Communications Technology in the Dover Strait – Expert Report for the Cranston Inquiry

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Date: 28th November 2024

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Field: Communications Technology

Prepared for the Cranston Inquiry

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1 Qualifications & Experience

1.1 I, Iain Ivory have been employed or worked as an independent consultant in the radiocommunications industry since graduating from Heriot Watt University in 1989 with B.Eng. (Hons) in Electrical and Electronics Engineering.

1.2 After initially working as a Design Engineer on secure radio communication systems for GEC-Marconi Secure Radio between 1989 and 1994 I led the engineering function for the European office of Transcrypt, a US secure communications provider before leading the Product Management team and later the Marketing and Product Management function for Maxon Europe, a manufacturer of radio communication systems.

1.3 From 2000 – 2012 I held various positions in Solutions Marketing and Strategy for Motorola Solutions, based in Basingstoke. In these roles I was responsible for product strategy, requirements capture, solutions definition and project support for Motorola's TETRA radio solutions and was heavily involved in the development and adoption of TETRA technology for UK public safety organisations using the Airwave network.

1.4 From 2012 – 2015 I held global responsibility for the TETRA radio business of Motorola Solutions, responsible for the development of complex communications solutions for critical communications users, leveraging a team of over 300 engineers and software developers to create new products and services government and industrial users globally.

1.5 In 2016 I set up Hermitage Comms LLP, an independent IT & Telecoms consulting firm and have worked predominantly in the public sector supporting organisations adopt new technologies.

1.6 I am an active member of both the British Association of Public Safety Communications Officials (BAPCO) and The Critical Communications Association (TCCA) which is the leading organisation promoting the development of solutions for public safety and other mission critical radio users.

1.7 Within TCCA I am an active member of the Critical Comms Broadband Group (CCBG) which drives the development and adoption of common global mobile broadband standards and solutions for users who work in a mission critical or business critical environment. I am also Co-Chair of the Future Technology Group within TCCA which conducts Horizon Scanning on technology developments that are of interest to the public safety community.

1.8 I reserve the right to alter my opinions and conclusions in the light of any further information of which I am currently unaware. Under such circumstances, I recognize, and will comply with, my obligation to inform the Inquiry.

2 References used in this report.

[BIBLIOGRAPHY]

3 Statement re Conflicts of Interest

3.1 I previously worked with Motorola Solutions from 2000 – 2015. Prior to (and following) Motorola's acquisition of Airwave Solutions in 2016, Motorola was the provider of the core infrastructure technology, and a leading provider of the radio terminals used on the Airwave network.

3.2 In the early years of Airwave, I provided SME support at meetings to present details of the products and solutions relating to devices to end user organisations. From 2010 onwards my role shifted to product strategy and from 2012 to 2015 I ran the global TETRA devices business, responsible for the devices used on TETRA networks including Airwave.

3.3 My role in Motorola was within the Product Group responsible for the design and development of the products, and not with the UK sales, deployment, operation and support teams working with Airwave. In summary, my involvement with the Airwave network whilst with Motorola was to develop and promote the products and solutions to end user organisations.

3.4 Since leaving Motorola Solutions in 2015, I have worked as a consultant within the public sector giving SME advice in a broad range of areas including the use of public safety communications systems. In respect of the Airwave network my work has focussed in the following areas:

a. Providing ongoing SME support to National Highways as part of a multi-year contract covering roadside communication and control room technology, and in planning for the transition of services from Airwave to ESN.

b. Providing support to the Metropolitan Police Service (MPS) on the transition from Airwave to ESN.

c. Providing support to the Scottish Fire & Rescue Service on the specification, procurement and deployment of call handling and mobilisations systems which use Airwave.

d. Industry engagement via BAPCO on the use of Airwave, interworking, and the transition to ESN

3.5 My work as a consultant also involves engagement with the Home Office and users of the Airwave network, but with a technology focus and not on day to day operational aspects. Examples of typical contacts are:

a. Working with the Home Office in relation to the proposed transition to ESN, e.g. as outlined above in relation to work with National Highways and the MPS.

b. At industry forums to discuss common aspects of the transition to ESN, for example National Highways and the Border Force are both "National Sharers" of the Airwave service and I take part in workshops and / or email exchanges including these organisations to discuss ESN topics.

3.6 As stated in section 1 I am also a member of BAPCO and the TCCA and its Critical Comms Broadband Working Group, and Co-Chair of the Future Technologies Working Group within the TCCA. In these roles I have chaired or taken part in panel discussions with Matt Leat, Assistant Chief Coastguard who is also a Trustee of BAPCO.

3.7 While I am a Partner of my own company Hermitage Comms, a significant part of my work comes from working as an Associate Managing Partner with Actica Consulting. While I have not been involved directly in any work with either Border Force or the MCA, Actica Consulting has worked with both agencies.

3.8 For clarity, I currently am not involved in any other communication systems used by UK authorities other than Airwave and its proposed replacement, ESN.

3.9 I am a member of occupational pension schemes relating to my employment with Motorola Solutions.

3.10 I confirm that I have no conflict of interest of any kind, other than any which I have already set out in this report. I do not consider that any interest which I have disclosed affects my suitability to give expert evidence to the Inquiry on any issue on which I have given evidence, and I will advise the Inquiry if, between the date of this report and the Inquiry hearings, there is any change in circumstances which affects this statement.

4 Overview of Relevant Communications Technology

4.1 Please provide an overview of the communications technology available for the purposes of search and rescue operations responding to small boats attempting to cross the Dover Strait in November 2021, including:

1. The Airwave network.
2. Marine VHF radio.
3. Mobile telephone, including the use of WhatsApp and social media.
4. Satellite telephones.

4.1.2 The UK Airwave Network

4.1.2.1 The Airwave network (Airwave) provides communications for public safety services and other users in Great Britain (Northern Ireland has a separate, similar network in place). Subject to organisational policies and system configurations, Airwave enables any user in GB to communicate with any other user. It supports several types of call:

a. Most calls are group calls - one to many, so working an all "all informed" basis for members of that group. This enables for example control rooms to communicate on a dispatch group to alert responders to an incident, or for responders to work on a dedicated incident group to manage an ongoing incident – freeing up the dispatch group.

b. Private, or one-to-one calls, where two users can communicate on Airwave in a similar way to a mobile phone call. This is typically used for longer discussions for example between an officer and a specialist service.

c. Airwave can also support calls from radios to an organisations internal PABX or to the PSTN, dependent on organisational policies and system configurations.

d. Short Data Services (SDS) are also offered, providing simple messaging similar to text messaging on a mobile, and also used to support simple data exchanges such as advising officer status (on duty / off duty etc).

4.1.2.2 The system is owned and operated under licence from the Home Office by Airwave Solutions, which has been owned since December 2015 by Motorola Solutions, who are also the principal technology supplier.

4.1.2.3 The primary users of Airwave are police, fire ambulance and other Category 1 responders, as defined in the "Civil Contingency Act 2004" [1] (Exhibit II/01; INQ010058) and listed in "Ofcom List of Generic Users" for Airwave [2] (Exhibit II/02; INQ010059).

4.1.2.4 Other users -known as sharers - are authorised to use Airwave by Ofcom as defined in "Ofcom List of sharer organisations" [3] (Exhibit II/03; INQ010060).

4.1.2.5 Airwave uses technology based on the ETSI TETRA standard [4] (Exhibit II/04; INQ010061), originally developed through the late 1980's and 90's to replace legacy analogue systems. The system is cellular based, like mobile phone systems, which allows communication between any location where there is coverage. Public safety networks using the same technology were deployed throughout the 2000's in most European counties, though notably France uses an alternate technology called TETRAPOL.

4.1.2.6 Airwave's licence terms require it to provide defined levels of coverage at street level, with individual user organisations able to contract for "uplifts" in coverage e.g. for indoor coverage in large sporting arenas. In addition, enhanced coverage is provided to the London Underground network. Currently Airwave claim coverage of 99% of the GB landmass – geographic coverage – although this should be interpreted as outdoors at street level and not indoor coverage.

4.1.2.7 The Airwave network is predominantly a land based communications system and while it provides some level of coverage in coastal areas its licence does not require the provision of coverage in offshore areas, as such it is not intended to be the primary system used for offshore search and rescue operations (SAR), but can be used to support coordination between agencies for SAR. Reference is made to the "Strategic Overview of Search and Rescue in the United Kingdom of Great Britain and Northern Ireland" [5] (Exhibit II/05; INQ010062). The topic of radio coverage is covered further in section 4.4.

4.1.2.8 To understand the communications systems used for SAR it is important to note that the Airwave network does NOT include the provision of command and control facilities or call handling systems for individual organisations. These are the responsibility of individual organisations, and this means that the suppliers, capabilities and age of systems varies between organisations. Airwave provides interfaces to control rooms so that control room operators have access to Airwave as a communications network to support the response to an incident.

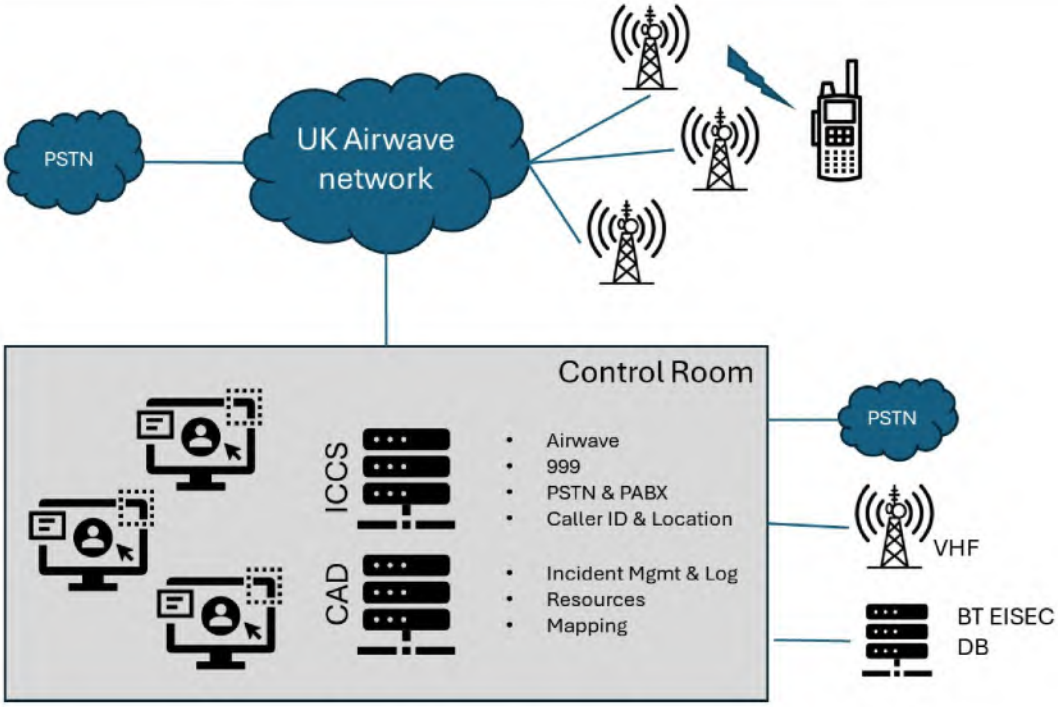


*Figure [SEQ Figure * ARABIC]: Simplified view of emergency control room systems.*

4.1.2.9 Organisations do not need a complex control room to use Airwave however all police, fire and ambulance services do so, as does HM Coastguard. The systems in a typical control room are as shown in simplified form in Figure 1. The major elements are:

a. The Integrated Communications Control System (ICCS), or sometimes known as the Integrated Command and Control System. This is used for call taking and handling, so the ICCS enables control room staff to answer a 999 call, communicate with responding officers via Airwave, and access external and internal resources using PSTN or PABX. The ICCS typically provides the interface to the BT operated EISEC system which provides caller ID and location details – this is addressed in more detail in section 5.1. The ICCS is typically integrated to a call recording system which can record some or all communications into the control room.

b. The Computer Aided Dispatch system is used for incident tracking and management and typically provides operator access to resource tools, mapping / GIS systems. The CAD may be integrated to the ICCS and will record details such caller ID, location, other call associated with the incident, plus what resources were assigned to the incident.

4.1.3 Marine VHF Radio Communications

4.1.3.1 The use of VHF radio communications for SAR can be traced back to the International Maritime Organisations (IMO) "International Convention for Safety of Life at Sea" (SOLAS) [6] (Exhibit II/06; INQ010063). Chapter IV of SOLAS specifies the Distress and Safety requirements. Specifically, regulations in Chapter IV cover undertakings by contracting governments to provide radiocommunication services as well as ship requirements for carriage of radiocommunications equipment.

4.1.3.2 The communications requirements of SOLAS are supported by the International Telecommunication Union (ITU) Radio Regulations 2020 ([HYPERLINK "https://www.itu.int/pub/R-REG-RR-2020"]), specifically in "Appendix 18 (Table of transmitting frequencies in the VHF maritime mobile band)" of the Radio Regulations 2020 [7] (Exhibit II/07; INQ010064) which defines VHF channels for marine use. The ITU is the United Nations specialized agency for information and communication technologies (ICTs), and they facilitate international connectivity in communication networks including the allocation of global radio spectrum and satellite orbits.

4.1.3.3 A key document governing the spectrum and use of VHF marine channels is the report ITU-R M2231.1, "Use of Appendix 18 to the Radio Regulations for the maritime mobile service" [8] (Exhibit II/08; INQ010065). This summarises the history of the use of VHF maritime radio including its use for maritime search and rescue.

4.1.3.4 In the UK The Merchant Shipping (Radiocommunications) (Amendment) Regulations 2021 ("the 2021 Regulations") give effect to the requirements of Chapter IV of the Annex to SOLAS and these are summarised in "Marine Guidance Note 641" [9] (Exhibit II/09; INQ010066). These regulations stipulate that for ships to which the convention applies must be equipped with VHF radio equipment, and the use of VHF radio for marine search and rescue.

4.1.3.5 In the 1990s the IMO and the ITU implemented a new enhancement to the marine VHF mobile service to facilitate search and rescue radiocommunications at sea, the Global Maritime Distress and Safety System (GMDSS). These defined mechanisms enable automatic reporting of distress, urgency and safety information. Maritime regulations now mandate the use of GMDSS capable radio systems in larger vessels, with smaller leisure craft exempt.

4.1.3.6 The GMDSS is a non-voice system and includes the use of radiocommunication in VHF, HF and MF maritime frequency bands and satellite communication systems. An overview of "Modern maritime communications" was presented by the IMO at the 29th World Radiocommunication Seminar in 2020 [10] (Exhibit II/14; INQ010071).

4.1.3.7 In summary, the use of marine VHF radio communications in the UK follows international regulations.

4.1.3.8 In terms of operation marine VHF radio is unlike systems such as Airwave – there is no underlying network providing national or international coverage, it relies on the use of specified radio channels and the assumption that there are other users, or a Maritime Rescue Coordination Centre (MRCC) within radio coverage who can receive communications.

4.1.3.9 If I consider a typical SAR scenario:

a. A marine vessel in distress would use the VHF radio on channel 16 to issue a voice mayday call, or if GMDSS equipped start a distress alert using this (typically pressing a distress button). The call or distress alert would be received by any vessel or shore station (e.g. Coastguard, RNLI or other monitoring station) within radio coverage.

b. The distress call would be received by or relayed to an HM Coastguard Marine Rescue Coordination Centre (MRCC) or the Joint Coastguard Rescue Coordination Centre (MRCC).

c. The SAR operation would use other VHF channels allocated specifically for SAR operations to coordinate operations.

4.1.3.10 As the marine VHF channels are coordinated internationally, authorities in the UK and France will use the same VHF channels and so operations can be coordinated across all responding agencies.

4.1.4 Public Cellular Networks

4.1.4.1 In the context of SAR operations, the role of public cellular networks is generally limited to enabling members of the public to raise a distress call – in relation to this investigation this could be a person in a small boat using the phone to call for help. The phone could be used in several ways, and I will address each of these:

a. Make a phone call 999, or 112 which is the European common emergency number. Both these numbers can be used to call the emergency operator in the UK.

b. To use social media applications such as WhatsApp to call someone for help.

c. To use social media messaging services to alert someone for help.

4.1.4.2 All mobile networks in the UK and EU must provide a capability for users to make an emergency call using 999 or 112, to an emergency operator. In the UK these requirements are contained in Part A3, Availability of services and access to emergency services of the "General Conditions for Entitlement" published by Ofcom [11] (Exhibit II/10; INQ010067) and also refer to the relevant EU regulations.

4.1.4.3 In the UK all 999 / 112 calls are directed to the BT 999 Operator service for initial handling and then forwarded on to the appropriate Emergency Authority (EA), including caller ID and location. I provide more information on this in section 5.1.

4.1.4.4 Only calls made from mobile devices connected to a UK licenced mobile network will be connected to the BT 999 Operator, irrespective of whether the phone SIM card is registered to a UK operator. If the mobile is connected to a French (or other EU operator) while in the Dover Strait, the emergency call would be routed to that country's emergency operator. Note that I consider the topic of mobile coverage further in section 4.4.

4.1.4.5 Where a caller is not using the native telephone capabilities in a phone but is instead using a 3rd party application, such as a Voice over IP app (e.g. Skype, phone.com, RingCentral) or more commonly using calling capabilities in social media apps such as WhatsApp, these call are typically not subject to the above Ofcom conditions – i.e. they are not handled by BT 999 operators. I cover this topic in more detail in section 4.1.5. and 4.1.6.

4.1.4.6 Similarly, someone in distress using solely social media messaging applications will not be able to directly access emergency operators.

4.1.4.7 Finally, I have considered the different generation of mobile technology generally available in November 2021, namely 2G, 3G and 4G LTE. Note that while 5G networks were beginning to be deployed in the UK in 2019 their rollout was focussed on dense urban areas and so not available in the Dover Strait.

4.1.4.8 In respect of the usage outlined above the type of mobile network is of little relevance in respect of making a 999 call as all generations must support this. In respect of social media and VoIP services all generations support some form of data bearer required to use these services however 2G is limited in speed and capacity (bandwidth), 3G is better and 4G is specifically designed and deployed to provide broadband data services required for applications such as social media.

4.1.4.9 All generations of technology share the same approach to the provision of location data for mobile devices, in that they provide a server known as the Gateway Mobile Location Centre (GMLC) which is the interface point between the mobile network operator and clients requiring location information for mobile devices. I cover this topic in more depth in section 5.1. and a useful overview of location systems in mobile networks is provided in the paper "Evolution of Positioning Techniques in Cellular Networks, from 2G to 4G" [12] (Exhibit II/11; INQ010068).

4.1.4.10 I have also addressed recent developments in mobile technology on how they could aid SAR operations in section 7.1.

4.1.5 Voice over IP (VoIP) Applications on Cellular Networks

4.1.5.1 In section 4.1.4. I stated that VoIP applications typically do not provide access to 999 / 112 calls. With the growth in the use of VoIP applications there had been concern in the communications industry and the emergency services on the impact on the ability – and expectation – of users to access emergency services. This was considered by Ofcom and subject to consultation in 2007 [13] (Exhibit II/12; INQ010069) on proposed regulation of VoIP services.

4.1.5.2 Following the consultation Ofcom published a statement on the regulation of VoIP services which modified General Condition 4 of the Communications Act 2003, with the new requirements [14] (Exhibit II/13; INQ010070) coming into force in September 2008.

4.1.5.3 Section 3.5 of the Ofcom consultation defined 4 types of VoIP:

1. Type 1: peer-to-peer services to make and receive voice calls over the Internet only, usually within the same application community;
2. Type 2: VoIP Out services to make voice calls over the Internet to the PSTN (Public Switched Telephony Network, the standard public phone network), but not to receive calls from the PSTN;
3. Type 3: VoIP In services to receive voice calls over the Internet from the PSTN, but not to make calls to the PSTN. Customers can be allocated an ordinary geographic number or a VoIP number (056);
4. Type 4: VoIP In and Out services to receive voice calls over the Internet from the PSTN and to make voice calls over the Internet to the PSTN. Customers can be allocated an ordinary geographic number or a VoIP number (056).

4.1.5.4 The modified regulations directed that Type 2 and Type 4 VoIP services – those that allow users to make calls to traditional fixed and mobile phones using national and international numbers – would be brought into the scope of General Condition 4.

4.1.5.5 General Condition 4 requires providers to ensure that any end-user can access the emergency services by calling 999 and 112 at no charge and, to the extent technically possible, make caller location information available to the emergency organisations handling those calls.

4.1.5.6 As an example of how this has impacted VoIP applications including WhatsApp:

a. Where and organisation adopts Microsoft Teams, and the implementation allows users to join a call from a fixed phone or mobile then this is either a Type 2 or Type 4 services and General Condition 4 applies, and access must be provided to 999 and 112 services.

b. For applications such as WhatsApp which only allow calling between users who have the application (i.e. members of that social community), this is a Type 1 service and General Condition 4 does not apply, and there is no need to support 999 and 112 services.

4.1.6 Social Media Applications on Cellular Networks

4.1.6.1 In respect of SAR operations, social media applications are not used in the response to an incident (other than perhaps public relations) and so this section will consider only the use of social media to alert responders to an incident.

4.1.6.2 Social media applications (e.g. WhatsApp, Instagram, Telegram and others) are data applications that use data services provided by the host mobile device. The data service itself may be a cellular network, wi-fi network or other service.

4.1.6.3 Some social media applications offer VoIP services, e.g. WhatsApp provided the ability to have one-one or one-many (group) calls between contacts, either voice only or video calls.

4.1.6.4 As outlined above, the requirement to support 999 / emergency calling is dependent on the type of VoIP service as defined by Ofcom. In November 2021 and as of the date of this report, most social media applications are of Type 1 and thus are not required to support emergency calling – i.e. if a user was to try to call 999 / 112 using WhatsApp, it is not possible.

4.1.6.5 Thus, for most social media applications the only recourse to attempt to alert emergency services would be to use some form of messaging, for example:

a. call or message an existing contact to request them to alert authorities.

b. message the social media channels of an emergency service.

4.1.6.6 When contacting an emergency service via social media channels these generally are directed to the services non-emergency contact centres and not the emergency control room.

4.1.6.7 It is important to note that the use of social media does not provide accurate location information to responders – this is covered in section 5.2.3.

4.1.7 Satellite Communication Services

4.1.7.1 In respect of SAR operations there are two key use cases to consider:

a. The use of satellite phone to raise an alarm, or for communication between those responding in a SAR operation.

b. The use of satellite services to track and coordinate SAR operations.

4.1.7.2 I will first consider the use of satellite phones to raise an alarm or for general communication. Instead of using land based mobile networks satellite phones use either Low Earth Orbit (LEO) satellites or Geosynchronous Earth Orbit (GEO) satellites. LEO satellites are closer to the earth and create smaller coverage zones, while GEO satellites cover larger areas but have higher latency due to their distance from the earth – this typically means there is a longer delay in audio and can impact data services.

4.1.7.3 The satellites function as relay stations between satellite phones and ground-based systems, so if comparing with mobile phone network the satellite can be considered as an orbiting mobile site. When a call is made from a satellite phone, the signal is sent to the nearest satellite and then relayed to a ground station, which connects the call to the public switched telephone network (PSTN) or internet.

4.1.7.4 As they are connected to the PSTN there is a requirement to support emergency calling, however there is a complication in that the call will be routed to the emergency services in the country where the ground station is located, which given the footprint of the satellite coverage area could be different from the location of the phone.

4.1.7.5 In relation to SAR, satellite phones main benefit is that they can provide coverage in open sea where a mobile phone network may not. Again, as they can connect with the PSTN they can be accessed from HM Coastguard (or other) control rooms and form part of the overall SAR response.

4.1.7.6 I next consider the use of satellite services to track and coordinate SAR operations. The GMDSS described in section 4.1.3. includes the use of satellite systems to track position indicating radio beacons, and satellite is used generally to track the location and operating conditions larger shipping vessels [10] (Exhibit II/14; INQ010071).

4.1.7.7 In the context of a small boat in the Dover Strait it is very unlikely they would be equipped with any such systems, but in a SAR operation such systems are beneficial in tracking and coordinating vessels in the search area.

4.2 Please describe the technology available in November 2021 for communicating with the French authorities, including MRCC Gris-Nez and other agents of the French state, including French naval vessels;

4.2.1 In respect of public safety communications in general and SAR specifically, my understanding is that communications between UK and French authorities is limited to the use of standard telephone service (PSTN and mobile) and the use of standard marine radio systems. I am not aware of any integrated solutions.

4.2.2 This approach is aligned with SAR principles set out by the IMO in their "Guidance on Minimum Communication Needs of Maritime Rescue Coordination Centres (MRCCs)" [15] (Exhibit II/15; INQ010072), which recommends the following as a minimum:

a. Telephone links.

b. Fax / Telex.

c. VHF and MF radio with Digital Selective Calling (DSC).

d. Ordinary VHF.

e. Cospas-Sarsat satellite alert system.

4.3 Please explain whether the methods of communication utilised for search and rescue operations in the Dover Strait in November 2021 had recording capabilities;

4.3.1 The recording of communications during emergency situations such as SAR is largely dependent on the capabilities in the coordinating control room, as addressed in section 4.1.2.

4.3.2 I cannot comment on the specific capabilities in relation to the events of November 2021 as this would require knowledge of which control rooms were involved and the configurations of these systems, however I can provide an overview based on current industry practices.

4.3.3 HM Coastguard control rooms are equipped with a DS3000 ICCS solution from NEC (previously known as Capita and then SSS). This was originally installed prior to November 2021 and a maintenance and support agreement was renewed in August 2021 [16] (Exhibit II/16; INQ010073) and further extended in December 2023 [17] (Exhibit II/17; INQ010074).

4.3.4 A typical ICCS installation, as provided by NEC DS3000, enables call answering and handling by a control room operator as outlined in section 4.1.2. This means that an operator can access multiple communication channels, for example PSTN, Airwave, VHF radio and others.

4.3.5 A typical ICCS installation will include a bulk recording solution that records the activity on selected communication channels – for example 999, the main Airwave dispatch talkgroups and VHF activity to / from the control room.

4.3.6 Note that in a typical installation it is the source communication channel that is recorded and not the activity at the operator's position (i.e. what they hear in a headset). This is the most effective solution as a channel may be monitored by multiple operators and to record each would be inefficient. As each channel is logged and timestamped, and the CAD element logs each action at an operator position it is possible to recreate comms activity at any specific operator position.

4.3.7 I say in my statement above that not all channels may be recorded. This reflects legacy systems where it may be technically challenging or not cost effective to record everything as recording required regular changing of recording media (initially tapes, then over time transitioning to computer hard drives). This situation is changing in more modern systems as recordings are often now stored in cloud storage systems allowing more channels to be recorded. I do not have the information required to comment on the specific configuration of HM Coastguard recording capabilities at stations involved in the incident in November 2021.

4.4 Please identify the limitations of the communications technology available in November 2021, including any known issues or obstacles to effective communications;

4.4.1 I have considered this question in relation to a) the ability of a person in a small boat in the Dover Strait to raise a distress call, or alarm, b) the ability of emergency authorities to locate such a person in distress and c) any limitations in respect to a SAR operation.

4.4.2 In providing the response to this instruction, I must make clear that this is my professional view in respect of the underlying technology. I am not an expert in SAR operations and have no operational experience in this area other than discussions during my career with end user organisations.

4.4.3 In respect of the ability of a person in a small boat to raise the alarm the RNLI publishes an overview of the methods available to raise an alarm [18] (Exhibit II/18; INQ010075). I have considered what devices a person undertaking a crossing in a small boat is likely to have and thus services they can access, and due to the need for many of these systems to be registered with the Coastguard or other authority, this is likely to be limited to a mobile phone at most - meaning they can either make a 999 / 112 call, a call to a known contact, or use social media.

4.4.4 The main limitation of mobile phones at sea is the uncertainty over network coverage. Mobile network operators' licences do not require them to provide coverage offshore and where it does exist it is often incidental. All mobile network operators are required to comply with the "Ofcom General Voice Obligation" [19] (Exhibit II/19; INQ010076), and Ofcom publish additional detail on requirements, measurement of compliance and operator specific conditions on their website ([HYPERLINK "https://www.ofcom.org.uk/phones-and-broadband/coverage-and-speeds/cellular-coverage/"]). For clarity, operators' licences do allow them to provide mobile coverage in the UK which "includes the United Kingdom territorial sea" as defined in the "Territorial Sea Act 1987" [20] (Exhibit II/20; INQ010077) – but it is not an obligation.

4.4.5 An example of the standard licence is one for EE for 700MHz spectrum which is the lowest frequency currently used for public mobile services and thus would be more likely to provide coverage further out to sea [21] (Exhibit II/21; INQ010078). While operators' licences allow coverage in the UK territorial sea there are also regulations governing the use of radio spectrum in cross border situations to minimise the risk of interference to neighbouring networks. Special Condition 5 of the aforementioned EE 700MHz Licence states:

> ***International cross-border coordination***
>
> *5. The Licensee shall ensure that the Radio Equipment is operated in compliance with such cross-border coordination and sharing procedures as may be notified to the Licensee by Ofcom from time to time.*

4.4.6 The cross border coordination of frequency use is set out in a series of Memorandum of Understanding (MoUs) by Ofcom "International Coordination" [22] (Exhibit II/22; INQ010079). The general approach is to define mechanisms to allow sharing, or coordination of spectrum use to enable each country to deliver services.

4.4.7 The outcome of the need to meet the above obligations or licence terms, plus commercial drivers is that while there is often mobile coverage in area of the English Channel, or Dover Strait, this is not guaranteed, and the behaviour of a mobile phone in the Dover Strait will differ from that normally experienced on the mainland including:

a. Coverage will vary and often be weak or unusable, especially in poor weather conditions as the mobile network signal will be affected by reflections of signal due to waves.

b. The network that a phone attaches will be subject to the origin of the SIM card, for example a SIM with a French mobile number will prefer to register to the French network. If the French signal is weak, it is likely to "hang on" to that signal even if there is a better signal available from a UK mobile operator. This may affect the ability to make a call.

4.4.8 In respect of point b) the ability to locate a person in distress, as stated in 4.4.3. there is a reliance on systems such as GMDSS and DSC to provide an emergency alert and location information, but these systems often require some form of licencing or registration and so are unlikely to be available to people crossing in small boats. There is therefore a reliance on either someone in the small boat having a phone with mobile service, or other users in the Dover Strait observing the boat in distress and reporting the location.

4.4.9 In respect of point 4.4.1.c) any limitations of the communications in respect to a SAR operation, I do not have operational expertise and thus am not in a position to comment on this area however I can state that the use of VHF communications systems in supporting SAR operations is well established and supported internationally enabling for example emergency authorities in the UK and France and other vessels in the Dover Strait to coordinate the response. Note that SAR organisations use other systems such as MF, HF and satellite to support the response, so are not wholly reliant on VHF.

4.5 To what extent was the technology used by different assets and stakeholders (such as the Home Office, MCA, RNLI and French authorities) able to mutually interface?

4.5.1 To address this instruction please refer to Figure 2 which offers a simplified view of the key communication systems used by stakeholders.

4.5.2 UK stakeholders have access to the Airwave system which enables interworking between all users. The principals of interworking (Joint Emergency Services Interoperability Principles) across emergency responders are maintained by the JESIP working group ([HYPERLINK "https://www.jesip.org.uk/"]) and summarised in the "JESIP Joint Doctrine" [23] (Exhibit II/23; INQ010080). In addition to using Airwave the JESIP principles cover the use other services such as the PSTN network and VHF radio.

4.5.3 The UK Airwave network a secure network and is accredited to carry information up to and including UK OFFICIAL SENSITIVE information, to allow for example the communication of sensitive personally identifiable information (PII) in addition to protecting operational procedures. This accreditation means that there are no interfaces to any agency outside the UK – i.e. French authorities cannot use Airwave.

4.5.4 A similar principal applies to French public safety communications networks.

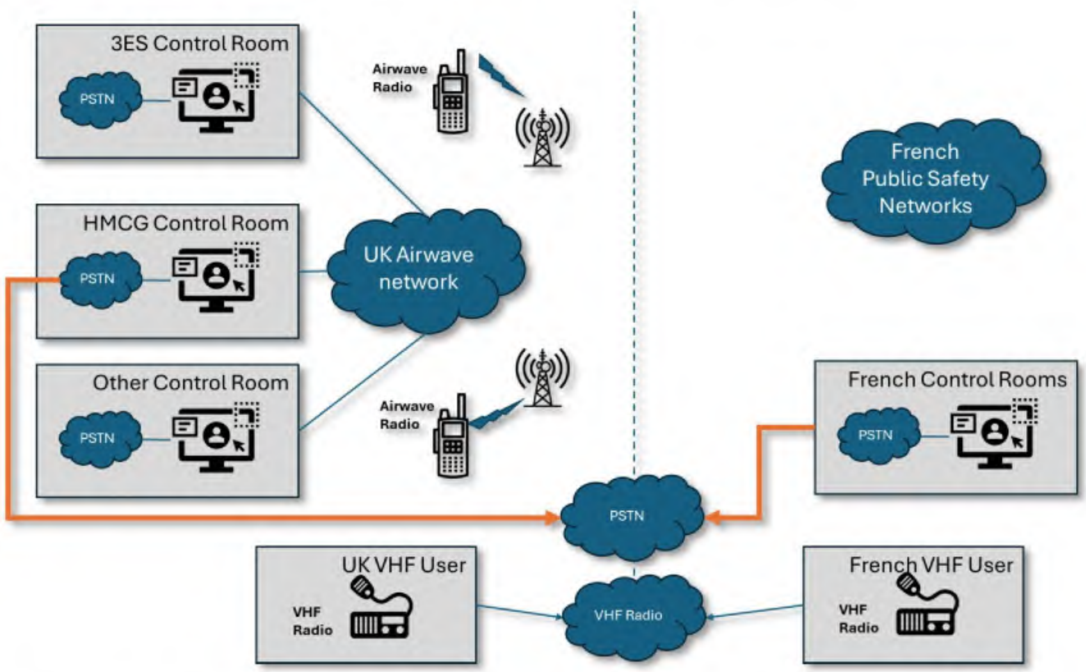


*Figure [SEQ Figure * ARABIC]: Illustration of communication services and interoperability.*

4.5.5 Referring to Figure 2 above, this means that while UK stakeholders can use Airwave to coordinate and share information, they cannot use Airwave to communicate with French authorities.

4.5.6 For communication between UK and French stakeholders there are two primary methods:

a. Using the PSTN, illustrated in Figure 2 where the HMCG control room communicates with French control rooms.

b. Using VHF radio.

4.5.7 For the SAR operation the principal system is marine VHF radio, using established international principals. As described in section 4.1.3 the marine VHF channels are globally regulated and all users whether in the UK or France would be able to "mutually interface", noting that this is in respect of voice communications.

4.6 Please identify any communications technology which was available for the purposes of maritime search and rescue operations in November 2021, but which was not used by the Home Office and/or MCA. In respect of each, please set out why you consider this technology should have been utilised;

4.6.1 In this report I have as per Instructions provided an overview (see section 4) of the communications technology available for the purposes of search and rescue operations responding to small boats attempting to cross the Dover Strait in November 2021.

4.6.2 I have no knowledge as to whether any or all these technologies were used in the search and rescue operations in November 2021, nor how they were used – this report sets out an overview of the capabilities and limitations of these systems.

4.6.3 I am not aware of any additional communications technology which was available for the purposes of maritime search and rescue operations in November 2021.

5 Technology for identifying the location of small boats in the Dover Strait in November 2021

5.1 General Principles for the Identification of Callers Telephone Number and Location

5.1.1 Before I consider the specific instructions of the inquiry, I have set out some general information on how emergency calls to UK 999 / 112 numbers are managed. The process for answering, responding to and the collection of the caller's telephone number and location are defined in "BT Supplier Information Note (SIN) 278" [24] (Exhibit II/24; INQ010081).

5.1.2 As stated in SIN 278:

> *1.1 Emergency Call Handling Overview*
>
> *When a BT operator receives an emergency call for Fire, Police, Ambulance, Mountain Rescue, Cave Rescue, or Coast Guard services they can pass to the relevant Emergency Authority (EA) certain information about the call verbally.*
>
> *Calling Line Identity (CLI) is a mandatory requirement for all UK originated calls. However, although CLI is available to the number being called, the facility to forward it to the Emergency Authorities is not available as a general network facility. This is due to 999 & 112 calls going via operators, who terminate the original call and determine the authenticity of the call. Operators access the ESDB system to determine the location of the person calling and a list of appropriate Emergency Authorities. For*

> *genuine calls, the call is then connected to the appropriate Emergency Authority remaining under the control of the BT switch- Ambulance, Coastguard, Fire, or Police.*

5.1.3 SIN 278 specifies the operation of the Enhanced Information Service for Emergency Calls (EISEC) interface which allows emergency services call handling systems (typically an ICCS – refer to section 4.1.2) to access and present to the call handler the caller identify and location information.

5.1.4 The EISIC interface was originally specified in 1997 and reported identification and location of fixed line services. Over time the service has been enhanced to support mobile telephony and IoT services such as eCall which is a vehicle based system which initiates emergency calls in the event of a serious impact.

5.1.5 In general terms the EISIC interface provides access to the EISIC database which is hosted by BT and holds information on all received emergency calls. The database contains information including caller identity and caller location, plus the origin of the call (e.g. fixed, mobile)

5.1.6 Focussing on mobile calls the location information is sourced from the Mobile Licenced Operator (MLO). Each MLO in the UK should provide a Gateway Mobile Location Centre (GMLC) which enables BT to query the location for emergency calls. I provide an overview of GMLC in section 4.1.4. This location is typically related to the servicing cell site – e.g. an ellipse indicating likely location with parameter for accuracy. The full specification of the location attributes is provided in SIN 278, Annex A section 4.73.

5.1.7 The location information provided by the MLO GMLC is independent of the device being used to make the call as it is based calculations from the mobile network.

5.1.8 The early locations from GMLC were often of low accuracy and concerns from emergency services led to the development in 2014 of the Advanced Mobile Location (AML) service which is a device based protocol that sends the location information of the caller to the EA via the EISEC interface. As modern devices have integrated GPS receivers and are complemented by location determination using crowd sourced data on Wi-Fi and other networks, they typically have more accurate location data compared to network based location.

5.1.9 In an AML enabled mobile phone the operating system detects when an emergency call is made and automatically generates an SDS message which is sent to the mobile network operator. The operator (MLO) will receive this information and make it available on its GMLC.

5.1.10 An SDS message may take time to transit the mobile network and so after receiving the initial 999 call and network based location via the GMLC, BT will poll the GMLC for AML data. Once this is received it is made available to the EA via the EISEC interface.

5.1.11 As a device based protocol AML is only available in devices where it has been adopted by the operating system provider – it is not an app. Over time AML has been adopted by both Android and Apple iOS and so can be supported on most modern mobile devices.

5.1.12 The AML specification has also been adopted internationally as a standard and is now supported in most European markets.

5.2 Response to specific instructions relating to location of small boats.

5.2.1 What technological avenues were available to emergency services and/or the Port of Dover (MCA) to obtain information about a caller's telephone number and location?

5.2.1.1 To answer this question, I first need to consider how the call is initiated, or received by the emergency services, assuming that the call is made from a mobile phone.

a. If the call was made from a phone connected to a UK mobile network, and the call is made to either 999 or 112 then the call would be handled as outlined in section 5.1 above.

b. If the call was made from a phone that was connected to a non-UK network (e.g. a French network) then the UK emergency services would not receive the call or any associated caller ID or location data. Assuming that this is collected by French authorities who receive the call then this information would have to be shared by other means with UK authorities involved in the SAR operation.

c. If the call was made from a phone connected to a UK mobile network, *but the call was made to a non-emergency number* then caller and location information would not be immediately available to the emergency services. If the calling phone did not inhibit caller ID, then the receiving agency would be able to see the caller ID. Note that for 999 / 112 calls, CLI is always presented.

d. If the caller (in a small boat) was using a social media application such as WhatsApp, then I refer to section 4.1.6. which outlines calling using social media. In this scenario the caller information is only available to the recipient of the call, who must be in the caller's contact list.

5.2.1.2 If I consider a) above as the only valid scenario where full number and location information would be available to a UK based emergency service, then as outlined in section 5.1 BT would present caller ID and location information in the EISEC database.

5.2.1.3 On the assumption that the caller requested the Coastguard, or the BT operator decided based on information received that the Coastguard was the appropriate EA then the call would be transferred to the closest HM Coastguard co-ordination centre.

5.2.1.4 As an EA, HM Coastguard will have access to the EISEC database and thus caller and location information as outlined in section 5.1.

5.2.1.5 Note that HM Coastguard would only have access to the AML element of location data if their call handling solution (ICCS) supports AML. I do not have information as to whether this was the case or not in November 2021.

5.2.1.6 If the caller is using WhatsApp, there is a feature introduced in 2017 to enable the user to share location (known as Live Location). This would allow the caller to provide live updates of the mobile location, so the recipient would then be able to share with SAR.

5.2.2 Was it possible for geolocation data to be obtained from a mobile phone without an internet connection? If so, please explain how.

5.2.2.1 To fully address this instruction, I will first consider whether the user of a mobile phone can access geolocation data for that phone, and then whether or how that information can be shared.

5.2.2.2 For the first point, both Apple iOS and Android operating systems include a Location Services function which constantly updates a devices location based on GNSS (e.g. GPS, European Galileo, Russian Glonass or other satellite based location systems), cellular, Wi-Fi and other data sources. In general terms the more sources available to calculate location the more accurate a location is likely to be. This is considered further in section 5.2.3.

5.2.2.3 In the case where a mobile phone does not have an internet connection – for this point I will view this as the phone has a weak, or non-existent network connection – then the phone will base its location on GNSS data. In open space GNSS systems can provide reasonably accurate locations but this is dependent on the number of visible satellites and in rough seas, this can be reduced. In summary however a mobile phone is likely to be able to determine its location without a network or internet connection.

5.2.2.4 If we now consider how a user can access, or the mobile phone itself can share location data in the absence of an internet connection. There are two scenarios I must consider – whether the phone can make a 999 call, or whether there is mobile service at all.

5.2.2.5 First, note that attempts to make a 999 call bypass the normal signal strength thresholds (due to it being an emergency call) required to make a non-emergency phone call. In this scenario the phone makes a "best efforts" attempt to initiate a call. In other words, while the signal may be too weak to provide an internet connection, it may still be possible to make an emergency call.

5.2.2.6 If the mobile phone has an adequate connection and can make a 999 call, then it would be possible to determine a network based location using data from the mobile network operator (see section 5.1). If the mobile phone supported AML, then it may also be possible to send an AML SDS message, improving location accuracy. In short, a mobile phone does not always require an internet connection to make an emergency call.

5.2.2.7 If the emergency call is not attempted using a 999 call but via WhatsApp for example, then an active internet connection would be required. Thus, in the case where there is not an adequate signal to support an internet connection then it would not be possible to use any social media or other apps to call or share location.

5.2.2.8 Where there is no mobile connection at all, it is possible for a user to access location information using applications on the device, as these apps access the mobile phone location data as described in section 5.2.3.

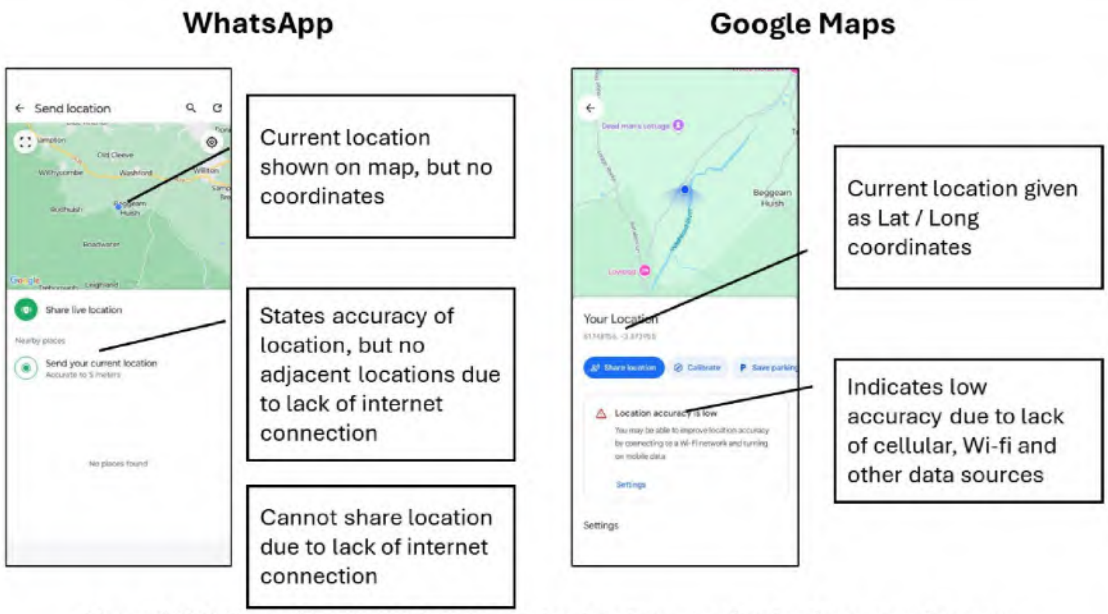


*Figure [SEQ Figure * ARABIC]: Determining location coordinates from popular apps.*

5.2.2.9 Figure 3 illustrates the different presentation of location data with two of the more common apps, WhatsApp and Google Maps.

a. Google Maps presents the used a map tile and the Lat / Long coordinates, so if a user had access to another communication device (e.g. a VHF radio) they could relay the coordinates by simply reading them out. Note that as the phone does not have an internet connection the map tile itself may not be shown, or shown in low resolution as it cannot download map data.

b. The only way to access location data in WhatsApp is via the "Share->Location" function, and this interface does not present the user with coordinates, only a preview of the information that will be shared with a contact. Given there is no active internet connection then it is unlikely the map tile displayed would have adequate resolution to share over an alternate communication medium.

5.2.3 How accurate were location coordinates obtained from Google Maps and/or WhatsApp?

5.2.3.1 For mobile phones using either the Android or iOS operating systems device location is a system function, in that it is the device that determines the location and shares this through an application interface (API) with the applications hosted on the phone. Therefore, the location accuracy is not dependent on the application.

5.2.3.2 Further information on mobile location functions can be found in the following references:

a. Android Developer Guide-> "Request Location Updates" [25] (Exhibit II/25; INQ010082)

b. Apple iOS Developer Guide -> "Getting the current location of a device" : [26] (Exhibit II/26; INQ010083)

5.2.3.3 For both Android and iOS applications using location, they must request permission from the host operating system by adding the relevant location permissions within their code. When a user installs the application, they are prompted as to whether they grant the application permission or not. Thus, it is possible that a user of WhatsApp will decline access to location services and in this case the application would continue to work but without access to location data.

5.2.3.4 Note that in the case of a user making a 999 / 112 call the phone application will always have access to location data as this is a native function of the operating system.

5.2.3.5 Both Android and iOS offer the choice of low or higher accuracy location – the relevance of this to the application is the response time – it can take longer to provide a high accuracy so where an application only requires a rough approximation of location, this is provided faster.

5.2.3.6 When an application request's mobile location data this is determined from a combination of GPS, Wi-Fi and mobile cell information. Both Android and Apple are continually crowd sourcing data sampled by mobile phones to build a database of Wi-Fi services and mobile cell site correlated with locations, so when a phone is determining its location, it can use GPS data plus any adjacent cellular of Wi-Fi services to improve accuracy.

5.2.3.7 In relation to the accuracy of the location it is not possible to state an absolute figure as there are several variables to be considered that will impact each report including the configuration of the application, the version of the operating system and the age of the host device (for example newer devices incorporate more sensitive radio receivers).

5.2.3.8 Android and iOS allow applications to request different location report accuracy, for example in the current versions of each:

a. For a low accuracy report (Android = ACCESS_COURSE_LOCATION, iOS Accuracy Constant = kCLLocationAccuracyReduced), the location is typically generated from a fast GPS fix – this can be accurate to only within a few square kilometres. For Android even if the known location accuracy is high, the coarse location is deliberately obfuscated to hide the device's exact location, and only reveal the approximate area of the device. This is typically used for apps which only require an approximate location for example a weather app.

b. For a high accuracy report (Android = ACCESS_FINE_LOCATION, iOS Accuracy Constant = kCLLocationAccuracyBest), the location is typically determined from a high accuracy GPS fix (which may take multiple minutes to determine) combined with additional sources such as adjacent Wi-Fi and mobile cell data,

Accuracy

Android supports the following levels of location accuracy:

Approximate

> Provides a device location estimate. If this location estimate is from the `LocationManagerService` or `FusedLocationProvider`, this estimate is accurate to within about 3 square kilometers (about 1.2 square miles). Your app can receive locations at this level of accuracy when you declare the `ACCESS_COARSE_LOCATION` permission but not the `ACCESS_FINE_LOCATION` permission.

Precise

> Provides a device location estimate that is as accurate as possible. If the location estimate is from `LocationManagerService` or `FusedLocationProvider`, this estimate is usually within about 50 meters (160 feet) and is sometimes as accurate as within a few meters (10 feet) or better. Your app can receive locations at this level of accuracy when you declare the `ACCESS_FINE_LOCATION` permission.

If the user grants the approximate location permission, your app only has access to approximate location, regardless of which location permissions your app declares.

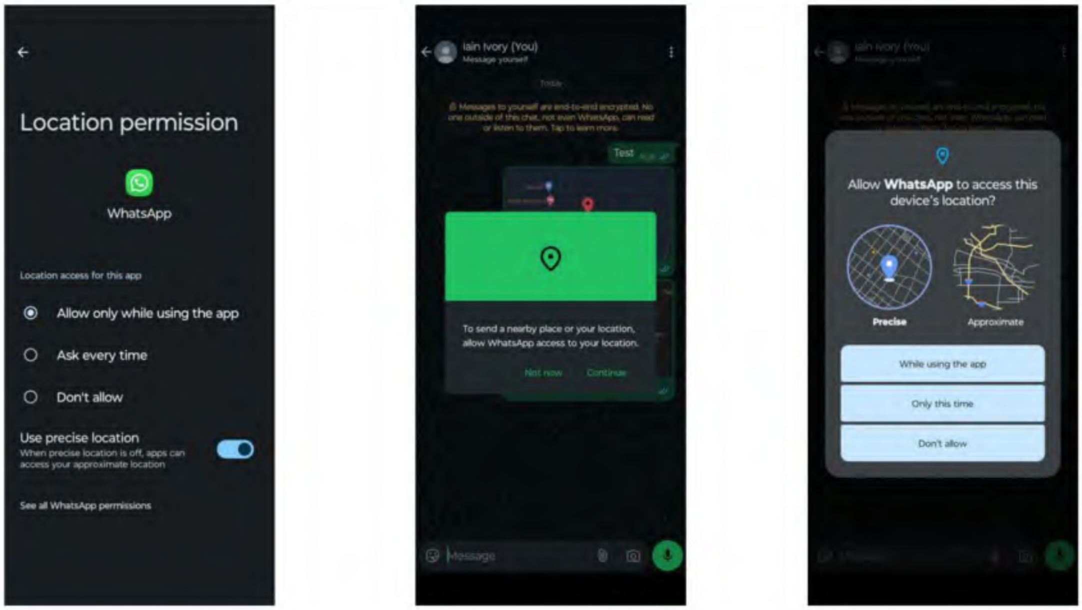
Your app should still work when the user grants only approximate location access. If a feature in your app absolutely requires access to precise location using the `ACCESS_FINE_LOCATION` permission, you can ask the user to allow your app to access precise location.

*Figure [SEQ Figure * ARABIC]: Extract from Android developer documentation referencing location services.*

5.2.3.9 If the location is provided as part of a 999 / 112 call then the mobile location report and subsequent EISEC database report contains a high level of detail on the accuracy of the location report (see section 5.1.6 above), enabling responders to adjust SAR plans accordingly.

5.2.3.10 If the caller provides the emergency services a verbal location (e.g. read from Google Maps or another application), then the accuracy would be dependent on how the user has configured permissions when each application is installed in addition to physical aspects such as GNSS coverage, or cellular and Wi-Fi coverage.

5.2.3.11 To illustrate, Figure 5 shows how permissions for access to location data are presented in WhatsApp on an Android device.



a) When installing, users are asked whether to grant access to location data

b) If sharing location, but permission was not granted at install, users are prompted to allow access

c) When changing permissions user are asked whether to allow Precise or Approximate access

*Figure [SEQ Figure * ARABIC]: Example permission setting in Android OS*

5.2.3.12 In figure 5(a) above, when a user installs an application, they are asked whether they grant permission for the application to access services such as location. These can be viewed in the Android privacy settings, with a) showing in this example that the users have granted access to precise location only when the app is being used.

5.2.3.13 If a user of WhatsApp tried to share their location but it did not have permission, the app displays a prompt to the user (Figure 5(b)) to change permissions. If the user chooses to do so, they are presented with a screen as shown in figure 5(c), where they are asked when to allow access, and whether location should be Precise, or Approximate.

5.2.3.14 Note that the screenshots in figure 5 have been taken on a mobile phone running Android version 14 which was introduced in October 23. The current version in November 2021 was Android 12 which was released in October 2021, with its predecessor Android 11 released in September 2020. Both version 11 and 12 presented similar permissions mechanisms when installing applications.

5.2.4 How was the ability to obtain and use geolocation data on mobile phones likely to be impacted by a phone being on a small boat in the Dover Strait?

5.2.4.1 As I have outlined in section 5.2.3 the mobile location data is typically determined from a combination of GPS, Wi-Fi and mobile cell information.

5.2.4.2 On land a mobile phone will use GPS location services supplemented by information such as any adjacent Wi-Fi or mobile cell towers – so in an urban area where there are likely to be multiple such services an accurate location can be determined relatively quickly.

5.2.4.3 At sea a mobile phone is likely to be limited to GPS and data relating to the mobile servicing cell site, assuming that the phone is within mobile coverage.

5.2.4.4 GPS locations depend on receiving signals from multiple orbiting satellites. In the open sea there is likely to be good visibility of multiple satellites due to the lack of obstacles (e.g. buildings, trees), especially if the sea is calm. In rough sea conditions there is an increased chance of signal blocking due to multiple reflections from waves, especially in a small boat.

5.2.4.5 Similarly, the ability to receive signals and thus service from a mobile site would be reduced in rough sea conditions due to blocking and / or multipath reflections.

5.2.4.6 In summary, in reasonable weather conditions a mobile phone would likely be able to obtain a reasonable location accuracy, but the location accuracy and ability to receive mobile service would be reduced during rough sea conditions. It is not possible to state any specific figures for either scenario due to the high number of contributory factors and variability of data.

5.2.5 How was the ability for a call handler in the UK to obtain information about a caller's telephone number and location affected by the geographical location of the caller, including whether they were outside of UK territory?

5.2.5.1 I have addressed this question in section 5.2.1., and provide the following summary:

a. A call handler in the UK would only be able to obtain information directly about the caller's number and location if the mobile phone was connected to a UK based mobile network. In this case assuming a call was made to 999 / 112 the call handler would receive information via the EISEC database as outlined in section 5.1.

b. If the call was made from a phone that was connected to a non-UK network (e.g. a French network) then the UK emergency services would not receive the call or any associated caller ID or location data. Assuming that this is collected by French authorities who receive the call – and have similar systems to EISEC - then this information would have to be shared by other means with UK authorities involved in the SAR operation, for example verbally.

5.2.5.2 It should also be noted that due to the regulations around spectrum allocation for mobile services and the nature of radio frequency propagation it should not be assumed that a caller located in UK territory within the Dover Strait would be served by a UK mobile operator, or similarly that a caller in French territory would be served by a French operator. This topic is addressed in more depth in section 4.1.4.

5.2.6 To what extent could the existence of an international dial tone indicate whether a mobile phone was located within French territorial waters?

5.2.6.1 I am unclear as to whether the question is being asked from the viewpoint of a UK based call handler, or from the caller (in a small boat) who is making the call, so I will address this from multiple perspectives.

5.2.6.2 First, I refer to section 5.2.5 and section 4.1.4 above, where I clarify that the location of the caller's mobile should not be implied from the network providing service. To illustrate, if we consider the scenario where a mobile which starts a journey on the French mainland, with a SIM registered to a French mobile network and then travels across the Dover Strait:

a. The mobile will retain connection to the French network if the received signal strength is good enough to maintain signal quality.

b. As the signal weakens as the mobile moves away from the French coast, the signal quality will weaken. The phone will still "prefer" to stay connected to the French network as that is its home network, rather than roam onto a foreign network.

c. Only when the signal passes close to or below a quality threshold will the phone look for an alternate network – and at this point is likely to attempt connection to a UK mobile network as a roaming device.

5.2.6.3 In this scenario it is quite likely that mobile phone would be well into UK territorial waters before it switched to a UK mobile network.

5.2.6.4 A further complication is that the transition point in the above scenario is not predictable, or likely to be consistent day to day as factors such as originating location, route across the Dover Strait, weather and sea conditions will all impact the signal quality seen by the mobile.

5.2.6.5 If I now refer to the instructing question, if the caller (in a small boat) attempted to make a call and listened to the dial tone this would not be a good indication of whether they were in French or UK territory. It would simply reflect whether they were on the SIM cards home network or had roamed onto a UK network.

5.2.6.6 Similarly, if a UK based call handler tried to call the mobile (e.g. after receipt of the initial call and in an attempt to reconnect using the mobile phone number) then the *ringing tone* they would hear cannot be taken as an indicator of the location of the small boat.

6 Factual questions related to the events of 23-24 November 2021

6.1 Please explain the system by which WhatsApp indicates the status of a sent message.

6.1.1 When a message is sent by WhatsApp the application uses a series of tick marks to indicate the status of the message including whether it has been read. According to WhatsApp documentation on "How to check read receipts" [27] , (Android (Exhibit II/27a; INQ010084) and Apple iOS (Exhibit II/27b; INQ010085)) this indicates the following:

> Check marks will appear next to each message you send. Here's what each one means:
>
> - ✓ The message was successfully sent.
> - ✓✓ The message was successfully delivered to the recipient's phone or any of their linked devices.
> - ✓✓ The recipient has read your message.
>
> **Note:**
>
> - If the recipient's phone is off and the message isn't delivered to any of their linked devices, the second check mark won't appear.
> - In a group chat, the second check mark appears when everyone has received your message. Two blue check marks appear when everyone has read your message.
> - Read receipts reset when you edit a message, so you can see who viewed your updates.
> - Seeing a clock means the message is not yet sent or delivered. This could be due to connectivity issues.

6.2 If a WhatsApp message were to be sent to a phone which is submerged in water, what would the likely outcome be? For example, would the message show as delivered? Would the person show as "offline"?

6.2.1 The first point I must consider in responding to this question is whether the phone would remain in working condition if it was submerged in water. While most modern phones offer some degree of protection to water such as rain or splashes, full protection from immersion to water is still considered a premium feature.

6.2.2 The ability of a phone – or any form of enclosure – to withstand the intrusion of dust or liquids is indicated by its IP rating, a system developed by the International Electrotechnical Commission. "IEC Ingress Protection (IP) Ratings" [28] (Exhibit II/28; INQ010086).

6.2.3 To withstand full immersion in the sea a phone would have to have a rating of at least IPx7. This is met by premium devices such as iPhone 15 or later, most current Samsung phones or Google Pixel 9, but most mid-tier mobile phones only meet ratings of IPx4 or less. If we also consider phones that were available prior to November 2021, then the likelihood of a phone having a rating of IPx7 is much reduced. On that basis I would view it unlikely that a phone used in the Dover Strait in 2021 would remain working if submerged in water.

6.2.4 If someone were to attempt to send a WhatsApp to a phone that was broken due to immersion in water (or for any other reason), this would be the same as if sending to a phone that was simply switched off, or out of network coverage. In that case the sender of the message would see a single grey tick (✓ The message was successfully sent) *unless* the recipient had a second linked device, e.g. another phone, iPad, or a desktop PC linked to the account. The second linked device could be in a completely different location and in this case, the sender would see two grey ticks (✓✓ The message was successfully delivered to the recipient's phone or any of their linked devices).

6.2.5 If someone were to attempt to call a phone that was broken due to immersion, again this would be the same as if calling a phone that was off. In this case what the caller would hear depends on some other factors:

a. If the mobile phone was connected to the network immediately prior to immersion in water, then the network would not be aware of it being disconnected. In this case the network will try to initiate the call to the phone but would fail due to lack of response. To the caller this could be experienced as a delay for a few seconds, followed by a message to say the call could not be completed, or diversion to voicemail if this service had been enabled.

b. If the mobile phone had no prior connection to the network for an extended period of time, then the caller would more likely be immediately directed to voicemail or advised that the call could not be completed.

6.2.6 If we now consider the scenario that the phone itself remained working, any outcome would be dependent whether the phone remained in coverage or not, however it is reasonable to assume that if submerged the mobile phone signal would be attenuated significantly - RF waves are rapidly attenuated in seawater due to conductivity, permeability, and permittivity as discussed in chapter 2 of "Cellular Communications in Ocean Waves for Maritime Internet of Things" [29] (Exhibit II/29; INQ010087), and thus likely to be out of coverage. This would however depend on where the small boat was in relation to the transmitting mobile phone site (the signal strength would be stronger closer to the site), and the depth of the water (deeper water would increase the attenuation.

6.2.7 Based on the summary of the WhatsApp read receipts notifications in section 6.1, the outcomes would be:

a. If the phone was out of coverage, a single check mark would be shown to indicate the message was sent, but the second check mark would not be shown.

b. If the phone was in coverage, even intermittently - for example in the bottom of the small boat and wave action means the boat is periodically submerged – then there is a reasonable chance that the message may still be delivered, and the second tick would be shown.

6.3 If a call were made to a phone which is submerged in water, what would the likely outcome be? For example, would the phone ring? Would the call go to voicemail? Would the call fail?

6.3.1 The response to this question is in effect the same – and based on the same conditions – as that of 6.2. If we assume that the phone remained in a working condition, then the outcome is likely to be as follows:

a. If the phone was out of coverage, the phone would not ring. Assuming that voicemail was enabled for the phone then the call would be answered by the voicemail service. If voicemail was not enabled, then the response would be dependent on the host mobile network, but this is typically an automated message like "it has not been possible to connect your call".

b. If the phone was in coverage, even intermittently - for example in the bottom of the small boat and wave action means the boat is periodically submerged – then there is a reasonable chance that the call would be successful, i.e., the phone would ring.

6.3.2 Would your answer be different if the call were made through WhatsApp rather than on a mobile phone network?

6.3.2.1 No, my answer would be unchanged. WhatsApp is dependent on a) a working phone and b) the phone being in coverage of a mobile network, thus the same conditions apply as my response above.

7 Changes to Technology following November 2021

7.1 Please give an overview of key changes to the technology available for the purposes of maritime search and rescue in the Dover Strait following November 2021;

7.1.1 In general, from a systems and networks perspective the communications technologies available today for search and rescue remain largely unchanged from those detailed in November 2021 and as detailed in section 4, in that marine VHF radio remains the preferred solution.

7.1.2 I have considered each of the technologies covered in section 4 in turn and a summary of the key changes are as follows:

7.1.3 **The Airwave network** remains largely unchanged in terms of the technology and its use by emergency services and other responders. The Home Office had intended to replace Airwave with a new Emergency Services Network (ESN) which will offer mission critical communication services based on 3GPPP standards. These new standards offer similar services to Airwave (e.g. group calling, prioritisation etc) over 4G LTE networks, with the additional benefit of broadband data.

7.1.4 The ESN project is running substantially late, with deployment and transition to the new network now not expected to complete until the end of the decade.

7.1.5 One aspect of the ESN project that has progressed is the renewal of control room technology by many of the Airwave users. This renewal was driven by the need to support connectivity between control room and the new ESN network, and to support changes in connectivity to the Airwave network itself to allow it to continue operation as the contract was extended due to ESN delays.

7.1.6 The introduction of new control room equipment means that services can are more likely to be able to support newer emergency call handling capabilities including:

a. Improved caller location capabilities based on the Advanced Mobile Location (AML) specification (see section 5.1). Although AML was first introduced in 2014 many control room systems pre-dated this with some either not able to be upgraded, or it not being cost effective to upgrade.

b. New interfaces and functionality for ICCS to enhance the ability for control rooms to support social media messaging for reporting of incidents. Note that there is currently no mechanism to indicate an emergency situation via social media – the incoming message is typically handled by a non-emergency call handler and then escalated according to internal processes.

7.1.7 There have been no significant developments in **Marine VHF radio** in the context of SAR operations that I am aware of.

7.1.8 In the **mobile telephone market**, there have been several technology developments related to the introduction of 5G networks that could be beneficial in supporting SAR operations. A summary of these is provided below and further information is available on the 3GPP website and summarised in the document "The 3rd Generation Partnership Project" [30] (Exhibit II/30; INQ010088). 3GPP is a global initiative that coordinates activities with seven telecommunications standard development organizations, known as Organizational Partners, to produce the Reports and Specifications that define the 3GPP system which has delivered 4G, 5G and is working on future standards.

a. **3GPP Location and Positioning** [31] (Exhibit II/31; INQ010089)**:** 3GPP Rel-16 specified various location technologies to support regulatory as well as commercial use cases. Activity within 3GPP working groups includes the positioning requirements for high accuracy, high availability and low latency. The TSG RAN Rel-17 target positioning requirements include horizontal/vertical positioning accuracy, physical layer and higher layer end-to-end positioning latency and GNSS positioning integrity.

b. **3GPP Non-terrestrial networks (NTN)** [32] (Exhibit II/32; INQ010090) are networks or segments of networks that use either Uncrewed Aircraft Systems (UAS) operating typically between 8 and 50km altitudes, including High Altitude Platforms (HAPs) or satellites in different constellations to carry a transmission equipment relay node or a base station. There are various use cases for NTN but in the context of SAR the benefits include:

1. Mobile broadband connectivity in underserved areas, for example offshore areas.

2. Improved network resilience including the ability to provide or restore connection to public networks for disaster relief or for public safety.

7.1.1.2 The deployment of 5G networks is ongoing and replacement of mobile phones with 5G capable devices by the public is relatively slow and so the benefits of the above work will take time to be realised fully.

7.1.9 In the **satellite communications market**, again there have been some technology developments that could be beneficial in supporting SAR operations. One of these is the introduction of non-terrestrial networks within mobile networks as outlined above.

7.1.10 The growth of low-earth orbit (LEA) satellite constellations such as Starlink may provide some benefits to SAR, although this use case is relatively immature to date.

7.1.2 To what extent have these affected impacted the capability to identify the location of small boats in the Dover Strait?

7.1.2.1 Of the changes outlined above the only one to have any tangible impact at this time is likely to be increasing access in control rooms to AML data. The remaining developments are likely to evolve over coming years and so provide future opportunities to enhance SAR activities.

7.2 Please explain the anticipated impact of the implementation of the Emergency Services Network ("ESN") on search and rescue responses in the Dover Strait;

7.2.1 I have outlined in section 7.1 how Airwave is intended to be replaced by ESN and that program is running significantly behind schedule.

7.2.2 In respect to the mission critical voice services used by public safety organisations, ESN is intended to replace Airwave on a like-for-like basis. The same is expected for geographic coverage, and so given the constraints of spectrum licencing and international coordination it must be expected that ESN will have similar limitations to Airwave in respect of offshore operations.

7.2.3 In summary other than the indirect benefits from the renewal of control room technology outlined above I can see negligible impact on SAR operations from the transition to ESN.

8 Statement of Truth

8.1 I confirm that I have made clear which facts and matters referred to in this report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinions on the matters to which they refer.

Personal Data

Iain Ivory,

22nd November 2024