in 2024, which contains information of 14 of CITEL's 34 Member States. Prior to the Smart Seas Project, 22 of the 34 Member States had never notified the ITU, this number has decreased from 22 to 20, with three of the 20 being in the process of preparing notifications. As such, the 14 of CITEL Member States have submitted notifications for ITU List IV. The IMO collects similar data on coast stations through GISIS, as part of its GMDSS and Global SAR Plan modules. In addition to this, data on Member States' national maritime legislation is requested. As of Jan 2025, none of CITEL's Member States have notified the IMO on its national maritime legislation, while 22 of the 34 Member States have notified on information for inclusion in the Global SAR Plan, and only 8 have notified on GMDSS national facilities.

Finally, each of the CITEL Member States that are members of the key UN agencies identified have all mapped local agencies to serve as point contacts. These are typically:

- *IMO*: Maritime administrations (MARADs)
- *WMO*: national meteorological agencies
- *ITU*: national telecommunicators regulators, spectrum management authorities or ICT ministries
- *FAO*: national fisheries ministries

Within the ecosystem, there are gaps and overlaps in responsibilities, particularly for UN notifications. While the preceding paragraph identifies a number of line agencies for the respective UN agencies, ITU, IMO and some of FAO's reporting requirements overlap for comms@sea. Overall, there is fairly good engagement across actors and sectors, though opportunity exists to strengthen collaboration and multi-agency efforts towards saving lives and supporting livelihoods for SSF through comms@sea.

Data on existing coast stations, which are vital for saving lives at sea, and play a critical role in the overall disaster management process, are not usually collected and stored by Member States, which may explain

the reason for low compliance rates with ITU and IMO, as the data simply is not collected. Data on the coverage of existing coast stations is not typically collected, due to the lack of field tests and routine simulations. This may result in limited coverage of station, which can pose a threat to safety of life at sea.

Within the policy and regulatory environment, there are many useful artefacts, including policies, regulations, legislations and frameworks, that empower and designate the roles and responsibilities of national telecommunications regulators and spectrum management authorities, including provisions for universal service and maritime licensing. Despite the existence of these, only 17% of CITEL Member States explicitly include provisions for maritime within their universal service frameworks, and none of them explicitly consider SSF as underserved. Many countries, which cover multiple territories through its MRCCs, do not have official SAR agreements in the form of bilateral agreements in place; instead multi-country SAR coordination is performed operationally among the relevant countries and agencies. Finally, there does not appear to be any national regulations that mandate the carriage of comms@sea. While simply passing regulations is the solution, they can greatly support the development of the enabling environment.

5 Gaps & Key Findings

The requirements in Chapters 3 (Demand) were compared to the existing comms@sea in Chapter 4 (Supply) to determine whether gaps exist, using the dimensions from the analytical framework in Chapter 2. Gaps were noted across devices, services, the enabling environment and data, as follows.

Gaps in accessible comms@sea for SSF = DEMAND: accessible comms@sea for SSF – SUPPLY: current state of comms@sea

5.1 Devices

The devices in Chapter 4 are assessed through the nominal requirements provided in Chapter 3, and use a traffic light rating (green, orange and red) to classify the features of each device. Furthermore, these devices are assessed in terms of their generic characteristics, to ensure fairness and minimize bias and overspecification of a particular make and model device. Of the devices assessed, many of them are not fit to be placed on pirogues, and are suited for larger vessels with access to live power, ultimately impacting the fitness-for-purpose of these devices for SSF. Gaps exist in the following areas:

1. Many of the devices assessed are not made to be exposed to maritime elements, such as seablast, and are generally not seaworthy
2. Many devices require live power, and are not portable, limiting their practicality for pirogues
3. Radios require specialized digital skills to safely and effectively operate
4. Non-GMDSS devices cannot broadcast alerts and can neither initiate nor cancel distress alerts
5. Some (but not all) GMDSS devices can receive navigational, meteorological and maritime safety information
6. None of the devices assessed particularly support catch tracking and provide fish market data

	Comms@Sea Solution	VHF-DSC Radio	MF-DSC Radio	Handheld VHF radio	EPIRB	SART/AIS -SART	NAVTEX receiver	Mobile Telephone	Satellite Phone	Radio Receiver
General	Use	V2V V2S	V2V V2S	V2V V2S	V2V V2S	V2V V2S	RX only	C2C	C2C	RX only
	Type	TX/RX	RX	TX/RX	TX/RX	TX/RX	RX only	TX/RX	TX/RX	RX only
	TX Mode	1:1 & 1:M	1:1 & 1:M	1:1 & 1:M	1:M	1:M	N/A	1:1	1:1	N/A
Lifesaving	Seaworthy?	No	No	Yes	Yes	Yes	No	No	No	No
	Battery? (HI, MD, LO, N/A)	N/A	N/A	MD	HI	HI	N/A	MD	MD	HI
	Complexity	High	High	High	Low	Low	Medium	Low	Low	Low
	Compact/portable?	Neither	Neither	Both	Both	Both	Neither	Both	Both	Some are
	Price basket	$$$	$$$$	$$	$$	$$	$$	$	$$	$
	Broadcast distress alert?	Yes	Yes	Yes	Yes	Yes	No	No	No	No
	Quick distress alert?	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
	Cancel Distress?	Yes	Yes	Yes	Yes	Yes	No	May receive through app	May receive through app	No
	RX NAV & MET MSI?	Yes	Yes	Yes	No	No	Yes	No	No	Yes
	Position logging?	Some do	Some do	Some do	Yes	Yes	No	Yes	No	No
Livelihood	Catch tracking?	No	No	No	No	No	No	Apps may allow catch tracking	No	No
	Market data?	No	No	No	No	No	No	Apps may provide data	No	No

Figure 11 Assessment of Comms@Sea Devices

Of the devise provided, many are not seaworthy, and should not be used by SSF while at sea; these devices were not designed to be installed on pirogues and, in some cases, even be used at sea. EPIRBS, handheld

VHF radios and SARTS/AIS-SARTS are seaworthy and rugged, which allow them to withstand sea blast and float if thrown overboard. A number of these devices are sometimes brightly coloured in orange, to allow them to be spotted easily from a distance.

The overall design for these devices to require live power supply impact the assessment of battery life as fixed and mobile VHF-DSC and MF-DSC radios as well as NAVTEX do not operate on battery power and instead require a live power supply. EPIRBS and SARTS are built to operate over long durations and can remain active for over 24 - 36 hours, which is desirable in life threatening situations. Handheld radios (VHF, VHF-DSC, MF/HF or MF/HF-DSC) operate on battery power, which can last from 8 - 24 hours in most instances, depending on its use. Constant transmissions as well as low squelch on battery-powered radios can decrease battery discharge times, while strategies such as transmitting at lower powers, and increasing squelch, may help extend battery discharge times. Many of the devices, both GMDSS and otherwise are compact and portable, while those what are designed to require a live power supply are not portable, unless a portable power supply is available.

Pricing was assessed using relative price backets, so to abstract from specific brands and normalize the results. Mobile phones and radio receivers, which are not GMDSS-compliant, are most affordable, while fixed VHF-DSC and MF/HF-DSC radios are more expensive. All other devices, GMDSS or otherwise, fall between these baskets.

GMDSS-compliant devices, with the exception of NAVTEX which is receive-only, are capable of initiating and cancelling quick distress alerts, which is of tremendous value in life threatening scenarios. Those outside of the GMDSS scope, such as cellular and satellite phones, so not allow for broadcast alerts, which is a major shortcoming of using these devices to communicate during emergencies. Ideally, devices designed for lifesaving communications should be configured to initiate and receive broadcast emergency alerts from other end user devices once within range. Cellular and satellite phones can, however, be used at the risk of the person making alerts, to communicate with authorities and other relevant persons while in life threatening situations. There is an additional risk in whether or not the call is answered over the direct calls made which, if unanswered, can cost lives. The time taken for the receiver to answer said calls also impacts whether phones can be used to make *quick* distress alerts.

In addition to simply communicating with relevant authorities while in life threatening situations, there is the need to receive navigational, meteorological and maritime safety information; this information can be used to inform fishing trips and areas ventured prior to launch, which can ultimately prevent the loss of life through early warnings. Radios (fixed; mobile; handheld VHF, MF/HF, VHF-DSC, MF/HF-DSC), NAVTEX and some FM radio receivers are able to receive this information, while EPIRBs and SARTs cannot. Cellular and satellite phones may be able to receive, though this would be through an application or national early warning system, and requires adequate coverage and quality to receive. Some radios allow for logging of positions, which can be valuable when transmitting or receiving distress alerts, to pinpoint the location of those in distress. This position data can also be used by fisherfolk to track and navigate to/from their daily catch, based on fishing spots of interest, which can support their livelihoods. EPIRBs and SARTs also facilitate position logging, but only when the devices have been activated, which should only take place during distress situations. Cellular phones, through specific apps, may also track position data, but require adequate coverage and quality to do so.

Finally, looking beyond comms@sea for lifesaving purposes, devices can support SSF's livelihoods. These devices can be used by fisherfolk to track and report on their catch, as well as obtain market data. Of all the devices assessed, only cellular phones can possibly be used for this purpose, at this time, and is once again dependant on the availability of adequate coverage and quality.

While cellular and satellite phones appear, from this analysis, to be better suited as accessible comms@sea solutions for SSF, their shortcomings in coverage and quality (discussed in the next section) as well as their inability to initiate and receive free distress alerts are key barriers to supporting accessible comms@sea for SSF from a lifesaving perspective.

5.2 Services

Accessible services go hand-in-hand with devices. For these assessments, services for the respective devices assessed previously are assessed, as follows. Gaps exist in the following areas:

7. Limited/variable coverage at sea, for services other than satellite
8. Limited cellular infrastructure to serve maritime areas
9. Inflexible pricing models and baskets for satellite phones
10. Absence of national standards for quality of service at sea for all devices

Comms@Sea Solution	VHF-DSC Radio 	MF-DSC Radio 	Handheld VHF radio 	EPIRB 	SART/AIS -SART 	NAVTEX receiver 	Mobile Telephone 	Satellite Phone 	Radio Receiver 
Infrastructure required?	No but range can be improved through infrastructure			No	No	No	Yes	Yes	Yes
Service availability @ sea	Depends on coverage of coast stations and distance to vessels			High	High	High	Low	High	High
Price basket	Free	Free	Free	Free	Free	Free	$	$$$	Free
Pricing model	Free	Free	Free	Free	Free	Free	Prepaid & Postpaid	Postpaid	Free
Broadcast capabilities	Yes	Yes	Yes	Yes	Yes	No	No	No	No
QOS Criteria	N/A	N/A	N/A	N/A	N/A	N/A	Depends on local regulatory framework	N/A	N/A
Licensing requirement	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Licensing cost	$	$	$	$	$	N/A	N/A	N/A	N/A

All devices other than radios require infrastructure. These include cellular and satellite infrastructures, which comprise satellite as well as end user terminals. The installation of repeater infrastructure can, however, greatly improve range. For radios, repeaters, which are unmanned, require full duplex channels, which is not the case for the emergency channels (VHF 16, 70; MF/HF 2182 kHz). As such, the extension of range through repeaters can only be done for channels which use routine (non-emergency) traffic. The installation of coast stations is another key interest in infrastructure deployment for radio comms@sea, as they can be installed on elevated topography to minimize the impact of line-of-sight communications, which affects those in the VHF bands and above. Unlike repeaters, these stations are operated by certified personnel and can operate on any radio channel (simplex or duplex) once the relevant radios are installed.

The availability of services varies by device assessed. As radio communications is infrastructure-less, the availability and range depend on the distance and operating power between transmitting and receiving stations, whether that be two stations at sea (boats) or one on land (coast station) and one at sea (boat). The installation of appropriate infrastructure to support radio communications falls to the owners of coast stations, as well as Administrations, to ensure that rescue co-ordination agencies such as national coast guards are appropriately equipped. EPIRBs, SARTs, NAVTEX and satellite phones typically operate off satellite networks, which have a high coverage at sea, making them an attractive option for all seafarers. Cellular phone coverage is, however, opportunistic at best. Many countries do not obligate mobile network operators to provide coverage at sea as part of their concessionary agreements, which result in gaps in cellular service at sea. In other countries, who have thriving oil and maritime sectors, may provide limited service to these areas.

Price baskets are used to comparatively assess the cost of services, similarly to the assessment done under the devices section. Most of the services are free to use, with the exceptions being cellular and satellite phones. The pricing model for these services include pre- and postpaid for cellular phones, while satellite phones typically only use postpaid subscription models. While satellite phones are able to provide ubiquitous coverage, their subscription-oriented pricing is less than desirable for SSF, and are typically outside of their affordability. Furthermore, for fishers who mainly wish to use these devices for safety only, a pay-as-you-go model would be better fitting, as they are unlikely to encounter life threatening situations

daily, decreasing the potential use of these services. As such, gaps exist in having an emergency communications service for satellite phones, which (i) use a pay-as-you-use model, and (ii) consider reduced rates for calling to rescue co-ordination centres. GMDSS-compliant devices, while they are free to use, require licenses from national telecommunications regulators and spectrum management authorities, for devices that have transmission capabilities (excludes NAVTEX and FM radio as these are receive-only). These licenses were found to be quite affordable and are crucial to maintain and ensure accountability of stations broadcasting over shared bands. Based on the nominal list of devices surveyed only the GMDSS-compliant devices which have transmitting capabilities also have broadcast capabilities. This is a highly desirable feature which can increase the probability of nearby stations (vessels, coast stations, etc.) receiving distress alerts and can potentially increase the number of persons that can assist during an emergency at sea.

5.3 Enabling Environment

An enabling environment is key in promoting accessible comms@sea for SSF. Among the 5 areas identified in Chapter 4, a number of gaps were identified across all 5 areas.

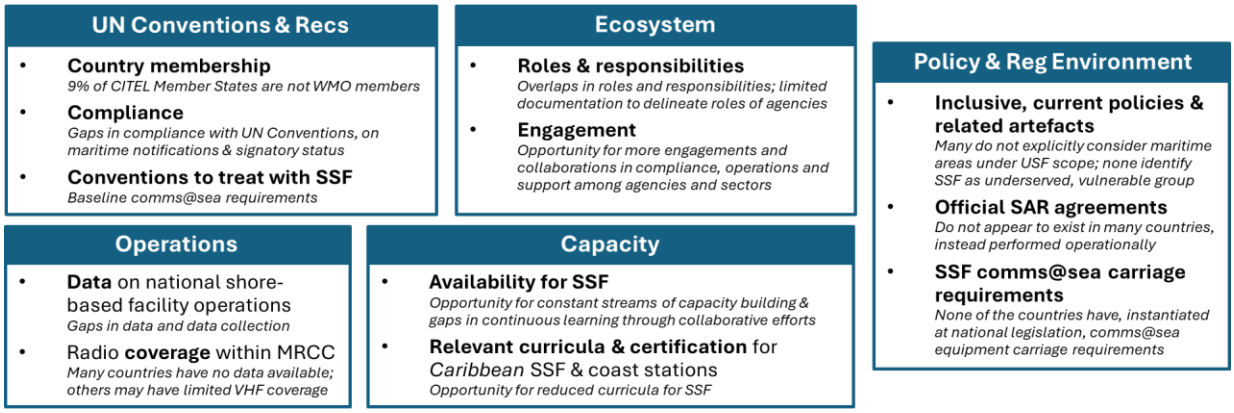


Figure 12 Gaps in the Maritime Comms Enabling Environment

6 Priorities to Enable Accessible Comms@Sea

This section outlines the essential priorities needed to enhance communication at sea, particularly for small-scale fishers (SSF). These priorities focus on standardization, research and development, infrastructure maintenance, and policy advocacy to create a more resilient and inclusive maritime communication environment.

This section outlines the priorities to create a robust enabling environment across the five dimensions critical to enhancing communication at sea for small-scale fishers.

6.1 Telecommunications Regulators & SMAs

Recommendation	Dimension
1. Support research and development by manufacturers to augment existing devices to fill gaps identified in this report (emergency broadcast capabilities, seaworthiness, livelihood-supporting features, etc.)	Devices
1. Lead the development of national QoS guidelines and frameworks, in consultation with key agencies, for comms@sea services 2. Ensure that pricing models for the services identified are fair and within purchasing power by SSF 3. Leverage, where they exist and where practicable, USF in supporting service availability at sea	Services
1. Review the membership status with the ITU, and signatory status of ITU Radio Regulations for countries under jurisdiction 2. Participate in regional and international fora on ICT development and maritime safety, advocating the need for accessible comms@sea for SSF 3. Review status of, and fill gaps in maritime notifications to ITU 4. Review and revise USF Frameworks, to align with findings of digital inclusion surveys 5. Review and revise national policies, regs & frameworks, as appropriate, to consider (i) maritime environment within universal service scope; and (ii) vulnerable populations who earn their living at sea 6. Support ongoing engagement among and within sectors and entities with overlapping strategic objectives of comms@sea, safety@sea and fishing 7. Take necessary action to minimize barriers to inaccessible comms@sea for all mariners, and promote the routine carriage and use of such solutions which satisfy the technical requirements of the GMDSS. 8. Co-develop and advocate for the inclusion of relevant ITU Study Group Questions across all three of the ITU sectors (ITU-D, ITU-T and ITU-R), to investigate means for filling gaps to accessible comms@sea for vulnerable communities who earn their living at sea 9. Advocate for the consideration of adapting communications standards for cellular and satellite phones, to enable the transmission of end-user broadcast emergency alerts 10. Advocate, in collaboration with MARADs, continuous reviews and modernization of the GMDSS, to consider emerging technologies 11. Support the digital skills development of SSF on basic as well as specialized communications, to support their lives on land and at sea 12. Support the fair pricing, or even subsidization of comms@sea devices and services, for use by vulnerable and underserved groups such as SSF 13. Include maritime provisions in national emergency telecommunications plans 14. Stimulate technological advances in livelihood supporting comms@sea tools and apps through hackathons and other competitions 15. Develop regional and international proposals on areas of study sea to support digital inclusion of communities who earn livelihoods at sea 16. Make available to all mariners and other key agencies, contact information on MRCCs and coast stations obtained during licensing	Enabling Environment

17. Ensure that licensing forms collect all data required for ITU notifications 18. Take any other action to minimize barriers to inaccessible comms@sea for all mariners, and promote the routine carriage and use of such solutions which satisfy the technical requirements of the GMDSS	
1. Coordinate, through multi-agency collaboration, UN notifications which require similar data (ITU MARS, IMO GISIS, WMO No-9 Vol D) 2. Routinely conduct and share findings of national digital inclusion surveys 3. Track the digital inclusion of SSF through periodic digital inclusion surveys 4. Periodically review, in collaboration with relevant agencies, the validity of notified information to the ITU 5. Support the development of national data hubs which collect, share and report on, among other things, incidents that occur at sea and marine weather and climate data	Data

6.2 Maritime Administrations

Recommendation	Dimension
1. Promote the use of GMDSS-compliance comms@sea by SSF 2. Explore opportunities for funding and subsidization of essential comms@sea solutions by SSF	Devices
1. Advocate, to SMAs, the need to consider USF coverage of maritime areas	Services
1. Review the membership status with the IMO, and signatory status of the SOLAS and SAR Conventions for countries under jurisdiction 2. Participate in regional and international fora on maritime development and safety, advocating the need for accessible comms@sea for SSF and all mariners 3. Review status of, and fill gaps in maritime notifications to IMO GISIS 4. Develop national maritime policies, regulations and legislation to mandate the carriage of comms@sea solutions by SSF 5. Support ongoing engagement among and within sectors and entities with overlapping strategic objectives of comms@sea, safety@sea and fishing 6. Advocate for the conduct of studies on adapting telecommunications standards, UN conventions, etc. to consider facilitating the transmission of broadcast emergency alerts through cellular and satellite phones 7. Advocate, in collaboration with SMAs, continuous reviews and modernization of the GMDSS, to consider emerging technologies 8. Support the digital skills development of SSF on basic as well as specialized communications, to support their lives on land and at sea 9. Advocate for the inclusion of maritime areas within universal service frameworks, as well as the recognition of SSF as underserved, vulnerable groups 10. Advocate for the formalization of SAR policies and agreements where they do not exist, among countries which perform the role operationally 11. Lead the development of, in collaboration with other key agencies, policy, regulatory and legislative provisions for SSF comms@sea carriage requirement, and consult with SSF and other key agencies during policy development 12. Take any other action to minimize barriers to inaccessible comms@sea for all mariners, and promote the routine carriage and use of such solutions which satisfy the technical requirements of the GMDSS	Enabling Environment
1. Coordinate, through multi-agency collaboration, UN notifications which require similar data (ITU MARS, IMO GISIS, WMO No-9 Vol D) 2. Periodically review, in collaboration with relevant agencies, the validity of notified information to IMO 3. Support the development of national data hubs which collect, share and report on, among other things, incidents that occur at sea and marine weather and climate data	Data

6.3 Mobile Network Operators (MNOs)

Recommendation	Dimension
N/A	Devices
Use the findings of this report in future developments of affordable comms@sea service models for SSF and all mariners Consider the extension of service to maritime areas, in consultation with regulators and while minimizing the likelihood of cross-border interference Consider proposing services extension to maritime areas, through joint-USF financing	Services
Consider supporting outreach to, and social good activities in support of, SSF, to improve their digital inclusion on land and at sea	Enabling Environment
Support the development of national data hubs which collect, share and report on, among other things, incidents that occur at sea and marine weather and climate data	Data

6.4 Satellite Network Operators

Recommendation	Dimension
1. Use the findings of this report in future developments of comms@sea devices, to promote their accessibility to SSF and use at sea	Devices
1. Use the findings of this report in future developments of affordable comms@sea service models for SSF and all mariners	Services
1. Consider supporting outreach to, and social good activities in support of, SSF, to improve their digital inclusion on land and at sea 2. Engage with SMAs and MARADs on projects to test the applicability of satellite solutions in the maritime environment, particularly on SSF vessels	Enabling Environment
1. Support the development of national data hubs which collect, share and report on, among other things, incidents that occur at sea and marine weather and climate data	Data

6.5 Manufacturers

Recommendation	Dimension
1. Use the findings of this report in future developments of comms@sea devices 2. Develop gap-filling augmentations for devices which already exist, such as: sea-proof casings, emergency broadcast capabilities, etc. 3. Engage with SSF and national regulators (telecommunications, maritime, fisheries) on the possibility of testing new devices to fill the gaps which exist	Devices
1. Collaborate with telecommunications regulators on the development of QoS requirements for services being provided at sea	Services
N/A	Enabling Environment
3. Support the development of national data hubs which collect, share and report on, among other things, incidents that occur at sea and marine weather and climate data	Data

6.6 MRCCs & Coast Stations

Recommendation	Dimension
1. Conduct routine tests to ensure the operation of all devices to standard	Devices
1. Conduct routine tests at sea to determine the coverage and quality of services provided	Services

2. Consider the deployment of redundant infrastructure to strengthen the service's resilience	
1. Support SMAs, MARADs and meteorological organizations' notification of MRCCs and coast stations to their respective UN agencies 2. Develop standard operating procedures for coast stations and MRCCs, grounded in UN conventions and international best practice 3. Disseminate daily maritime safety information, navigational warnings as well as meteorological information through communications channels	Enabling Environment
1. Support maritime notifications to respective UN agencies 2. Digitize and maintain records of situations at sea 3. Disseminate daily maritime safety information, navigational warnings as well as meteorological information through communications channels 4. Support the development of national data hubs which collect, share and report on, among other things, incidents that occur at sea and marine weather and climate data	Data

6.7 Fisheries Regulators

Recommendation	Dimension
1. Promote the use of GMDSS-compliance comms@sea by SSF 2. Support research and development of livelihood-supporting comms@sea devices which can, among other things, share fishing market data as well as perform catch tracking 3. Seek funding, subsidization and project support for the procurement of essential comms@sea solutions by SSF	Devices
1. Share findings or reports of coverage and quality of service in areas where SSF operate, with regulators, service providers and MRCCs and coast stations, to support future upgrades and maintenance	Services
1. Participate in relevant FAO working groups which support the development of comms@sea for lifesaving and livelihood-supporting operations of SSF 2. Perform outreach and social media campaigns to raise awareness of comms@sea which can save SSF lives and support their livelihoods 3. Ensure that there are no overlaps in roles and responsibilities with other key agencies, such as on SSF vessel registrations, etc 4. Advocate for SSF to license GMDSS-compliant comms@sea devices which they own, as applicable under national regulations and legislation 5. Advocate for a continuous learning capacity building programmes for SSF, which includes components lifesaving and livelihood-supporting comms@sea 6. Facilitate consultations and outreach with SSF on policy, regulatory and legislative developments for comms@sea and safety at sea 7. Advocate for the inclusion of maritime areas within universal service frameworks, as well as the recognition of SSF as underserved, vulnerable groups 8. Advocate for the formalization of SAR policies and agreements where they do not exist, among countries which perform the role operationally 9. Support MARADs in the development policy, regulatory and legislative provisions for SSF comms@sea carriage requirements, by engaging SSF in consultations/supporting SSF participation in consultations	Enabling Environment
1. Support maritime notifications to respective UN agencies 2. Support the development of national data hubs which collect, share and report on, among other things, incidents that occur at sea and marine weather and climate data 3. Encourage lifesaving and livelihood-supporting data sharing by SSF with key agencies in the ecosystem	Data

6.8 Fisherfolk Organizations, NGOs and SSF

Recommendation	Dimension
1. Support the adoption and routine use of applicable and practical comms@sea solutions, as captured in the GMDSS 2. Advocate, to SMAs, fisheries regulators and MARADs, the need to consider alternative communications methods, as applicable, for proposals to the UN	Devices
1. Share observations on coverage and quality of service in areas where SSF operate, with regulators, service providers and MRCCs and coast stations, to support future upgrades and maintenance 2. Advocate for SSF to get their equipment licensed, as applicable, through SMA 3. Advocate for the maintenance of these licenses through SMF	Services
1. Participate in consultations on maritime safety, comms@sea and fisheries policy and regulatory developments 2. Continue advocating for the needs of SSF with respect to comms@sea for use in lifesaving and livelihood-supporting operations	Enabling Environment
1. Encourage lifesaving and livelihood-supporting data sharing by SSF with key agencies in the ecosystem 2. Support the development of national data hubs which collect, share and report on, among other things, incidents that occur at sea and marine weather and climate data	Data

6.9 Regional & International (UN) Agencies

Recommendation	Dimension
1. Share with membership, the gaps identified, and advocate for support in gap filling 2. Consider the inclusion of accessible comms@sea for SSF in the work of existing Working Groups	Devices
1. Share with membership, the gaps identified, and advocate for support in gap filling 2. Develop global best practice guidelines on USF frameworks to consider (i) maritime areas and (ii) vulnerable communities who earn livelihoods at sea	Services
1. Develop global best practice guidelines on USF frameworks to consider (i) maritime areas and (ii) vulnerable communities who earn livelihoods at sea 2. Collaborate with other UN agencies to minimize the redundancy in notification requirements across sectors 3. Advocate to, and raise awareness of, membership on the need for collaboration, support and emphasis in providing accessible comms@sea for SSF, as well as they gaps which exist, as captured in this report 4. Advocate for the review of existing UN Conventions, to include provisions for SSF and fishing vessels	Enabling Environment
1. Continue and improve, where practicable, outreach to Member States on notifications, to fill data gaps which exist	Data

6.10 Academia

Recommendation	Dimension
1. Support collaborative research, development of innovative comms@sea devices prototypes for lifesaving and livelihood supporting SSF operations 2. Develop prototypes and simulations to fill the gaps in existing devices (battery extenders, practical power supplies for pirogues, emergency broadcasting for phone, etc.	Devices
1. Develop and simulate innovative services and protocols to augment and strengthen existing ones	Services

2. Co-develop and support the measurement of QoS requirements for comms@sea solutions, and recommend gap-filling actions	
1. Support the development of an enabling environment, which is inclusive and supports innovation and development 2. Strengthen support and collaboration for research and innovation among academia, regulators, fisherfolk organizations, NGOs, SSF and service providers	Enabling Environment
1. Support the development of national data hubs which collect, share and report on, among other things, incidents that occur at sea and marine weather and climate data 2. Leverage the use of emerging technologies to support the digitization of records, and explore the possibility of predictive analysis and insights on data collected through data hubs	Data

7 Forward Looking

Emerging technologies, such as IoT and D2D, present promising opportunities for enhancing the maritime communications and its operations. These technologies can aid in lifesaving operations and for the acquisition and dissemination of livelihood-supporting data.

This chapter aims at exploring opportunities to advance research, development and innovation in comms@sea solutions, to save lives and support livelihoods. Two sample initiatives are explored under this Chapter, which include:

1. Direct-to-Device (D2D)
2. Internet of Things (IoT)

7.1 Direct-to-Device (D2D)

As outlined in previous chapters of this report, gaps are present in accessible comms@sea for SSF. Direct-to-device (D2D) is an innovative means of filling the connectivity gap. It allows the delivery of satellite-based connectivity to end-user devices such as smartphones, tablets, IoT devices, etc. requiring intermediary hardware like satellite terminals or ground station[25]. It represents a convergence between satellite and terrestrial telecommunications networks, and hence requires partnerships between mobile satellite providers, as well as mobile network operators (MNOs). According to the Mobile Satellite Service Association (MSSA 2024), D2D is expected to fulfil the following use cases:

1. complement existing MNO infrastructure and connect underserved or unserved parts of urban and suburban areas, as well as mountainous, maritime, aeronautical, isolated, and rural areas, and;
2. facilitate short-term, urgent requirements such as disaster response

While cellular and satellite phones fall outside of the scope of lifesaving comms@sea solutions, as detailed in **Chapter 4: Supply**, D2D enables these devices to provide complimentary support to the suite of comms@sea solutions, and can be used in livelihood-supporting activities. In the dire event where it is that authorities cannot be reached through the GMDSS-compliant comms@sea solutions, D2D-enabled devices may be leveraged as a *last-resort* to contact authorities due to its global range.

A significant limitation of using D2D communication for lifesaving situations is its inability to transmit broadcast alerts from end-user devices, unlike standard (GMDSS-compliant) lifesaving comms@sea solutions. This limitation restricts distress calls to a single recipient over mobile or satellite networks, which can be problematic if the intended recipient is unavailable or unresponsive. This constraint is one of the primary reasons why cellular and satellite phones are excluded from the GMDSS. However, as noted by the FAO, ILO, and IMO (2012), while not a standardized solution, cellular and satellite phones may offer greater accessibility and practicality for SSF. These devices do not require specialized training or licensing, which are typically necessary for GMDSS-compliant communication systems.

As of January 2025, direct-to-device (D2D) technology has not yet undergone testing or deployment in the Caribbean. However, satellite companies such as SpaceX have initiated testing of direct-to-cell (D2C), an application of D2D, with devices from flagship smartphone manufacturers such as Samsung, Apple and Google. SpaceX highlights that D2D services can be utilized by cellular devices that are at least LTE-enabled, without requiring any additional hardware modifications[26].

[25] Mobile Satellite Service Association (MSSA). *Considerations for Direct-to-Device Satellite Technology*. Mexico: CITEL PCC.II, 2024
[26] Noah, Smith. *Elon Musk has done it: iPhones and Android smartphones can now use his satellites to make calls anywhere on Earth*. JasonDeegan High Tech News Updates, 2024. https://jasondeegan.com/elon-musk-has-done-it-iphones-and-android-smartphones-can-now-use-his-satellites-to-make-calls-anywhere-on-earth/

While D2D offers a number of opportunities to achieve accessible comms@sea for SSF, and by extension, meet international goals for universal and meaningful connectivity, a great deal of work is still required among key stakeholders within the maritime communications ecosystem. These include but are not limited to:

Stakeholder Group	Action
Telecommunications Regulators & SMAs	• At the national level, ensure that MSS D2D is enabled within the existing global regulatory framework that supports today's MSS services as well as massive adoption of MSS D2D in coming years, leveraging the work already done at the 3GPP to complete Release 17 and 18 which includes non-terrestrial networks (NTN) and addresses satellite's role in the global IMT ecosystem; • Actively participate in regional studies related to D2D, such as under CITEL PCC.II or otherwise • Actively participate in studies related to ITU WRC-27 Agenda Item 1.13 (A.I. 1.13), on regulatory, technical, and operational challenges stemming from the provision of IMT D2D
Mobile Network Operators Satellite Network Operators	• Support, in collaboration with relevant agencies, D2D-based studies and the development of national policies, regulations and frameworks
Regional Telecoms Organizations	• Support the participation of Member States in ITU WRC-27 A.I. 1.13 • Attend and serve as inter-regional co-ordinators for D2D-related studies, and pilot projects, liaising with national regulators, MNOs and satellite network operators
UN Agencies	• Coordinate global studies, in collaboration with Member States, Sector Members, Academia and other key stakeholders, on the methods and means to support the technical developments of D2D • Develop, in collaboration with Member States, nominal regulatory frameworks, guidelines and templates to support the policy and regulatory environment in preparing for the integration of D2D • Support sensitization campaigns of integrating D2D services in connecting the unconnected and enabling universal and meaningful access for all • Consider the applicability, gaps and need for future work in D2D to support lifesaving and livelihood supporting comms@sea, particularly for SSF • Foster collaboration among relevant actors in the ecosystem
Standardization Bodies	• Conduct studies on, and explore the possibility of developing standards for end-user cellular broadcast messaging in emergency situations • Engage with MNOs, satellite network operators, regulators and other key agencies to determine the most applicable spectrum utilization approach for D2D solutions, and a baseline regulatory framework

7.2 Internet of Things (IoT)

The Internet of Things (IoT), while not a new concept, offers significant opportunities for enhancing comms@sea. IoT sensors can facilitate data acquisition and dissemination, enabling advanced analysis of collected data to provide actionable insights into sustainable fishing practices, navigation, weather patterns, and sea state information.

A key IoT technology in this domain is Narrowband IoT (NB-IoT), a low-power, wide-area network (LPWAN) technology specifically designed for IoT devices. NB-IoT features low power consumption, extensive coverage range, and narrow bandwidth, making it well-suited for comms@sea. According to 3GPP Release 17, there are ongoing efforts to extend NB-IoT capabilities from terrestrial networks to satellite systems, also referred to as NTNs (5G Americas, 2022**Error! Bookmark not defined.**). This advancement enables sensors to acquire and disseminate data through satellite systems, offering extended coverage and connectivity.

Table 6 highlights some of the emerging IoT solutions in the Maritime Communications Ecosystem

Table 6: Example of Emerging IoT solutions in the Maritime Ecosystem

Solution	Features	Application	
		LIF	LIV
Smart Fishing	• Real time-tracking of data related to vessel status, fishing activities, weather, and sea conditions for operational optimization through use of sensors (ESA 2023)**Error! Bookmark not defined.**. • data analysed using AI to provide insights to support sustainable fishing • utilizes satellite communications as well as positioning, navigation, and timing (PNT) solutions, such as GPS and location-tracking services.		✓
Smart Catch Tracking	• Identification of fish they being caught while they are in the net using a video, lighting and sensor system. This can help reduce bycatch and improve fishing efficiency (SmartCatch n.d.)**Error! Bookmark not defined.**.		✓
Smart Buoy Networks	• Provision of real-time data to improve maritime safety and aid in navigation as well as monitor sea state, through use of buoys equipped with sensors (Bluetech Maritime & Diving Services 2020)**Error! Bookmark not defined.**. This data can then be disseminated to mariners for navigational safety and sea state and weather information.	✓	✓

Table 7 highlights the benefits and limitations of NB-IoT over NTNs

Table 7: Benefits and limitations of NB-IoT over NTN

Benefits	Limitations
Extended coverage to remote areas where terrestrial networks cease to exist	Large propagation delays, especially if GEOs are used (500ms or more)
Low data rate support even with satellite delays by techniques like bandwidth adaptation	Significant Doppler shifts from the satellite's motion (especially LEOs) requiring compensation
Support diverse IoT applications like environmental monitoring and tracking etc. (5G Americas 2022**Error! Bookmark not defined.**)	Mobility challenges, as NB-IoT does not natively support mobility, so beam handovers could be problematic without enhancements

Nominal recommendations for action to streamline IoT development within the comms@sea ecosystem are as follows:

Stakeholder Group	Action
Telecommunications Regulators & Spectrum Management Agencies	• At the national level, ensure that MSS D2D is enabled within the existing global regulatory framework that supports today's MSS services as well as massive adoption of MSS D2D in coming years, leveraging the work already done at the 3GPP to complete Release 17 and 18 which includes non-terrestrial networks (NTN) and addresses satellite's role in the global IMT ecosystem
Mobile Network Operators Satellite Network Operators	• Support the development of regulatory frameworks to promote the safe and effective use of IoT to support SSF livelihoods, as well as the maritime industry
Regional Telecoms Organizations	• Serve as regional co-ordinators for IoT-related studies, engage in pilot projects with national regulators, MNOs, satellite network operators and academia
UN Agencies	• Conduct studies on the viability of IoT for supporting livelihoods at sea • Develop, in collaboration with relevant agencies, baseline regulatory frameworks to support the safe and efficient rollout of maritime IoT
Standardization Bodies	• Conduct studies on, and explore the possibility of developing standards for end-user cellular broadcast messaging in emergency situations • Engage relevant agencies to determine the most applicable spectrum utilization approach for IoT solutions, and a baseline regulatory framework

8 Channels for Action

The multi-sectoral, multi-stakeholder nature of this Agenda provides many channels to advocate for, and directly action, accessible comms@sea for SSF; including the maritime, fisheries and telecommunications sectors. The key priorities identified are a seed for consideration by administrations at national, regional and international fora.

Figure 13 highlights the potential channels for action within the telecommunications sector, using the Americas (AMS) region as an example. Administrations are invited to develop contributions for consideration at their regional level which, for the AMS region, is Inter-American Telecommunication Commission (CITEL). These may be furthered, or directly submitted to the respective ITU conferences (WTDC, WTSA, WRC, etc.), for consideration at the international level. These can generate a number of outputs and means for iteratively exploring and actioning inaccessible comms@sea for SSF, through new or revised resolutions, study questions and international regulations and best practice.

8.1 ITU

On an international level, progress tracking can be done via various ITU study groups, conferences, and expert groups such as, ITU-D's Study Group 1- Enabling Environment for Meaningful Connectivity and Study Group 2: Digital Transformation (ITU n.d.)[27].

The World Radiocommunications Conference (WRC) can facilitate discussions on spectrum management for preventing interference on distress frequencies, spectrum efficiency etc. While there are no obvious areas for work currently exist, modernization of GMDSS through consultation with SSF stakeholders could be explored.

The World Telecommunication/ICT Indicators Symposium (WTIS) can contribute to developing indices to gauge the accessibility of comms@sea for SSF. Expert groups could define, revise and harmonize indicators that could be applicable to SSF.

At the World Telecommunication Development Conference (WTDC):

- Review agendas for the next meeting and ensure alignment with the Agenda for Accessible Comms@Sea for SSF
- Prepare contributions and work with ITU member states to submit contributions
- If not aligning with the agenda, work with sectors members to flag this as an area of contribution

At the Plenipotentiary Conference (Plenipot), member states can propose resolutions related to accessible comms@sea for SSF.

At the World Telecommunication Standardization Assembly (WTSA):

- Technical solution exploration for broadcast from cellular networks can be done.
- Brainstorming with stakeholders, proof of concepts/requirements analysis and obtaining buy-in can lead to developing proposals.
- Efforts can be made to drive and encourage the innovation of cellular phones for use at sea.

Additionally, progress can be tracked through collaboration with the World Bank for financing projects, the Joint IMO/ITU Experts Group on Maritime Radiocommunication Matters, the IMO Sub-committee on Radiocommunications and Search and Rescue (COMSAR), and other UN projects like the FAO's CC4FISH programme (and potentially upcoming Phase II).

[27] ITU. n.d. "ITU-D Study Groups." Accessed March 2024. Available at: https://www.itu.int/net4/ITU-D/CDS/sg/index.asp?lg=1&sp=2022

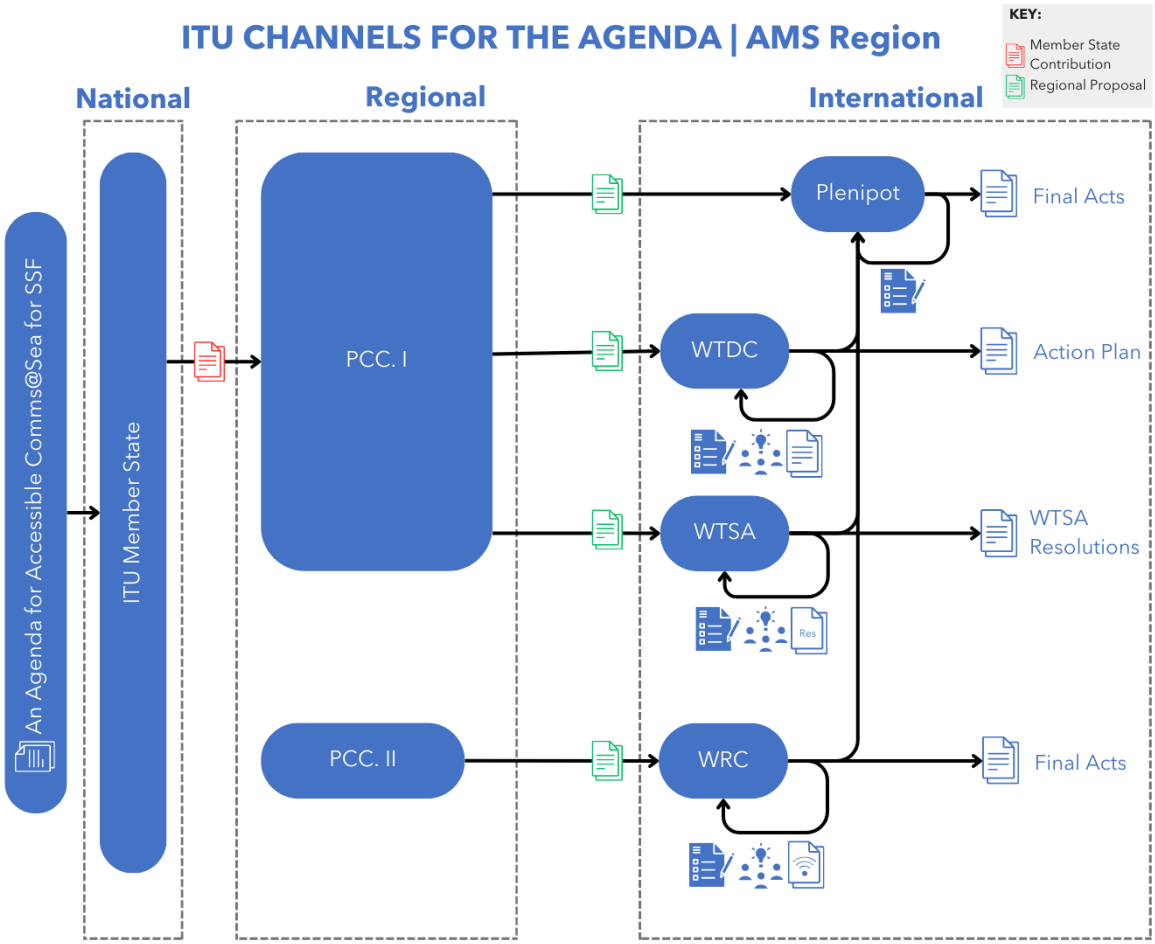


Figure 13 ICT Channels for Action: AMS Region

8.2 Other UN Channels

UN Agency	Nominal Channels & Opportunities
IMO	1. **Maritime Safety Committee** (MSC; IMO n.d.[28]): can facilitate the development of strategies that prioritize the safety of small-scale fishers. This includes exploring the feasibility of a certification scheme tailored to SSF, providing training on maritime safety and the effective use of communication technologies. The MSC can also evaluate and advocate for the modernization and adaptation of global systems, such as the GMDSS to meet the unique needs of SSF, ensuring these systems are accessible and practical for smaller vessels operating in diverse maritime environments 2. **Sub-Committee on Navigation, Communications, and Search and Rescue** (NCSR; IMO n.d.[29]): can facilitate global discussions to define carriage requirements and performance standards for navigational and comms@sea equipment by SSF. Through collaboration with the International Telecommunication Union (ITU) via the IMO/ITU Expert Group, the NCSR can raise awareness of safety-at-sea challenges and drive the adoption of innovative solutions. This partnership can foster global

[28] IMO. n.d. "Maritime Safety Committee (MSC)." Accessed March 2024. Available at: https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MSC-Default.aspx
[29] IMO. n.d. "Navigation, Communications and Search and Rescue Overview." Accessed March 2024. Available at: https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/NCSR-default.aspx

UN Agency	Nominal Channels & Opportunities
	alignment on SSF-specific requirements, ensuring that emerging technologies and regulatory frameworks support affordable and accessible comms@sea for SSF
WMO	1. **Commission for Weather, Climate, Hydrological, Marine and Related Environmental Services and Applications** (SERCOM; WMO n.d.[30]), particularly its *Standing Committee on Marine Meteorological and Oceanographic Services (SC-MMO):* can support the achievement of accessible comms@sea by developing proposals for international standards in marine meteorology, oceanography, and coastal services. Furthermore, SC-MMO can support coordination planning of maritime safety services, emergency response systems, and capacity development initiatives to enhance service delivery for SSF 2. **SERCOM/SC-DRR Expert Team on Early Warning Services** (ET-EWS; WMO n.d.[31]): can further the agenda by providing guidance for the Worldwide Met-Ocean Information and Warning Service. Its efforts should focus on developing strategies to ensure these services are accessible and user-friendly for low-resource seafarers, including SSF, thereby strengthening their ability to respond to environmental risks effectively
FAO	1. **Committee on Fisheries** (COFI; FAO n.d.[32]): can promote and develop policies and frameworks on safety at sea for SSF 2. **Regional Fisheries Bodies** (RFBs; FAO n.d.[33]): can foster regional collaboration on fisheries management, offering platforms to share best practices on comms@sea for SSF and strategies to strengthen the capacity of SSF 3. **Fisheries and Aquaculture Division** (NFI): can support recommendations for integrating ICTs into fishing, modernizing monitoring systems, and improving access to safety and weather information for SSF 4. **Global Action Program for SIDS** (GAP-SIDS): can include under its mandate, an emphasis on saving lives and supporting livelihoods through ICTs for SSF in SIDS 5. **Emergency and Resilience Program** (ERP): can support the development of, and studies on, ICTs for emergencies and disaster resilience, with emphasis on EWS 6. **Technical Cooperation Programme** (TCP): can support national, and regional projects to further studies and developments on accessible comms@sea for SSF

8.3 Standardization Bodies & Other Relevant Agencies

The Institute of Electrical and Electronics Engineers (IEEE) is a technical professional organisation that promotes the advancement of technology. The 3rd Generation Partnership Project (3GPP) is a standards body comprising numerous standards organisations who work together to develop mobile telecoms protocols. The Agenda can be promoted through such bodies as seen below.

Agency	Nominal Channels & Opportunities

[30] WMO. n.d. Standing Committee on Marine Meteorological and Oceanographic Services (SC-MMO). Available at: https://community.wmo.int/en/activity-areas/sercom/sc-mmo
[31] WMO. n.d. Expert Team on Early Warning Services
[32] Food and Agricultural Organization of the United Nations (FAO). Committee on Fisheries. Rome: n.d. https://www.fao.org/cofi/en
[33] Food and Agricultural Organization of the United Nations (FAO). Regional Fisheries Bodies. Rome: n.d. https://www.fao.org/fishery/en/topic/16800/en

3GPP	SA WG1 – Services (3GPP n.d.)[34]: Develop service requirements for mobile at-sea communications Further, as well as fast-track, the standardization for NTN networks which can allow for ubiquitous coverage out at sea SA WG6 - Application Enablement and Critical Communication Applications (3GPP n.d.)[35]: Propose specifications to guide the development of applications used to support SSF's safety and livelihoods
IEEE	IEEE Communications Society (ComSoc): can promote the advancement in maritime communications technologies as well as innovation in communication standards to make these technologies more accessible and foster innovation among technical and professional members to further do research and development in the maritime communications space to increase accessibility IEEE Oceanic Engineering Society (OES) through its technology committees (IEEE OES n.d.)[36]: *Data Analytics, Integration and Modelling:* Propose ways in which computational intelligence, artificial intelligence and machine learning and visualization tools can be used for maritime data to support SSF's safety and livelihoods *Ocean Observation Systems and Environmental Sustainability:* • Facilitate discussions on the use of technologies for and ways in which this data can be disseminated to support SSF's safety and livelihoods • Propagation of relevant agenda items in ocean conferences and workshops *Current, Wave, Turbulence Measurement and Applications:* • Develop innovative methods for measuring sea state parameters to support SSF and other low-resource seafarers • Determine ways in which sea state parameters could be used in improving maritime safety

[34] 3GPP. n.d. SA WG1 – Services. Accessed March 2024. Available at: https://www.3gpp.org/3gpp-groups/service-system-aspects-sa/sa-wg1
[35] 3GPP. n.d. SA WG6 - Application Enablement and Critical Communication Applications Specifications. Accessed March 2024. Available at: https://www.3gpp.org/3gpp-groups/service-system-aspects-sa/sa-wg6
[36] IEEE. n.d. Available at: https://ieeeoes.org/technical-activities/technology-committees/

References

9 Acknowledgements & Thanks

[a full list of all contributors and their designations will be placed here on editorial review: March 2025]

Appendix A: Extracts from Key UN Conventions

UN Convention	National Obligations
SOLAS Convention (IMO 1974)	**Chapter IV: Radiocommunications** Regulation 5 - Provision of radiocommunication services 1 Each Contracting Government undertakes to make available, as it deems practical and necessary either individually or in cooperation with other Contracting Governments, appropriate shore-based facilities for space and terrestrial radiocommunication services having due regard to the recommendations of the Organization. These services are: 1. a radiocommunication service utilizing geostationary satellites in the maritime mobile-satellite service; 2. a radiocommunication service utilizing polar-orbiting satellites in the mobile-satellite service; 3. the maritime mobile service in the bands between 156 MHz and 174 MHz; 4. the maritime mobile service in the bands between 4,000 kHz and 27,500 kHz; and 5. the maritime mobile service in the bands between 415 kHz and 535 kHz and between 1,605 kHz and 4,000 kHz. 2 Each Contracting Government undertakes to provide the Organization with pertinent information concerning the shore-based facilities in the maritime mobile service, mobile-satellite service and maritime mobile-satellite service, established for sea areas which it has designated off its coasts.
SAR Convention (IMO 1979)	**Chapter 2: Organization and Co-ordination** 2.1 Arrangements for provision and co-ordination of search and rescue services 2.1.11 Parties shall forward to the Secretary-General information on their search and rescue service, including the: .1 national authority responsible for the maritime search and rescue services; .2 location of the established rescue co-ordination centres or other centres providing search and rescue co-ordination, for the search and rescue region or regions and communications therein; .3 limits of their search and rescue region or regions and the coverage provided by their shore based distress and safety communication facilities; and .4 principal types of available search and rescue units. Parties shall with priority, update the information provided with respect to any alterations of importance. The Secretary-General shall transmit to all Parties the information received. 2.3 Establishment of rescue co-ordination centres and rescue sub-centres 2.3.1 To meet the requirements of paragraph 2.2, Parties shall individually or in co operation with other States establish rescue co-ordination centres for their search and rescue services and such rescue sub-centres as they consider appropriate. 2.3.2 Each rescue co-ordination centre and rescue sub-centre, established in accordance with paragraph 2.3.1, shall arrange for the receipt of distress alerts originating from within its search and rescue region. Every such centre shall also arrange for communications with persons in distress, with search and rescue facilities, and with other rescue co-ordination centres or rescue sub-centres. 2.3.3 Each rescue co-ordination centre shall be operational on a 24-hour basis and be constantly staffed by trained personnel having a working knowledge of the English language.
Radio Regulations (ITU 2024)	**Article 20 Service publications and online information systems** 20.16 Administrations shall take all appropriate measures to notify the Radiocommunication Bureau immediately of any changes in the operational information contained in Lists IV and V, in view of the importance of this information, particularly with regard to safety.

Appendix A: Defining Demand

Table 8 User & Enabling Environment Requirements

	Requirement	Type[37]		Use Case[38]									
		LIF	LIV	Distress			Urgency		Safety		Routine		
				Pir	Sink	MoB	EnF	Med	Nav	Met	CI	Pos	Cat
	Comms@sea												
Device	seaworthy and resilient to the maritime environment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	simple to use	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	compact and portable	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	priced appropriately, and within SSF's buying power	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	operates without continuous power supply and have adequate battery life to cover nominal durations of SSF's journeys to sea	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	comply with national policy and regulatory provisions	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	minimalistic in design & operations allowing for simple and quick initiation of alerts	✓		✓	✓	✓	✓	✓					
	design & operations should allow for the cancellation of active distress alerts	✓		✓	✓	✓	✓	✓					
	capable of receiving maritime safety information (navigational) from authorities responsible for the issuance of navigational warnings	✓							✓				
	capable of receiving maritime safety information (meteorological) authorities responsible for the issuance of weather forecasts and warnings	✓	✓							✓			
	allow for the updating of position or vessel travel information	✓									✓		
	feature the collection and transmission of location information	✓										✓	
	allow tracking of catch during the fishers trips		✓										✓
	provide market data on the catch, upon user request, recommend actions (catch or release)		✓										✓
Service	available in areas where SSF operate	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	priced appropriately (free for lifesaving applications, and within SSF buying power, for livelihood-supporting applications)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	capable of being received by (i) the nearest rescue coordination centre and (ii) nearby vessels	✓		✓	✓	✓	✓	✓					

[37] LIF = Lifesaving, LIV = Livelihood-supporting

[38] Pir = Piracy, Sink – Sinking Vessel, MoB – Man Overboard, EnF = Engine Failure, Med = Medical Advice, Nav = Navigational Warning, Met = Weather Forecast, CI = Check-in. Pos = Position Reporting, Cat – Catch Reporting & Tracking

Requirement		Type[37]		Use Case[38]									
		LIF	LIV	Distress			Urgency		Safety		Routine		
				Pir	Sink	MoB	EnF	Med	Nav	Met	CI	Pos	Cat
	allow the continuous transmission of location information to SAR authorities	✓										✓	✓
	Data												
	follows data provenance best practices during data collection, storage, analysis, etc.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Vessel name, description and additional identifiers (e.g. call sign (voice) MMSI (DSC))	✓		✓	✓	✓	✓	✓			✓	✓	✓
	Vessel position (location)	✓		✓	✓	✓	✓	✓			✓[39]	✓[40]	✓[39]
	Number of persons on board	✓		✓	✓	✓	✓	✓			✓		
	Nature of situation, with supporting details (number of pirates, reason of sinking, names and descriptions of those onboard, etc.) *where possible*	✓		✓	✓	✓	✓	✓					
	Name of authority issuing warning	✓	✓						✓				
	Location/area	✓							✓	✓			
	Nature, severity and description of hazard	✓							✓				
	Forecast period	✓	✓							✓			
	Forecast information and warnings on parameters[41]	✓	✓							✓			
	Duration of fishing trip	✓									✓		
	Number of persons onboard	✓									✓		
	Safety & comms@sea solutions on board	✓									✓		
	Estimated time departure	✓	✓								✓		
	Estimated time of return	✓	✓								✓		
	Area of operations	✓	✓								✓		
	Fish catch data		✓										✓
	Market data on fisheries		✓										✓

[39] Optional
[40] On an ongoing basis (continuously)
[41] Such as wind conditions, wave height, wave period, visibility, precipitation, atmospheric pressure, sea temperature, tidal information, etc.

Appendix B: Defining Supply

Error! Reference source not found. details the communication solutions and their features. While these are applicable to, and fit-for-purpose for SOLAS-compliant vessels, not all of the above are fit-for-purpose for SSF.

Table 9 SOLAS and Safety Rec Comms@Sea Solutions to SSF

Solution	Features	Uses
VHF telephony with DSC	VHF comms with DSC capability	Vessel-to-vessel and vessel-to-shore communication in maritime environment
	Transmits/receives DSC on CH 70 (156.525 MHz)	
	Transmits/receives radiotelephony on CH 6 (156.300 MHz), CH 13 (156.650 MHz and CH 16 (156.800 MHz)	
	Continuous watch on CH 70 (156.525 MHz)	
MF telephony with DSC	MF comms with DSC capability	Long-range communication for vessels operating beyond VHF coverage areas
	Distress and safety communications on MF (2187.5 kHz using DSC and 2182 kHz using radiotelephony)	
	Continuous DSC watch on frequency 2187.5 kHz	
	Transmits/receives general communications using radiotelephony or direct-printing telegraphy	
Hand-held waterproof VHF radio	VHF comms with DSC capability	Emergency communications and onboard safety
	Transmits/receives DSC on CH 70 (156.525 MHz)	
	Transmits/receives radiotelephony on CH 6 (156.300 MHz), CH 13 (156.650 MHz and CH 16 (156.800 MHz)	
	Continuous watch on CH 70 (156.525 MHz)	
	Portable, rugged and waterproof	
	Dual/Tri-Watch	
	Quick Channel Select Button	
NAVTEX receiver	Receives NAVTEX (Navigational Telex) messages containing maritime safety information	Receipt of weather forecasts, navigational warnings, and other safety-related information
	Operates on a frequency of 518 kHz	
	Covers a range of typically 200-300 nautical miles	
	Low power consumption	
	Printing ability	
Float-free satellite EPIRB	Automatic activation when submerged in water	Automatic alerts to SAR authorities in cases of vessel distress or sinking
	Waterproof and can withstand the harsh maritime conditions	
	Comprises strobe lights, which enhances visibility during rescue operations	
	Dual distress signals (406 MHz and 121.5 MHz)	
Search and rescue locating	Portable self-contained device	Locating distressed vessels by transmitting AIS messages or radar signals
	Transmit AIS messages containing position, static and safety information	
	Autonomous operations	

Solution	Features	Uses
device: SART/AIS-SART		
Mobile (cellular) telephone[42]	Portability	General point-to-point communications if there is adequate cellular coverage at the seafarer's location
	Access to Over-the-top (OTT) services such as WhatsApp messaging	
	Affordable, accessible and require no license	
	Enable the dissemination of relevant information such as weather data and livelihood -supporting data	
Radio receiver to receive weather forecasts	Receivers weather forecast and other relevant information	Staying informed about weather conditions to plan their voyages

[42] According to the FAO/ILO/IMO Safety Recommendations, cellular phones may be used at sea, in lieu of other recommended solutions, subject to the availability of adequate coverage. In many cases, particularly in the Caribbean, cellular coverage at sea is highly opportunistic. As such, cellular phones have been listed as a periphery solution, not an operational one