Digital Selective Calling: The Weak Link of the GMDSS

Capt. Anthony H. Patterson and Capt. Philip S. McCarter

(*School of Maritime Studies, Marine Institute of Memorial University of Newfoundland, Canada*)

Digital Selective Calling (DSC) is causing serious problems for Search and Rescue (SAR) providers. Administrations must seriously consider the humanitarian and legal implications of continuing the implementation of DSC. They may be in violation of the Safety of Life at Sea Convention, the International Convention on Maritime Search and Rescue, 1979, and the United Nations Convention on the Law of the Sea, 1982, by knowingly implementing communications technology that may jeopardize lives at sea even though the primary intent of DSC is to establish a suitable distress alerting method. States may very well open themselves to legal liability if loss of life or environmental damage can be linked in any way to the known faults of DSC.

1. introduction. The primary obligation of a State, party to either the Safety of Life at Sea Convention (SOLAS Convention) or the International Convention on Maritime Search and Rescue, 1979 (SAR Convention), is to enhance the safety of life at sea. Both Conventions recognize the importance of maritime Search and Rescue (SAR) in saving lives, and contain provisions requiring Parties to establish effective SAR systems. The United Nations Convention on the Law of the Sea, 1982 (UNCLOS III) contains similar provisions for SAR. A fundamental requirement for maritime SAR operations is efficient communications. The SOLAS Convention specifies the equipment to be carried on board ships in order to facilitate distress and emergency communications. The system described in the SOLAS Convention is called the Global Maritime Distress and Safety System (GMDSS). Under the SOLAS Convention, Parties are obligated to implement the GMDSS on their Safety Convention vessels by 1 February 1999.[1] Associated with this requirement is the modification of shore-side infrastructure such as coast stations that, most importantly, includes SAR capabilities.

The international SAR community – after much consideration – has concluded that the Digital Selective Calling (DSC) portion of the GMDSS degrades SAR operations, and threatens to increase its detrimental affect well into the future.[2] This conclusion cannot be taken lightly. Administrations must consider what is a *reasonable* means of distress alerting, and it is argued that DSC falls far short of the laudable aspirations of the GMDSS pioneers. Administrations should not rush forward with DSC implementation, privy to the knowledge that the DSC system is operationally flawed, merely to comply with the carriage requirements of SOLAS.

This paper will outline some of the key provisions of SOLAS, the SAR Convention, and UNCLOS III; describe the operational flaws of DSC, and discuss some of the legal implications of continuing with DSC implementation. The conclusion provides

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a recommendation to defer DSC implementation until its operational flaws can be addressed.

2. the conventions. Under the SOLAS Convention, Parties are required to provide coast watching, and to make arrangements for the rescue of persons in distress at sea around the coasts.[3] Furthermore, under SOLAS provisions, masters of vessels at sea are required to render assistance to other vessels in distress.[4] For the purpose of this discussion Chapter IV of SOLAS, which deals specifically with communications, will be examined. In accordance with Chapter IV, Parties and ships at sea are required to have specialized communications equipment designed to receive and transmit distress alerts and other important safety-related information. The system described in SOLAS is the GMDSS.

GMDSS, which is in its final stages of implementation, had its beginnings in 1973, with Assembly resolution A.283 (VIII). Through this resolution, the International Maritime Organization (IMO) announced its policy on the modification of the existing maritime distress system so as to incorporate satellite communications and foresaw the possibility of automatic alerting and transmission of maritime distress and safety information. GMDSS, as it exists today, was designed by communications engineers in the late 1970s.

The GMDSS carriage requirements are primarily based upon areas of operation. Tonnage does not influence the carriage of GMDSS equipment other than to set the lower limit of application of Chapter IV of the SOLAS Convention. A major principle in GMDSS is that on any ship at sea, in any geographical location, mariners shall be able to communicate efficiently and effectively with suitably equipped shore and ship stations.[5]

Satellite and radio systems, which are part of the GMDSS, have individual limitations concerning coverage areas and availability. In order to ensure that communication functions will be available at all times, requirements are made to duplicate such vital functions as alerting, warning and communications. Ships in distress should be able to alert each other, coast stations and associated Rescue Co-ordination Centres (RCCs). Acknowledgement of the distress message will usually be made by the shore facilities. The RCC co-ordinates subsequent direct communications with ships in the vicinity of the vessel in distress to facilitate the rescue.

Such a system is in complete contrast to the traditional view of distress alerting – that of ship-to-ship relays with possible interception by a shore station. In the MF band, distress alerting is facilitated by, until 1999, a two-tone alarm that triggers a dedicated 2182 kHz receiver. With the new philosophy, shore facilities become essential elements in the GMDSS, and this has placed an increased responsibility on Administrations to upgrade or establish modern shore communications facilities. No doubt the engineers who designed the GMDSS envisaged that Parties to SOLAS would establish a seamless communications matrix during the GMDSS implementation period.

Carriage requirements, with respect to radio equipment, depend on which sea areas the ship is sailing, and to a certain degree the size of the vessel. In GMDSS, four sea areas are defined:[6]

A1 Within VHF DSC coverage [approximately 40 miles from the coast]
A2 Not within an A1 area, but within MF DSC coverage [approximately 150 miles from the coast]

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A3 Not within an A1 or A2 area, but within INMARSAT coverage [70° N to 70° S latitudes]
A4 All other areas (the Canadian Arctic for example).

The main ship-board components of the GMDSS are:[7]

(i) Digital Selective Calling (VHF, MF & HF)
(ii) INMARSAT A[8] & C
(iii) 121·5/406 MHz, INMARSAT E, or VHF DSC EPIRBs[9]
(iv) X-band Search and Rescue [radar] Transponders (SARTS)
(v) NAVTEX MSI receivers
(vi) Enhanced Group Call receivers
(vii) Radio Telex.

Carriage requirements for GMDSS equipment are primarily based upon the needs of vessels coming within the scope of the SOLAS Convention – the so-called Convention vessels. Many non-Convention vessels, which comprise the vast majority of a State's coastal traffic, will not be able to carry a full suite of GMDSS equipment due to small size[10] and prohibitively high installation costs.

The SAR Convention was created in 1979 by an international conference on Maritime Search and Rescue. Modelled closely to Annex 12 of the Convention on International Civil Aviation 1944 (ICAO Convention), the maritime SAR Convention requires Parties to provide for 'adequate search and rescue services for persons in distress at sea round their coasts'.[11] The SAR Convention outlines actions Parties must take upon the reception of distress alerts; provisions Parties must make to create a SAR service; and lists the key SAR facilities that Parties must establish.

Of particular interest is the requirement for Parties to the SAR Convention to

> have adequate means for the receipt of distress communication via a coast radio station or otherwise … [and] communication with its rescue units and with rescue co-ordination centres or rescue sub-centres as appropriate, in adjacent areas.[12]

This obligation is seen by the authors to establish clearly a link between the SAR Convention and the provisions in SOLAS dealing with the GMDSS.

Under the SAR Convention, a Party is also required to establish a Search and Rescue Region (SRR) within which it is primarily responsible for co-ordinating SAR efforts. Unlike Annex 12 of the ICAO Convention where SRRs are established as part of a multilateral process at the Regional ICAO meetings, maritime SRRs are established through bilateral agreements between neighbouring States. The SAR Convention assures States that the establishment of SRRs shall not prejudice the delimitation of any boundary between States.[13] Clearly the tenor of the SAR Convention is to save lives at sea regardless of nationality.[14]

It is interesting to note that Article 98 of UNCLOS III, complementing Regulation 10 of Chapter V in SOLAS 74 and the tenor of the SAR Convention states that:

> Every coastal State shall promote the establishment, operation, and maintenance of an adequate and effective search and rescue service regarding safety on and over the sea and, where circumstances so require, by way of mutual regional arrangements co-operate with neighbouring States for this purpose.[15]

Article 98 of UNCLOS III captures similar provisions contained in a previous Law of the Sea Convention.[16]

As can be deduced from the above paragraphs, States party to SOLAS, the SAR

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Convention or UNCLOS III are required to establish adequate and effective search and rescue services. In addition, the SOLAS and SAR Conventions provide for the reception of distress alerts and the co-ordination of rescue efforts. The ultimate aim for all these provisions is to establish *reasonable* measures to saw lives in peril at sea.

3. operational flaws of dsc. From the SAR perspective, reliable and effective communications are a paramount operational requirement. Any deficiency in communications will result in the degradation of SAR system performance. The GMDSS is not without its well-documented problems. Difficulties with GMDSS reported to the IMO include:[17]

(i) Slow acceptance by ship owners
(ii) Slow implementation by Administrations
(iii) High capital costs associated with implementation
(vi) High false alarm rates [see Appendix]
(v) Potential communication problems between Convention and non-Convention vessels
(vi) Incomplete or inaccessible vessel identification databases
(vii) Interoperability or incompatibility with other communications systems.

Despite the above problems, the GMDSS represents a tremendous leap forward in improving safety and distress communications for ships at sea. Readers wishing to learn more about the GMDSS are encouraged to refer to one of several excellent publications that are available through most nautical libraries.[18]

The authors believe that the DSC technology is not sufficiently mature to supplant the existing distress alerting methods used in A1 and A2 sea areas. The following paragraphs will explore the limitations of DSC in replacing a listening watch on either VHF Channel 16 or 2182 kHz.

Clearly in the coastal zone there will be a potentially dangerous blend of GMDSS-compliant Convention vessels and smaller, non-Convention, long-range coastal vessels. Furthermore, SAR co-ordinators note that the vast majority of incidents occur in coastal A1 and A2 sea-areas. At the present time, most coastal vessels, including pleasure craft, carry marine band VHF on board for inter-ship communications. Many long-distance non-Convention coastal vessels also carry MF radios operating on 2182 kHz. This provides a means for distress alerting and rescue co-ordination over a common set of frequencies. Extensive shore-based VHF and MF networks facilitate emergency radio communications in the coastal environment. Inter-ship communication on VHF frequencies, especially in North America, is also a vital component in collision avoidance.

In the GMDSS era, Convention vessels will establish initial contact through DSC, which functions as a paging system. The DSC distress alert requests vessels to switch to a dedicated channel for voice communications. For example, VHF Ch. 16 is such a dedicated frequency. More importantly, however, is that the primary function of the shipboard equipment is to transmit and receive distress traffic to and from a shore station such as a RCC or CRS. Convention vessels will be equipped with receivers that can intercept these messages if they happen to be in the area. Non-Convention vessels, unless fitted with DSC, will be completely unaware that a vessel is in distress and has requested assistance. If there are no domestic requirements for coastal vessels to maintain a listening watch on pre-designated frequencies, they will not be alerted by RCCs, and will not be available to render assistance.[19]

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Table 1. Gmdss false alerts, 1992–6

	1992		1993		1994		1995		1996	
	TA	FA	TA	FA	TA	FA	TA	FA	TA	FA
INMARSAT†										
A	136	67	130	36	183	44	101	35	128	21
B							2		4	2
C	73	20	133	32	181	46	245	56	298	68
RCC Ijmuiden		55		107		157		242		298
Total INMARSAT	209	142	263	175	364	247	348	333	430	389
DSC†										
VHF	4	3	25	4	64	2	94	26	111	16
MF	10	7	37	15	70	30	68	21	182	86
HF	1	1	4	4	4	4	1	1	17	17
RCC Ijmuiden		4		43		102		115		189
Total DSC	15	15	66	66	138	138	163	163	310	308
Other alerts (EPIRBs)	363	355	514	497	556	548	628	622	635	622
MRCC Falmouth	662	640	891	860	903	864	997	959	973	943
Total	1249	1152	1734	1598	1961	1797	2136	2077	2348	2262
% false alerts	92·234		92·157		91·637		97·238		96·337	

* TA, Total alerts, FA, False alerts.

† Data from RCC Stavanger, RCC Bodoe and RCC Ijmuiden.

The same holds true for a situation where a non-Convention vessel attempts to transmit a distress alert on VHF or MF voice frequencies. Other non-Convention vessels may intercept the call, but Convention vessels – and perhaps shore stations in some areas of the world[20] – will not receive any alert because they will not be required to maintain a listening watch on the voice frequencies. In this situation, a major SAR incident could be occurring at sea where small vessels would attempt to co-ordinate a rescue without the aid of an RCC or nearby Convention vessels merely because they were not able to establish contact. In the two examples given above, the only sure method of transmitting a distress alert to nearby vessels will be through visual signals. Ironically, the introduction of new technology may result in the increased reliance on methods that predate the *Titanic* disaster!

Both non-Convention and Convention vessels rely upon each other for assistance in times of emergency. Volunteer rescue services operate in many States, providing a vital component of the SAR system in domestic waters. In some States, the service is comprised of non-Convention pleasure craft and small fishing vessels. The move from Channel 16 and 2182 kHz to their DSC equivalents could have a dramatic negative impact on these volunteer rescue services. Many are not funded sufficiently for a retrofit to DSC equipment by the implementation date in 1999.

The lack of a continuous listening watch creates an incompatibility with radio equipment normally carried on board non-Convention vessels. Recognizing that non-SOLAS vessels are unlikely to meet carriage requirements in the next few years, the Maritime Safety Committee of the IMO decided at its 68th Session that mandatory monitoring of VHF Channel 16 should continue after 1999. IMO has yet to determine how long this extension should apply, but it is interesting to note that the extension does not apply to 2182 kHz.

Another serious flaw with DSC, and shared with most GMDSS sub-systems, is the generation of a large and increasing volume of false alerts. Recent statistics from European RCCs clearly show the high percentage of false alarms attributed to GMDSS equipment (see Table 1).[21] Figure 1 clearly evinces the ominous upward trend.

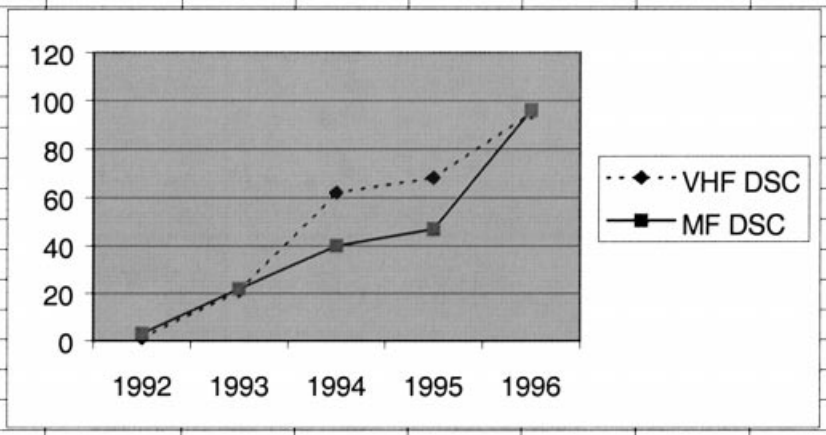
High false alarm rates have plagued the existing MF system as well. Some may argue that the high number of false DSC alerts are an overstated problem; for example, figures from Dover Coast Guard indicate upwards of 43000 false alarms from 2182 kHz two-tone distress alert generators were received annually! The reader must, however, consider the impact of receiving a two-tone alarm on operations; first on the mariner/watch-keeper and secondly on the SAR infrastructure. Pragmatically, and from a mariner's perspective, a 2182 kHz two-tone alarm caused little anxiety on the bridge with many faint signals not being logged at all. Any pertinent distress information such as position, time and nature of distress had to be gleaned from subsequent voice communications – often weak and distorted. Only loud and strong two-tone signals caused the watch-keeper to be drawn to the radio set elevating his/her awareness. Perhaps the officer of the watch may have sufficient time to obtain a DF bearing. If no voice communications were heard on 2182 kHz following a strong and steady two-tone alarm signal, routine procedure dictated that an 'enquiry' call be made. Failing any further communications, RCCs attempted to correlate the signal with overdue vessel reports, or other indicators that a vessel might be in distress. In the absence of any corroborative information, the two-tone alarm would be deemed to be false.

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GMDSS Alerts received by Netherlands CoastGuard Centre

	INMARSAT	VHF DSC	MF DSC	EPIRB's
1992	52	1	3	228
1993	114	21	22	291
1994	172	62	40	240
1995	250	68	47	334
1996	314	95	96	291

Note: As of December 1996 - Approximately 35 - 40% of the World's Merchant Fleet are GMDSS equipped



Source: 7th North Atlantic MRCC meeting. Hamilton, Bermuda. 9-11 July 1997. Report by the Netherlands. Alerting Under GMDSS 1996

Figure 1. DSC false alert trends.

On the other hand DSC provides no relief for the watch-keeper or the RCC. The far-reaching digital signal triggers an alarm on the bridge causing the watch-keeper to respond, often incorrectly, to the situation. In some cases the distance between vessels may be too great for subsequent voice communications on 2182 kHz. Associated and subsequent DSC relays and inappropriate acknowledgements could confuse the beleaguered watch-keeper, who is now armed with position, time and nature of distress information. However, the individual must wait for a 'reasonable' time and do nothing unless a coast station acknowledges the distress alert. Such a dilemma! Clearly, DSC has a much greater impact on watch-keepers than the existing two-tone alarm system.

False alerts from DSC, however, have a much more dramatic impact upon the workload at a RCC than other GMDSS systems.[22] Alerts from INMARSAT ship earth stations, for example, can be easily verified. The ship's identity is quickly determined through the comprehensive INMARSAT database, and attempts to contact the vessel will soon confirm if a real distress alert has, in fact, been transmitted. DSC alerts, on the other hand, are difficult to verify if contact cannot be

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re-established with the transmitting vessel. Given the poor state of the Maritime Mobile Service Identifier (MMSI) databases (the equivalent to the digital telephone number for the ship's DSC unit), determining the identity and whereabouts of ship transmitting the alert can be very difficult.

A recent study by The Netherlands indicates that the number of DSC alerts is expected to decline by the year 2003 (see Figure 2).[23] Their projections, however, are

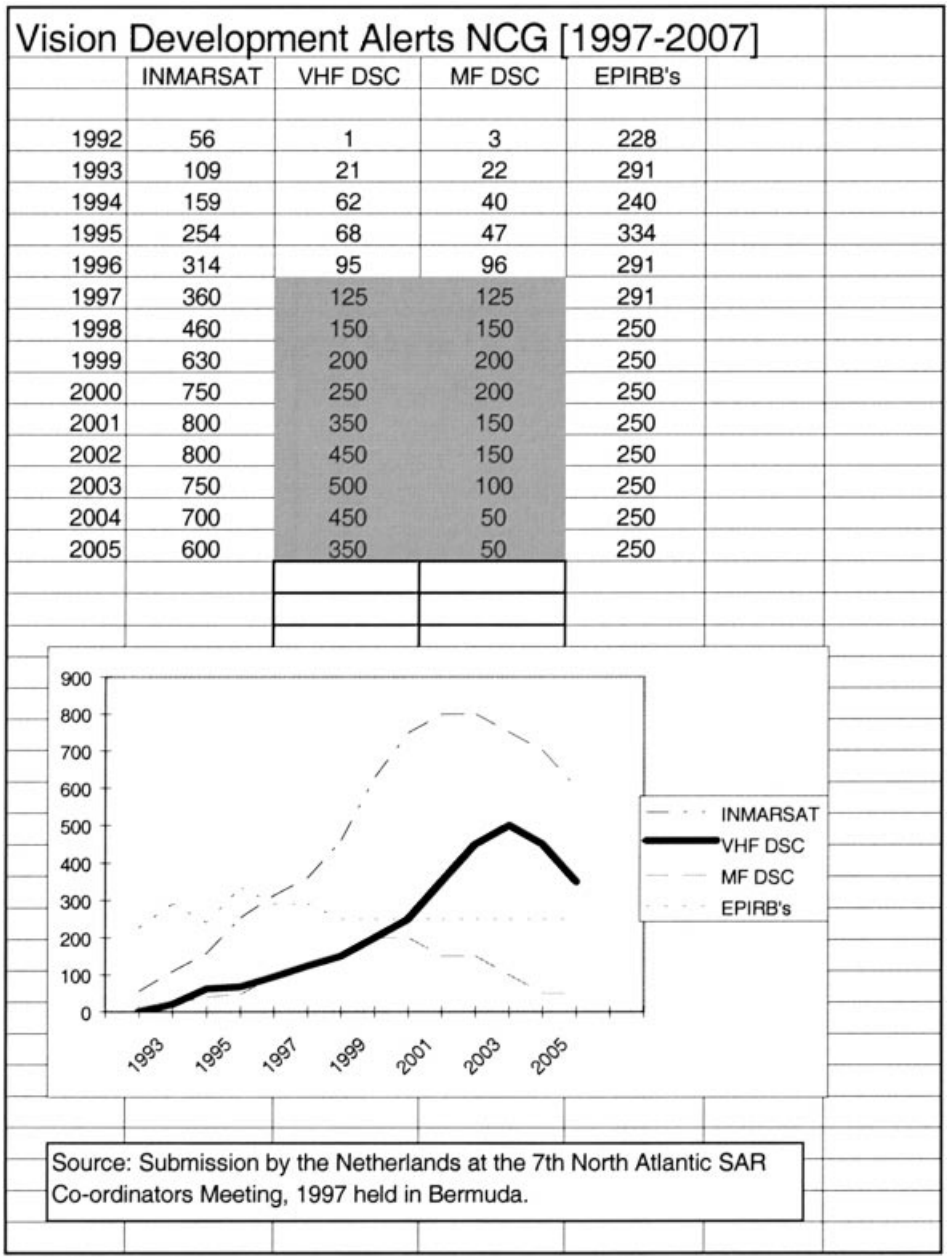


Figure 2. Projected false alarms in the GMDSS.

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partly based on the assumption that training will have a positive impact on false alerts generated by Convention shipping. Missing from their analysis is the large component of domestic traffic that will most certainly be generated by poorly trained operators. The authors postulate that the flood of false alarms will in fact occur later, with the graphical trend remaining upwards as low-cost DSC[24] enter the small boating market early in the next century.

Originally, certain DSC units could be configured to relay distress alerts automatically.[25] By selecting this option, a shipboard unit would re-transmit any DSC alert that it received. Significant problems arose with this option, and IMO quickly recommended that the automatic relay capability be removed from DSC units.[26] Debate continues, however, on the utility of semi-automatic distress relay capability, and procedures to be followed by ships at sea upon receipt of a DSC alert. For example, Volume 5 of the Admiralty List of Radio Signals (ALRS) advises Masters not to acknowledge a DSC alert unless it becomes apparent that no shore station is responding.[27] This procedure puts Masters in the uncomfortable position of delaying response to a distress alert. The United Kingdom noted that some coastal stations are transmitting acknowledgements without following-up on voice frequencies to determine the cause of transmission.[28] This practice, if it continues, will most certainly result in disaster.

Ships' officers at sea are feeling the impact of the large volume of false DSC alerts. Anecdotal evidence from the participants of GMDSS courses suggests that the ship's complement has a much more drastic and immediate method of eliminating the annoying and distracting DSC alerts – they turn their DSC units off! Not only does this permanently silence the copious false alarms, but ensures that the ship is also blinded to real distress alerts unless they come through INMARSAT or are seen visually. The DSC unit therefore is relegated to the equipment dustbin.

For shore authorities, the strategies employed to decrease false alerts on DSC are increased training, special procedures for handling DSC alerts by ships, and amendments to procedures followed by RCCs when dealing with DSC alerts. The Communications and SAR sub-committee of the IMO (COMSAR) has recognized the important contribution of training to successful GMDSS implementation.[29] Evidence links the high number of false alarms to operator error.

One author has observed that difficulties encountered by students participating in the GOC course are primarily attributable to DSC operations and procedures. Anecdotal observations of past failures or bare passes (70%) on the GMDSS course inevitably point towards the student being unable to grasp DSC fundamentals. We draw the conclusion that in the current GOC format, the time allotted for DSC familiarization and training is inadequate to reduce operator error.

Clearly training standards need to be improved. For example, the United States recently recognized that their existing FCC GMDSS licence testing procedure does *not* fulfil STCW 1995 requirements for practical demonstration of knowledge.[30]

The lack of comprehensive training requirements for non-Convention domestic vessels further increases the probability that the number of DSC false alerts will rise in the future. For example, Canada is considering a proposal which will not require any training for the thousands of boaters who are likely to fit DSC units on-board. Instead, a candidate attempts a multiple-choice test with a few questions pertaining to the GMDSS; however, the individual is not tested practically.[31] Given the difficulties encountered at the GOC level, the authors predict that this course of

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action will further increase the number of false alerts generated.[32] Unfortunately, training efforts to date have had little impact in stemming the flow of false alerts. The authors note that there are a wide variety of DSC user interfaces available on the market for which training on simulators cannot possibly prepare students. Convoluted procedures to transmit distress alerts challenge even the most astute watch-keeper, and exacerbates the complexity of DSC. The authors are of the opinion that there are not sufficient standards to guide DSC manufacturers in creating standard user interfaces. Manufacturers have inevitably gone their own way and attempted to produce equipment as close to the standards that are applicable to that date. The result has been a plethora of shipboard DSC units that suffer from:

(i) Small LCD display areas.
(ii) Multiple frequency distress alerting.
(iii) Complex user manuals.
(v) Complex menu trees.

From a rescue co-ordination perspective, DSC alerts cannot be acted upon in the same manner as a 'Mayday' broadcast without overloading the SAR system. RCCs normally verify the validity of incoming DSC alerts before diverting vessels or committing SAR resources. The SAR controller decision-making matrix is therefore more complicated, perhaps sufficiently enough, to generate a wrong conclusion. The repercussions could have dire consequences in terms of loss of life.

Another difficulty was recognized at COMSAR 1 where the delegation from the United Kingdom submitted that:[33]

> GMDSS ships are usually provided with radio equipment to operate over several radio communications services. If a distress alert is broadcast from different radio equipment on board a ship, the alert will probably, ultimately, be received by more than one, possibly several, RCCs. If this alert does not contain the ship's position, or is a position for which there is no known responsible RCC, each RCC acts independently unless, and until, it becomes aware that others are similarly involved with the same incident. This is wasteful duplication of SAR effort particularly in light of the high level of inadvertent activations of 'distress alert' facilities on ships.

Neither can the DSC be used in actions to avoid collisions as it is very unlikely that the sole watch-keeper is either aware of or has the time to determine the MMSI number of the vessel bearing down on the port side at night. Conceivably the distraught watch-keeper may wish to make a geographical area call, or alternatively, transmit an all-ships PAN PAN or SECURITE in a valiant attempt to establish contact with the give-way vessel. Recall that one of the main attributes associated with the GMDSS technology is the establishment of simple radio-communications procedures to alleviate the workload of stressed and fatigued watchkeeping officers. Equally distressing, if the problematic green sidelight is emanating from a non-Convention vessel, it would be oblivious to the frantic watch-keeper's calls![34]

The above points explored the limitations of DSC as a distress alerting method in the coastal environment. The authors of this paper strongly agree with similar conclusions drawn at the 7th North Atlantic SAR Co-ordinators Meeting in 1997[35] which highlighted the negative impact of DSC on SAR communications.

4. the legal perspective. As described previously, SOLAS, the SAR Convention, and UNCLOS III oblige Parties to put an effective SAR system in

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place for the rescue of persons in peril within defined areas of responsibility. Communication facilities are critical components of the SAR system established by a Party. Reception of distress alerts and co-ordination of rescue efforts are severely restricted if an inadequate communication system exists in a State.

A conundrum is now emerging for States party to either SOLAS, the SAR Convention, or UNCLOS III, namely, that by introducing DSC and eliminating a listening watch on both VHF and MF voice frequencies, States are not capable of fulfilling their SAR requirements under the Conventions. Surely the premise of safety of life at sea must supersede the provisions related to DSC equipment carriage requirements (including the discontinuation of listening watch by deck officers). The question remains, which provisions are to prevail? From the international law viewpoint, SOLAS arguably carries much more weight as 98 % of the world's tonnage are signatory to it and therefore represents a significant corpus of *opinio juris*.

Consider Article VI of the International Convention for the Safety of Life at Sea, 1974 which pertains to prior Treaties and Conventions. Specifically, Article VI states:

> (b) All other treaties, Conventions and arrangements relating to safety of life at sea, or matters appertaining thereto, at present in force between Governments parties to the present Convention shall continue to have full and complete effect during the terms thereof as regards:
> (i) ships to which the present Convention does not apply;
> (ii) ships to which the present Convention applies, in respect of matters for which it has not expressly provided.
> (c) To the extent, however, that such treaties, Conventions or arrangements conflict with the provisions of the present Convention, the provisions of the present Convention shall prevail.
> (d) All matters which are not expressly provided for in the present Convention remain subject to the legislation of the Contracting Governments.

Its future applicability is maintained expressly in the Protocol of 1978 to SOLAS 1974 where, in Article II it states *inter alia*:[36]

> The provisions of articles … VI (b), (c) and (d) … of [SOLAS 1974], are incorporated in the present Protocol …

Should a conflict emerge between SOLAS and other Conventions, Article IV(c) of SOLAS, coupled with its expressly included chapters on communications and co-operation amongst States Parties, provides little latitude for debate, and it appears that SOLAS 74/78 should prevail. Lending support to this observation, Article 94 of UNCLOS III, though not expressly referencing SOLAS 74/78, provides, in part, that:

> 3. Every [flag] State shall take such measures for ships flying its flag as are necessary to ensure safety at sea with regard, inter alia, to:
> (a) the construction, equipment and seaworthiness of ships;
> (b) the manning of ships, labour conditions and the training of crews, taking into account the applicable international instruments;
> (c) the use of signals, the maintenance of communications and the prevention of collisions.
> 5. In taking such measures called for in paragraph 3 … each State is required to conform to generally accepted international regulations, procedures, and practices and to take any steps which may be necessary to secure their observance.

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Rather weakly, Article II of the 1979 SAR Convention, drafted during the period of delicate negotiation amongst States to conclude a comprehensive Convention on the law of the sea, refers to other treaties and interpretation in section 2 which states:

> No provision of the [SAR] Convention shall be construed as prejudicing obligations or rights of vessels provided for in other international instruments.

This seems to suggest, again, that SOLAS 74/78 is to prevail. Therefore, a State must consider whether DSC is a 'reasonable' alerting system under SOLAS 74/78 being cognisant also of the much-documented problems and pitfalls associated with the application of the technology as a distress alerting method in coastal waters.

Guidance on interpreting treaties can be found in Section 3 – Article 31(1) of the Vienna Convention on the Law of Treaties (1969) which states:

> A treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in light of its object and purpose.

With this in mind, logically, and from a natural law perspective, it is far more important to save lives than to meet carriage requirements for GMDSS. In other words, the SOLAS provision dealing with the establishment of a SAR system should supersede the provisions dealing with DSC carriage and the discontinuance of the listening watch in VHF and MF frequencies.

5. scenario. There is, at present, a very real possibility for a major SAR incident to be hampered by existing and proposed DSC infrastructure/units primarily through a degradation in the efficiency of a SAR response to a DSC distress alert. A reduction in efficiency can take on many forms such as:

(i) Difficulty for shipboard operators to cancel false alarms
(ii) Fatal Operator Error {shipboard and/or land controller} incurred when distinguishing amongst multiple frequency distress and distress-relay messages
(iii) Improper tasking of limited marine and aeronautical resources
(iv) De-sensitization of SAR controllers to DSC alerts
(v) Potential for misuse of information or mis-information is heightened
(vi) Increase an Administration's exposure to expensive gross-negligence and/or liability court actions
(vii) Extra-ordinary delay of an appropriate response resulting in a casualty
(viii) A built-in redundancy of infra-structure increasing the cost burden for an Administration.

Consider a scenario where a RCC receives distress transmissions from a ship-board MF/HF DSC. The RCC in question is unable to confirm the validity of these messages. In addition for this scenario, due regard must be taken of the following circumstances:

1. The vessel is in distress.
2. Non-Convention vessels are in the area and do not receive any distress alert.
3. Convention vessels in the area receive the alert, but delay responding due to an acknowledgement being transmitted by a shore station outside of the SRR.
4. The acknowledgement is transmitted automatically by the shore station, and no follow-up communications is conducted.
5. The RCC delays tasking resources while it attempts to verify the validity of the DSC alert and determine the last known position of the vessel.

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6. A subsequent casualty investigation by an independent safety board reveals that the time spent by the RCC to verify the integrity of incoming DSC messages, and the delay for the vessels on scene to realise that a distress was occurring, was causally linked to loss of life and environmental damage.

A multi-layered jurisdictional matrix emerges should an incident, like that described above, occur. Ensuing litigation will challenge even the most astute lawyer. Could it not be argued that the State is *privy* to such difficulties and *knowingly* chose to ignore them? – thereby emulating the dicta of Lord Denning M.R. in the seminal Admiralty case *Eurysthenes*. What would be the recourse of individuals or corporate entities should an incident be causally linked to this privity? In some States substantial lawsuits will most certainly ensue. Notwithstanding UNCLOS III, this conflict can be resolved by removing, delaying, or altering the implementation of the carriage requirements for DSC under SOLAS and the GMDSS. Such action would enhance SAR capabilities as resources could be tasked much more effectively and efficiently.

6. conclusions

The Global Maritime Distress and Safety System is founded on the premise of saving lives at sea. As this system has evolved, shortfalls in the digital selective calling component have surfaced and have been documented. It is also common ground that the ability of an Administration to provide for the GMDSS is unequivocally linked to its compliance with the SAR provisions in SOLAS, the 1979 SAR Convention, and UNCLOS III. Unfortunately, as this paper has highlighted, DSC technology is too immature to supplant existing distress alerting methods, and its implementation in coastal waters could degrade SAR capability. Pursuant to analysis presented in this paper, the following recommendations are submitted:

1. Full implementation of the DSC component of the Global Maritime Distress Safety System (GMDSS) should be delayed until its utility for distress alerting is re-evaluated.
2. Any review of DSC must include an analysis of the impact upon intercommunication between Convention and non-Convention vessels; training standards for all vessels; trends in false alerts; standard user interfaces for DSC units; MMSI databases; and the impacts on SAR operations of DSC units.
3. Continuous listening watch be maintained by all vessels and shore stations on voice distress and hailing frequencies, including 2182, until such time as the review of the utility of DSC in SAR is completed.
4. The review of DSC must not delay the implementation of the other components of GMDSS.

Such a clarion call for a review is exacerbated since full compliance of DSC by Administrations, as required by the SOLAS amendment, is required by February 1999. It is the view of the authors that a State's SAR obligations in SOLAS, the 1979 SAR Convention, and UNCLOS III support the call for a review of DSC. The authors are hopeful that the DSC juggernaut can be slowed, and that after suitable provisions are made, the eventual implementation of DSC will result in an improvement in SAR operations.

references and notes

[1] SOLAS Chapter IV: Part A – Regulation 1(5).

[2] Proceedings of the 7th North Atlantic MRCCs meeting held 9–11 July 1997. See also, the preliminary

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draft proposal of the USA dated August 1998 to modify recommendation ITU-R M.541–7: Document available at **http://www.navcen.uscg.mil/marcomms/othrcoms.**

[3] SOLAS 1974 Chapter V: Regulation 15.

[4] SOLAS Chapter V: Regulation 10(a)

[5] There are nine functions for GMDSS equipment: SOLAS Chapter IV, Regulation 4.

[6] SOLAS Chapter IV: Regulation 2(.12–.15).

[7] SOLAS Chapter IV: Regulations 7–11.

[8] The analogue INMARSAT-A system is being phased out and is being replaced by digital INMARSAT-B.

[9] In practice, VHF DSC EPIRBs are not widely used.

[10] Transport Canada's Draft Regulatory Assessment Methodology (RAM) document issued 24 November 1997.

[11] Annex to the 1979 SAR Convention – Section 2.1.1.

[12] Annex to the 1979 SAR Convention – Section 2.3.3.

[13] Article II(1); Annex to the 1979 SAR Convention – Sections 3.1.5 & 2.1.7.

[14] Annex to the 1979 SAR Convention – Section 2.1.10.

[15] This article reflects the text in Chapter IV of SOLAS; Part B – Undertakings by Contracting Governments.

[16] Article 12(2) in the International Convention on the High Seas (1958).

[17] The proceedings of COMSAR 1 and COMSAR 2. See also, GMDSS survey in *Compuship*, October 1997, 1.

[18] Tetley, L. and Calcutt, D. (1994). *Understanding GMDSS*. Edward Arnold, London; Lees, G. D. and Williamson, W. G. (1996). *Handbook for Marine Radio Communication*. Lloyd's of London Press, London; See also, the *GMDSS Handbook*. International Maritime Organization.

[19] Canada is an example of a State which intends to continue requiring a listening watch after 1999; see Minutes to Canadian Marine Advisory Council, 6–7 May 1997.

[20] ALRS Vol. 5 for GMDSS coverage maps.

[21] Proceedings from the 7th North Atlantic MRCCs meeting. 9–11 July 1997. Hamilton, Bermuda. See also, MSA29/1995 Report on GMDSS false alerts by the United Kingdom, which states that 'the false alarm rate is better expressed in terms of the number of ships using the GMDSS which gives a figure of 1 in 20 years'.

[22] Report from the RCC Halifax GMDSS Workshop, 28–30 November 1995. Halifax, Nova Scotia.

[23] Submission by The Netherlands at the 7th North Atlantic SAR Coordinators Meeting in 1997 held in Bermuda.

[24] There are different classes of DSC equipment. See *IMO GMDSS Handbook* for specifics.

[25] Annex 2: COMSAR 2/13 – Draft COMSAR circular. Relays of Distress Alerts by DSC.

[26] NRC/GMDSS-8. North Sea Regional Co-ordination Conference under GMDSS. 12–14 June 1997.

[27] ALRS extracts operational procedures for DSC from ITU-R M.541–5.

[28] Proceedings of the North Atlantic SAR Coordinators Meeting. See also COMSAR 1/9/10.

[29] Proceedings from COMSAR 1 and 2. See also Proceedings from annual GMDSS Conferences held in Plymouth, UK.

[30] Comment CCG 95-062 from Capt. J. Fuechsel, Executive Director, National GMDSS Implementation Task Force, 23 July 1996.

[31] Personal conversation with Industry Canada representatives.

[32] Workload on the SAR controller will undoubtedly increase as noted in the RCC Halifax submission to the 7th North Atlantic MRCCs meeting held in Hamilton, Bermuda 9–11 July 1997. Halifax RCC states: 'It is the Canadian proposal for GMDSS carriage requirements on domestic vessels that may result in the largest increase in workload at RCC'.

[33] COMSAR 1/9/10, 24 November 1995.

[34] Arguably, this scenario is no different than the present problem with SOLAS vessels not monitoring VHF Channel 16 – a problem that DSC was designed to rectify.

[35] Proceedings from the 7th North Atlantic MRCCs meeting, 9–11 July 1997. Hamilton, Bermuda.

[36] This protocol is being superseded by the 1988 SOLAS Protocol.

key words

1. Communications. 2. Search & Rescue. 3. Safety. 3. Sea.

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