SECOND ICAO/IMO JOINT WORKING GROUP ON SAR (1994)

Montreal, 26 to 30 September 1994

Agenda Item 3: Harmonization of aeronautical and maritime SAR plans and procedures - provisions of conventions, plans, manuals and other documents affecting SAR

INMARSAT SYSTEMS FOR RESCUE COMMUNICATIONS

(Presented by Mr V. Spiridonov (Inmarsat))

1. INTRODUCTION

1.1 The attached document 'Inmarsat Systems for Rescue Communications' provides background information on present use of Inmarsat communications systems and its potential for future effective rescue operations. More details of the present status of the Inmarsat systems operations can be found in other Inmarsat publications available to the group.

2. DISCUSSION

2.1 The document also provides an insight into present areas of operational and institutional concern: false calls, distress alert routing, coding and registration of Inmarsat-E EPIRBs, Inmarsat-based Distress Alert Quality Control System, as discussed at the first meeting. The paper examines possible ways of solution to the problems and represents the individual views of the expert, rather than Inmarsat organization, in line with the LSR draft terms of reference (IMO Circular letter No 1692, 7 September 1993).

3. ACTION PROPOSED

3.1 Members of the Joint Working Group are invited to use this material for discussions in the group, especially those items on the list of priority, and further use as may be found necessary.

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INMARSAT SYSTEMS FOR RESCUE COMMUNICATIONS

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1. INTRODUCTION

The following discussions explain how the Inmarsat systems are used for rescue communications. Current arrangements for distress alerts routing between the Inmarsat coast earth stations (CESs) and associated rescue coordination centres (RCCs) may represent an initial stage in the concept of a rescue communications network. Economic, operational and management rational are explored toward a possible avenue for further development.

The rescue communications network will include the following primary GMDSS communications functions available to users through Inmarsat systems:

- ship-to-shore distress alerting;
- shore-to-ship distress alert relay;
- ship-to-ship(s) distress alerting;
- search and rescue co-ordinating communications.

The principle divider between this group of GMDSS functions and the others emanates from the nature of communications. The information circulating within the rescue communications network requires immediate rescue-related decisions and actions, rather than preventive safety-related activities.

With the growing number and categories of ships operating Inmarsat terminals, the number of occasions when the ship earth stations were directly or indirectly involved in distress communications remains relatively stable. Over the years of Inmarsat operations, the distress priority system was used by the Inmarsat-equipped ships directly or indirectly involved in 58 distress situations with more than 150 distress calls via satellites.

The operational objective guiding the concept of the rescue communications network is to reduce "alerting phase" and "uncertainty phase" at a rescue centre by rapid delivery of information related to a distress incident. These operational criteria are in full conformity with requirements of the SAR Convention 1979 (Ch.1, Para 1.3.9, 1.3.10; Ch.4, para 4.2.3.2; Ch.5; Ch.6).

The intention of the rescue communications concept development is to explore the possibility to implement Resolution 6 adopted by the International Conference on Maritime Search and Rescue, 1979. This resolution addressed the importance of the development of distress and safety telecommunications networks for efficient operation of the global search and rescue plan.

2. STATUS

Currently, on the radio path, the rescue operation is exploiting a matured Inmarsat-A Priority 3 System, emerging Inmarsat-E and Inmarsat-C Distress Alerting Systems and arrangements made between the earth stations and associated rescue centres.

Typical layouts of the networks, based on the Inmarsat two-way communications systems, Inmarsat-A and Inmarsat-C, are given in Figure 1 and Figure 2.

FIGURE 1

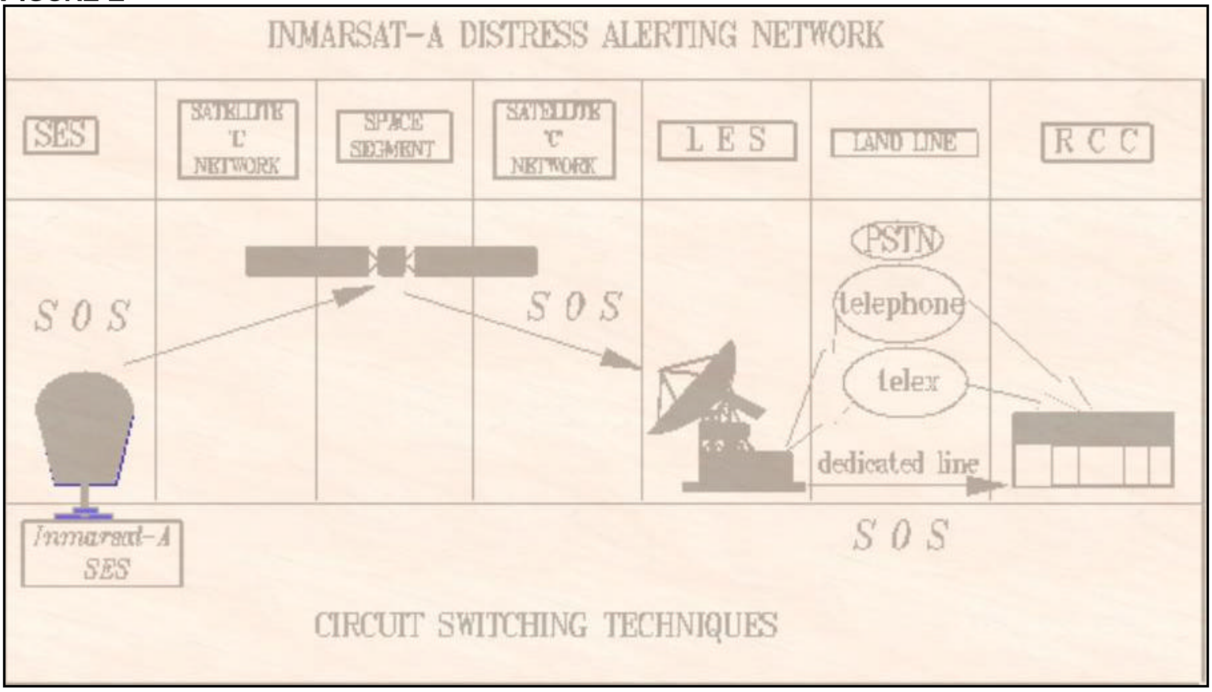
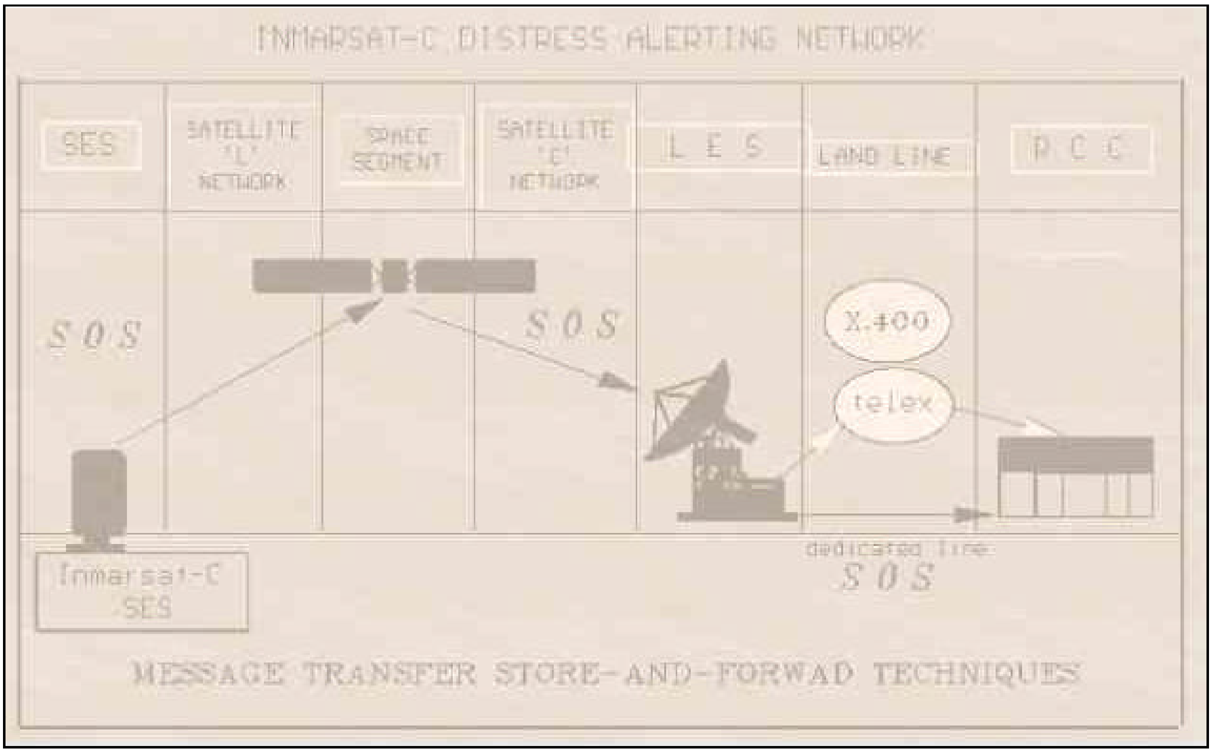
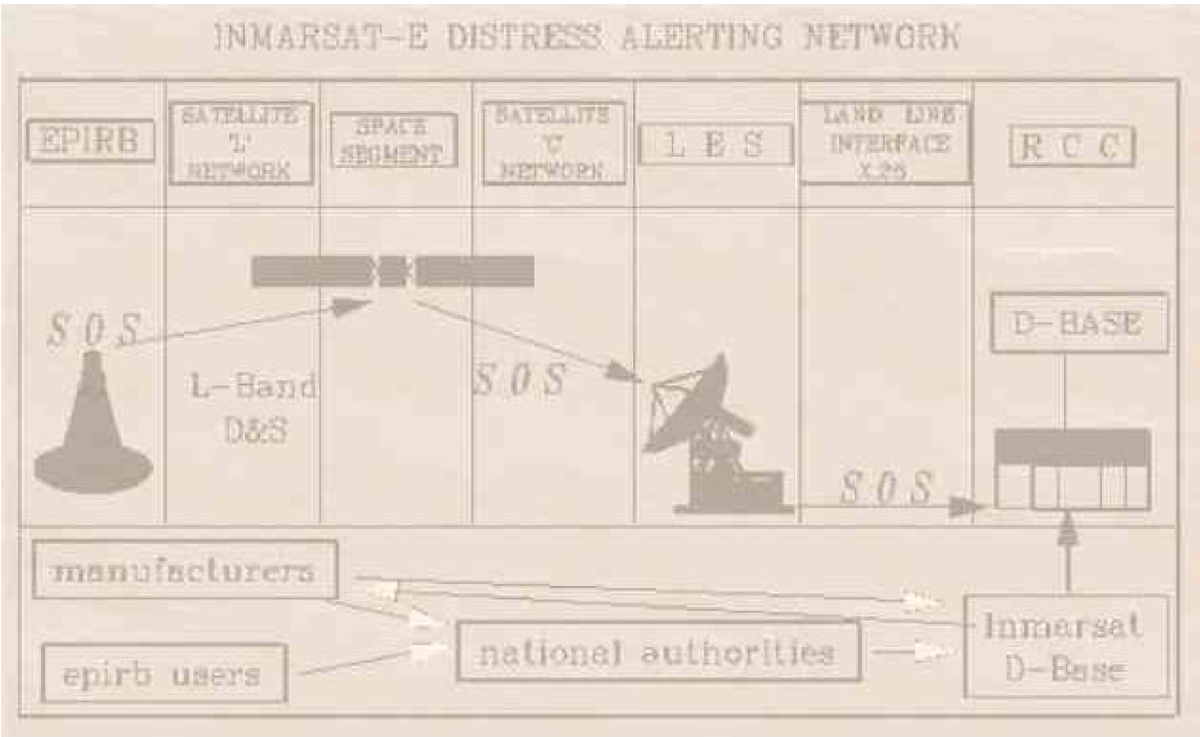


FIGURE 2



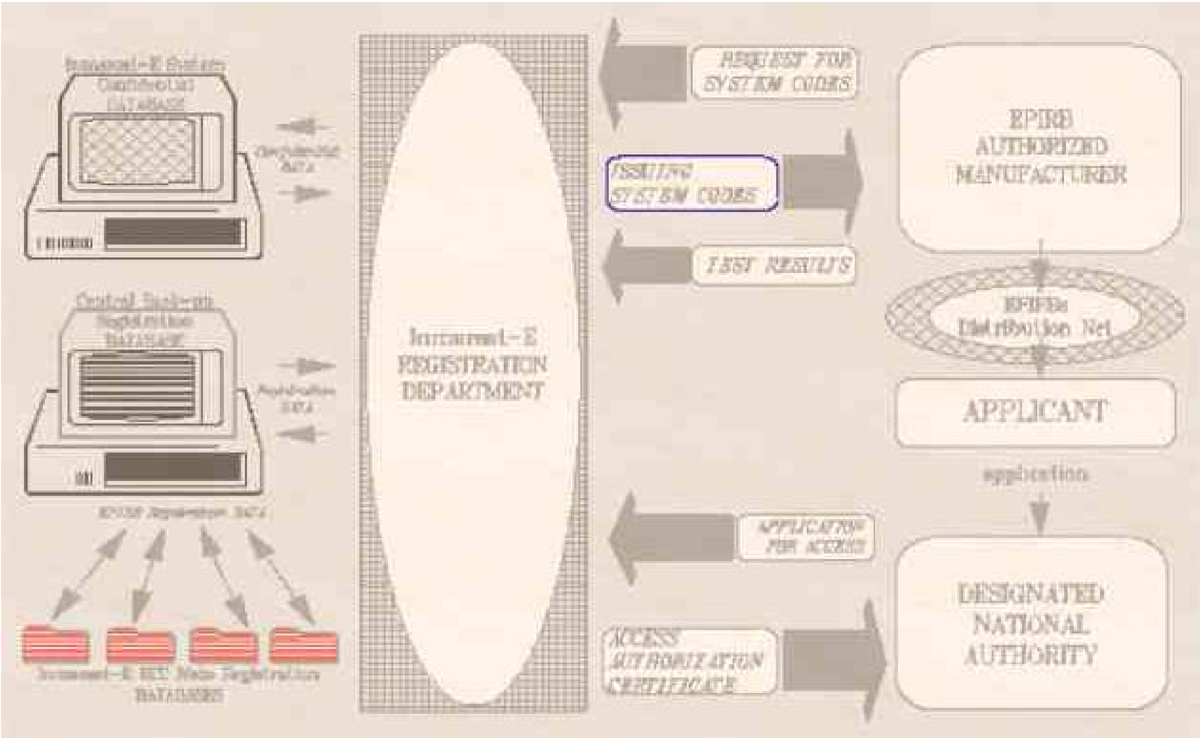
The distress alerting network based on the Inmarsat-E system is different from those based on two-way communications systems. The configuration is presented in Figure 3. The Inmarsat-E system, unlike other Inmarsat systems, is designed for one-way reliable delivery of a distress alert, generated and transmitted by an automatic beacon incapable of receiving a response from a rescue centre.

FIGURE 3



Due to these specifics there is a need for special technical, operational and administrative arrangements to make the system effective for search and rescue. The most important additions appeared to be the interfaces with the X.25 network, registration system and its database, availability control and spectrum monitoring system. Figure 4 shows the flow chart of collection and distribution of registration data.

FIGURE 4



System and rescue-related registration data. A Rescue Centre essentially turns out to be an integral terminating element of the satellite network, equipped with a main registration database. Instant access to this essential part of the Inmarsat-E system may significantly reduce the alerting phase at the RCC and expedite the process of rendering assistance to those in distress. Any other location of the database is not excluded, but will require additional communications, and potentially prolong the alerting phase.

The content of the registration database comes from the user's registration application. Essentially there are two types of data: system-related and service-related.

System data include an EPIRB's system code, EPIRB's frequency slot(s), Inmarsat Type Approval Certificate, manufacturer's name, model and serial number. System data essentially serve the purpose of identification of the EPIRB as one commissioned to operate with the Inmarsat space segment.

Service data include details of the applicant, licensee, owner and operator, vessel data, MMSI, radio call sign and particulars of two-way communications equipment carried on board. The service-type data mainly serves the needs of RCC personnel. The registration information may also include optional details of the desired destination of any alert. This option may significantly reduce the load on the Inmarsat-E RCC watchstanders as to the follow-up and coordinating communications.

Inmarsat-E Frequency Plans. Unlike other Inmarsat systems, Inmarsat-E does not operate on demand assigned frequency pairs. Instead, a 50 kHz portion of the distress and safety band is initially provided for the service. Two guard bands of 10 kHz on the top and bottom edges of this bandwidth enclose the main 30 kHz band. Within this band the Inmarsat-E system operates 100 slots on 0.3 kHz spacing.

In order to make existing rescue communications services more efficient and meet operating criteria, a number of modifications to the Inmarsat-E system have been advanced. The format of the message and its corresponding satellite channel have been enhanced to exploit the high accuracy provided by a GPS receiver integrated into the EPIRBs. This enhancement enables the rescue people to locate the EPIRB within 300 m. The distress alert printout at the Inmarsat-E RCC has been improved and fixed as a standard to produce a recorded routing of the distress alert.

The following table provides for essential information on the status of rescue communications services and achieved operational objectives. Arrangements for routing made between coast earth stations and associated rescue centres are playing a vital role in providing rapid and reliable delivery of the rescue related communications.

TABLE 1.

GMDSS SERVICE	SYSTEMS	arrangements for routing ces/rcc	connection set-up time (seconds)	message delivery time (seconds)	availability (%)
Distress alerting from a ship to the associated RCC, telex	Inmarsat-A Priority 3, circuit switched, two-way	Dedicated circuits	7-15	60	99.95
	Inmarsat-C Distress alerting system, store-and forward, two-way	Dedicated circuits	60-600	60	?
	Inmarsat-E distress alerting system, low signal, one-way	X.25, packet switching public networks	15-20	45-120	100
Distress alert relaying from an associated RCC to ship(s), telex	Inmarsat-A system	Dedicated circuits	20-30	60	99.95
	Inmarsat-C EGC system, one-way SafetyNET, store-and-forward	telex network	20-30	60-600	99.95
Distress alerting from a ship to ship(s)	technically and operationally possible, not used				
SAR Coordinating communications	For the RCC-to-Ship(s) communications, the same arrangements can be used as for the distress alert relaying; for RCC-to-RCC communications, arrangements are not in place.				

Despite the use of different signal processing techniques, all services are equally supported by

■well established Inmarsat network operating procedures;

- a reliable mechanism of technical and administrative control over the quality and availability of the distress communications services, including protection against interference and abuses;

- an authorized access to the system through type approval and commissioning tests. A qualified team of competent professionals have been maintaining integrity of the system and network services;

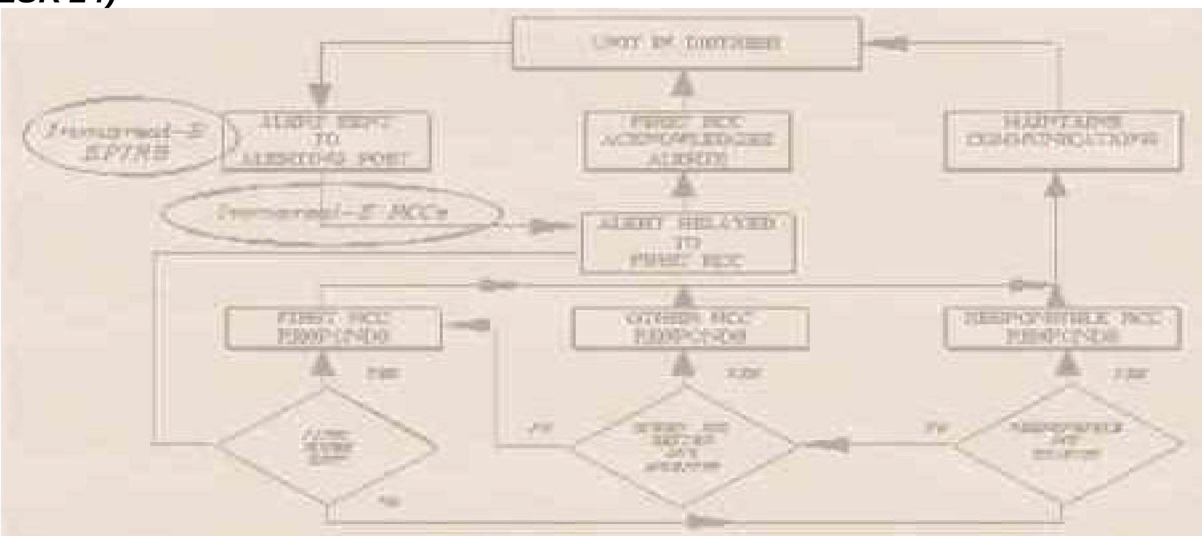
- national institutional arrangements. The IMO Performance Standards and Inmarsat design and installation guidelines have been made available to the national designated authorities, of the countries contracting to the SOLAS Convention and responsible for issuing a ship's safety certificate. These documents form the basis for national standards of control over installation and operation of the GMDSS;

- a created mechanism of educating the users. Inmarsat publications such as Manuals, Handbooks and others have been included into the syllabus for training courses and programmes at marine academies and other institutions.

3. AREAS OF COMMON OPERATIONAL CONCERN

Multiple alerts. Co-ordinating communications between rescue centres have become an essential ingredient of search and rescue activities as to the use of available means of communication. The flow chart of actions by the first received RCC is shown in Figure 5.

FIGURE 5 ***Flow chart of actions of the 'First received RCC' (based on source: IMO LSR 24)***



This area of activities needs attention. A lot of duplicating efforts may be involved in responding to the request for assistance generated by the multiple communications systems of the same vessel. The economy of search and rescue resources can be achieved by routing a distress alert directly to a rescue centre responsible for the sea area of the distress incident. The concept of a rescue communications network provides a solution to this problem.

'False calls.' Also, an area of growing concern is the increasing misuse of distress alerting systems and networks, which may be referred to as "false calls". The misuse causes serious waste of expensive resources by the rescue force and telecom operators, let alone the engaged resources, made unavailable to those in real need.

The present scale of misuse occurrences provokes a "cry wolf" syndrome, where people may assume that alerts are false. In most cases, false alerts are caused by a human error, partly resulting from the "wet paint" syndrome - the desire to try a "distress button" which one is not allowed to fiddle with. Inmarsat has already demonstrated a successful attempt to attack the problem by having established the Distress Alert Quality Control System. Misuse of Inmarsat-A distress communications systems is presented below on a year base.

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994 1ST HALF
SES	1550	2180	3070	3840	5150	6480	8160	10000	10900	FORECAST OF 1990			
										18000	20100	25000	29000
										REAL BY JULY 1994			
										12875	14570	16004	16700
FALSE	465	221	166	170	195	212	345	556	835	FORECAST OF 1990			
										1032	1188	1455	1760
										ADJUSTED FORECAST 94			
										986	1115	1224	1277
										REAL BY JULY 1994			
										1020	703	1-3Q=4Q 777=73	36

Live testing. An adjacent area of concern is the need for live testing of every component of the GMDSS communications systems and provision of the telecommunications networks for operational exercises and training of the rescue forces and crews. A growing portion of false calls is due to unauthorised testing.

Inmarsat systems allow for certain provisions of resources for these activities, e.g. the Inmarsat-E system provides specially allocated capacity, while Inmarsat-A offers the automatic priority three testing service, which has recently been put into operation. These measures will contribute to the reduction of false calls.

Definition of alert. In the present Radio Regulations, current definitions of distress alert are applicable to two modes of transmissions: digital selective calling, representing a two-way communications system and satellite EPIRBs, a one-way transmit. Inmarsat-A, Inmarsat-B and Inmarsat-C, two way communications systems, are not, strictly speaking, falling under the current definition.

On the rescue services part, the distress alert and distress alerting phase terminology have come from the SAR Convention, 1979. As such they define a certain stage in the progress of operations undertaken by rescue co-ordination centres.

The main difference between definitions of distress alert and distress communication appears to be in its effect on the status of the distress alerting phase at the rescue centres. When one way communications systems (EPIRBs) are involved, it takes rescue people some time to accomplish the alerting phase, since they cannot communicate back to the EPIRB over the same system in order to check the call and acknowledge its receipt. In the case of a distress call originated in two-way communications systems, all necessary information can be obtained instantly while the ship is on the line.

By definition, the distress alert and distress message formats do not contain the point of destination, addressee or any other routing indicator. The Radio Regulations also admit by definition that a distress alert may contain simply a ship station identity. A distress alert, virtually addressed to everyone in the manned systems (500 kHz), appears as a non-addressed message in integrated automatic systems, as such, it cannot be processed and routed by any automatic switching facility.

In the traditional 500 kHz distress communications systems, the decision how and where to pass a received distress message appeared to be a responsibility of national administrations. The radio station operator followed national instructions, whereby the distress priority message had to be passed to the responsible rescue authority. In turn, he had to act accordingly and, if needed, direct the message to the RCC which appeared to be in a better position to render assistance. At present, the gateway of an Inmarsat CES to the telecommunications network offers the rescue authority an automatic connection to the nominated associated rescue coordination centre.

According to the GMDSS concept, rescue centres are recognized to be the point of destination of distress communications. The associated RCC takes the role of the First Received RCC and should act according to the flow chart, developed by the International Maritime Organization. In automatic telecommunications systems, of which Inmarsat systems have turned out to be vital radio communications components, the routing of a distress call is partly determined by the SES operator, normally by selecting a particular CES.

However, there are views of some administrations, whereby the distress communication should be routed automatically to the responsible RCC. According to this view, the co-ordinates of the distress message contents should be used by automatic communications systems to work out the routing to the appropriate RCC, either nearest to the ship in distress or responsible for the distress area. Although the view is in some conflict with the flow chart discussed above, the implementation of the method seems to be technically feasible. The appropriate location of routing facilities appears to be a fundamental question: if telecommunications operators are to be the host of the routing equipment, then the radio regulations must be amended accordingly to establish legal and operational grounds for these arrangements within the GMDSS, which would require telecom operators to read the message content.

Identification. In theory, as proved by the history of civilization, one-way signalling must not carry more than one straightforward meaning, otherwise, misinterpretation of the signal and further confusion are unavoidable. E.g. in the early days, a signal about an enemy intervention was transmitted to the centre by sequential lighting of piles of wood, made in advance, on a sight-of-line between the nearest two. The signalling brought only one meaning - intervention. There was always a little bit of redundancy in the signalling, due to the a priori knowledge of the process and system of its transmission. One could make out the direction of the signalling, its speed and timing.

In a one-way system, according to this theory, a single identity must be given only one

meaningful function. This principle is implemented in the Inmarsat-E system. The Inmarsat-E EPIRBs are using a single unique identity - system code, to which other identities can be easily associated on a registration database. This approach allows to harmonize two functional requirements for the unique identification of the EPIRB related to the diverse purposes of: (a) in-system performance control and (b) rescue operations.
The system code is an essential element of the signal processing within the Inmarsat-E system and serves the needs of system performance control. The system code is represented in two forms. Its binary digits combination is processed on the satellite path in the "ship's station identity" field. This code is fixed by the manufacturer and protected electronically and mechanically throughout the EPIRB's life against any alterations of the unique system identity. This should be proved by the type approval and commissioning tests. The decimal combination of the system code is allocated to the EPIRB manufacturers by Inmarsat from the pool of nearly one billion codes. This allocation method enables Inmarsat to establish control over saturation of the system capacity by means of distributing associated frequency slots in the most economic and reliable way. For this purpose, the electronic database has been arranged to manage the registration system.

The applicant may use any suitable identity for registration. At present, the internationally recognized form of the ship station identity is MMSI, as recommended by Radio Regulations, Appendix 43. This applicant identity is used for communications needs outside the Inmarsat-E system.

The method of system coding enables the owner of an EPIRB to make its use flexible in this most sensitive operational area. Removal of an EPIRB from one ship to another only requires the owner to provide formal updating of its new location, there is no change in the in-system performance control and therefore there is no need for recommissioning tests.

The method of system coding also helps to reduce the possibility of fraudulent use of an applicant identity and unauthorized access to the system without commissioning tests, and makes a chance of false calls negligible. All these advantages eventually result in effective use of rescue resources and reduction of their waste.

4. INSTITUTIONAL MATTERS

The current SOLAS Convention makes provisions for carriage requirements, while footnotes to the Convention recommend the use of performance standards for particular on-board equipment to comply with technical, operational and installation requirements. On the shore side, the Convention and IMO Resolutions urge governments, contracting to the SOLAS Convention, to provide GMDSS communication services and shore-based facilities to make these functions available globally and internationally.

New Radio Regulations and ITU-R recommendations protect frequencies for GMDSS operations by providing adequate procedures and standards.

The GMDSS technical and operational requirements for telecommunications, such as an integrated radio and terrestrial network, seem to have only recently become a subject for considerations of its performance by the IMO and ITU. The GMDSS concept needs to spread the focus of attention beyond shipborne equipment to an overlay consisting of an integrated network of maritime mobile satellite radio systems and shore-based telecommunications networks. The need for objectives or goals for rescue communications networks is also justified by the following discussions.

Shipborne equipment vs rescue communications networks. Although IMO Performance Standards for Inmarsat ship earth stations have been developed with due regard to the specific system characteristics, still this is not all that makes the ship terminal an acting and correctly performing element in both Inmarsat and GMDSS systems. It becomes such an element when it is Inmarsat type approved, installed, commissioned, licensed, registered and operated properly.

Any deviation from the system parameters or established operating procedures by the ship terminal makes the GMDSS in-operative and might be a cause of deterioration of GMDSS services offered to other users in need. The objectives for a rescue communications network and its systems design essentially would be incomplete if it were to provide only for single methods of protection by prioritization and pre-emption of resources, such as spectrum, power, distress channels, circuits, processors etc.

Objectives vs system design techniques. A single isolated satellite communications system, even of the best possible design, can hardly deliver its advanced technology to reduce alerting phase and lead time of search and rescue operation. The practice of Inmarsat operations over a decade proves that only a mature telecommunications network can provide a satisfactory solution for the GMDSS communications services. The objectives for the network and services, provided by the governments contracting to the SOLAS Convention, might be the right approach.

Objectives vs SOLAS Convention. The appropriate legal position of objectives under the SOLAS Convention is appropriate for a footnote similar to the legal position of the performance standards for shipborne equipment. This would be an effective tool for the contracting governments to license the networks and services in order to fulfil their commitments for provision of the shore-based facilities and GMDSS communication services.

More than ten years of operation of the Inmarsat-based satellite communications network suggests that the system availability and reliability should be central to the successful delivery of the GMDSS communications services. These qualities should be measured against performance criteria.

Operational criteria and objectives for the concept of the rescue communications networks. The operational criteria should relate to the main objective of developing a telecommunications tool for efficient operation of the search and rescue plan as required by the SAR Convention 1979 and Resolution 6 of the International Conference on Maritime Search and Rescue, 1979. This approach to the telecommunications in the GMDSS is wider than an approach based on merely standards for a satellite system or an on-board terminal. The telecommunication provisions involve operational elements, such as routing of distress communications to the right destination, availability of the network to perform the service, and the delivery time of rescue communications.

Operational criteria for the rescue communications network, external to the satellite systems, can be used by the network operators and registered services providers as objectives for selection of adequate engineering methods and techniques of signal processing, development of technical requirements for system components, operating procedures and manuals. All of them are to form the network and services.

The following operational criteria for the rescue communications network should facilitate uniformity of services and its compatibility with the GMDSS:

- The delivery time of error-free distress communications between the points of origination and destination should be within one minute for two way real-time communications systems and two minutes for one-way distress alerting systems.

- The availability of the network services should be maintained at the level of 99.95% over an operational period of one year, one single interruption not exceeding a transmit/receive cycle in a particular distress alerting system.

The rescue communications network operators should demonstrate that

- the network performs in full compliance with the established criteria;

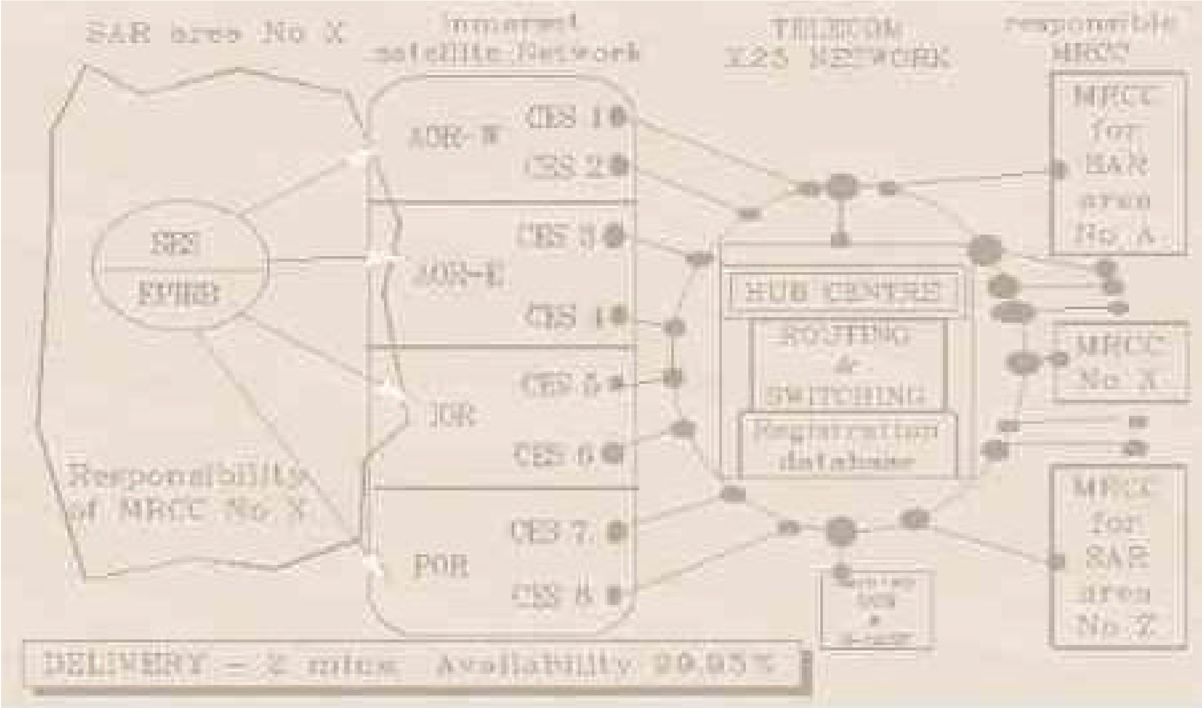
- the shipborne equipment is designed, type approved, installed, operated and administered in full compliance with the standards recognized by the International Maritime Organization (IMO).

- the network is managed at a high level of professionalism, expertise and skills, adequately supported by the recognised system operating procedures, manuals and other documentation infrastructure.

5. RESCUE COMMUNICATIONS NETWORK CONCEPT DEVELOPMENT

The concept of the rescue communications network, which might be abbreviated as RescueNET, with a new technology utilized by the Inmarsat M/B Distress Call Systems and modifications made to the systems currently in operation, could gradually fill in the existing gap in RCC-to-RCC co-ordinating communications by developing a number of the rescue communications services. The concept architecture is explained in Figure 6.

Figure 6. ***The concept of Rescue Communications Network***



Effective communications of the first received RCC requires essential details of the ship in distress. The rescue communications network concept suggests that all data provided by the user for registration with the network should be available for regular update of the databases by means of regular broadcast or circulation of updates or instant access to the registration database.

The registration information is expected to be voluntarily provided by Inmarsat users. The registration of users of the Inmarsat-E/GMDSS Distress Alerting System will continue to be mandatory.

The rescue communications network concept uses a prototype of an RCC terminal. The terminal would be a stationary configuration, based on all or only one (Inmarsat-M) standard, including computer and modems. Using this terminal, the responsible RCCs would be able to run co-ordinating communications, to receive broadcast of registration data and to have instant access to the Inmarsat-based registration data. It would be also possible to receive broadcasts of distress alerts relay from the EGC SafetyNET Service, communicate with the ships and broadcast distress alert relay via EGC.

According to the concept, the users of the rescue communication network would be encouraged to have an Inmarsat approved Distress Communications Unit. The design would allow either a stand alone or an integrated unit. The prototype will be developed and tested in order to assess its feasibility. The unit would be required to perform with any Inmarsat and possibly conventional radio equipment approved for GMDSS. The most important functions are to generate a distress message and log all distress communications. This 'black box' type of equipment would assist national authorities in investigations of marine casualties.

According to the concept of rescue communications network, the functionality of the rescue communications network must be supported, as described below.

The HUB Centre is the final point of destination of all non-addressed and multiple distress alerts in the Inmarsat communications systems. As such, it partly takes the role of the currently defined First Received RCC to perform the following functions:

- check, if the same alert has already been received and dealt with, thus eliminating the problems of alert multiplicity, ambiguity and errors;
- check the ship's position in the distress message contents to identify the desired routing address of the responsible RCC;
- check the registration database to retrieve information related to the ship in distress. Compile the distress message and associated registration data into a distress package and transfer this to the responsible RCC, or to the specific address, as may be instructed in the registration documentation;
- receive an automatic confirmation from the network recipients of these communications;
- receive a human acknowledgement from the network recipients of the distress package;
- if no confirmation is received in 10 seconds, circulate the distress package to all responsible RCCs in the network; keep records of received acknowledgements and circulate it if needed. Relay a distress alert to the ships in the area of the ship in distress;
- update databases regularly;
- maintain a programmable conversion table of the coordinates of SAR areas into network addresses of corresponding RCCs.

The responsible RCC would take over the responsibility for rescue operations and further communications with the ship in distress. The following functions within the rescue communications network must be supported:

- send an automatic confirmation to the HUB centre and the ship;
- send a human acknowledgement of the distress alert to the ship;
- send a distress alert relay to the area of the ship in distress, if needed.

The network coordination station and a back-up coordination station in the Inmarsat system would be the best candidates for provision of dedicated resources of the rescue communications network, as such, they would have to perform the following functions:

- Demodulate the signal and reformat the package for transmission over X.25;
- Transfer the package to the HUB centre;
- Keep the channel open for at least 20 seconds until the confirmation and acknowledgement of receipt from a responsible RCC is received and retransmitted to the SES;
- Confirm transmission of acknowledgement to the HUB and Responsible RCC.

Inmarsat would have to keep registration of users and circulate regular update over X.25 to the HUB registration database; as a back-up the regular broadcast of the registration data may be performed over the satellite to the RCC equipped with Inmarsat terminals.

Economic Viability. Cost analysis suggests that the optimal architecture of the rescue communications network should consist of two CESs of every standard in each ocean region directly connected to two global communications hubs, operational and a back-up. The role of an operational CES preferably must be taken by a CES collocated with the NCS, and a back-up role should be placed with a back-up NCS. However, on the technical and operational base, the concept does not exclude integration of any number of additional coast earth stations.

According to the concept, all responsible RCCs would be integrated into the rescue communications network by means of a special data terminal. All in all, in capital terms the rescue communications network would have 8 coast earth stations for each system, two communications HUBs and 20 - 30 interfaces with X.25, while present arrangements for distress communications involve about 100 coast earth stations. Assuming that maintenance and operating expenses are apportioned to the capital cost of the CESs involved, one can make out very rough figures, which indicate that the total (capital and operating) cost of the rescue communications network would be 10 - 15 times lower then the cost involved in present and future systems.

The cost of traffic related to rescue operations may be as high as $80.000 - $100,000 a year. The cost of traffic generated by live testing, training and demonstrations is likely to be around $500,000, and 'false distress' traffic generated by misuse of the network can be well above $500,000.

The concept of the rescue communications network gives an optimum solution, which would require minimum capital investment and involve reasonable maintenance and operating cost, while the quality of global search and rescue operations would be of highest possible standards due to the centralized control over GMDSS communications functions. The misuses of the system and live testing services could become a source for partial reimbursement of the invested capital through the recovery mechanism.

6. CONCLUSIONS

The Inmarsat communications systems presently used by mariners and rescue authorities for distress communications prove to be a reliable telecommunications tool in the search and rescue operations and still possess a great potential for further improved applications.

The routing arrangements for distribution of non-addressed distress alerts and associated inter-MRCC coordinating communications require further improvements to match operating criteria of the Inmarsat satellite communications systems.

The proposed concept of the rescue communications network may represent an economically viable solution to the recently emerged operating problems, such as *efficient delivery* of distress alerts and related registration information to the responsible rescue centre; vigorous *control over misuse* of the network (*false distress calls*) at an early stage; minimization of the number of CESs and RCCs to maintain high level of distress alert service availability; opportunity to exploit generic multiplicity of distress messages in the GMDSS for error correction and elimination of ambiguity; minimization of the number of registration databases and required resources for maintenance and updating; efficient RCC-to-RCC coordinating communications and back-up for the communications between a responsible RCC and the ships at sea.

The proposed concept is not intended to answer the question who should or may implement the rescue communications networks. Concerted actions of governments contracting to the SOLAS Convention, national rescue authorities, partners and members of the Cospas-Sarsat programme and the Inmarsat organization may be required to overcome institutional issues of Radio Regulations and national practice in respect of an integrated telecommunications network.