SATELLITE BASED LONE WORKER ALARM SYSTEMS

UPDATE

R&D Project 409

August 1993

NATIONAL RIVERS AUTHORITY

SATELLITE BASED LONE WORKER ALARM SYSTEMS - UPDATE

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EXECUTIVE SUMMARY

This study has been undertaken to update the previous study into the possibility of providing a satellite based system for Lone Worker Alarms (LWAs) for National Rivers Authority.(NRA) employees.

Previous investigations up to 1991 had identified one satellite system which could be technically and commercially suitable, but which at that stage was unlikely to receive regulatory approval. The system is known as COSPAS/SARSAT and is used for marine search and rescue operations.

Since 1991 several new satellite systems have been planned. The study considered the range of these planned systems, and explored with regulatory bodies (Department of Trade and Industry, Police, etc.) the potential for LWA use.

The majority of the newly planned satellite systems are for the 'sky phone' concept and could be technically suitable for LWAs. The systems are however unlikely to be in service before the late 1990s at the earliest because of their very large capital investment.

The study has concluded that COSPAS/SARSAT remains the most viable technical option for several years.

The continuing interest of the NRA in protecting its employees with LWAs in general and in the possible use of satellites in some instances, has been matched by a more sympathetic view by the regulatory authorities to land based use of search and rescue satellites.

The study has recommended that a short trial of COSPAS/SARSAT should be undertaken, to test its effectiveness on land, and as a focus for further liaison with the regulatory authorities.

LIST OF REFERENCES

1 National Rivers Authority, Lone Worker Alarm Feasibility Report document No 65360/420/00003.

2 National Rivers Authority Lone Worker Alarm Feasibility Report - Supplementary Information on COSPAS/SARSAT System Document No 65360/420/00004.

SECTION 1

INTRODUCTION

1 INTRODUCTION

This report is to provide additional information on the use of a Satellite based system to provide Lone Worker Alarms (LWAs) for NRA employees.

A preliminary investigation was undertaken in 1991 and a report titled National Rivers Authority, Lone Worker Alarm Feasibility Report, Supplementary Information on COSPAS/SARSAT System, document no 65360/420/001 dated April 1991 was issued detailing possible options for satellite based LWA systems.

Since 1991 several new possibilities have been identified and these, as well as existing systems, have been further investigated and reviewed as possible LWAs. The report addresses the suitability or otherwise of these new developments and their long term prospects and proposes a goal for the short term with a proposal to implement the limited LWA system using satellite systems currently in service.

SECTION 2

SURVEY

2 SURVEY

Since the original report a large number of new proposals have been identified for satellite based communication networks. These proposals have been investigated, and the respective organisations contacted to establish the suitability of the system for providing lone worker alarm systems.

2.1 THE TECHNOLOGY

From a users point of view a satellite based LWA is the most desirable: press the button and some how the alarm is received in the control room. The user need do nothing other than carry the alarm unit and press the button should the need arise. The COSPAS/ SARSAT system was identified in the previous report as embodying this principle; the marine user purchases an alarm unit and should the need arise, presses the help button. After a delay, up to 45 minutes, a lifeboat or helicopter is alerted and thus help provided. The ground infrastructure to support this facility is provided by the countries throughout the world, with four countries: USA, CIS (USSR), Canada and France building, launching and operating the space segment (satellites).

Satellite systems are available using different operating principles, each with their advantages and disadvantages. All the satellite based systems have the same basic components, the major differences being the type of earth orbit the satellite is in, and the operating frequencies.

2.1.1 Satellite and Orbits

Today there are approximately 2000 satellites orbiting the earth, each in a different orbit. These orbits may go around the equator, over the poles or any orbit in between. The equatorial orbit is called a "zero degree inclination" orbit whereas an orbit over the poles is called a "ninety degree inclination" orbit. In addition to the position of the orbit the height of the orbit is also important. These two parameters determine the basic characteristics of the satellites orbit. For the purposes of the LWA applications there are two basic orbit types that influence the operational characteristics and thus its suitability for use; these are Low Earth Orbits (LEOs) and geostationary orbits. To be visible to users in the UK a satellite in LEO needs to have an inclination (to the equator) of more than 50° or be in polar orbit. A geostationary orbit is a satellite that has an inclination of 0° (equatorial orbit) and at a height such that it takes 24 hours to go around its orbit; thus, as the earth rotates once every 24 hours the satellite appears from the earth to be stationary.

(a) Low Earth Polar Orbits

Satellites in this type of orbit complete one revolution of the earth several times a day. This means that a large number of satellites are required to give continuous coverage. Being a low orbit the distance between the satellite and earth in relatively short, 300-1500 km, and this has distinct benefits for communications. The major drawback with this type of orbit is that it is visible over a particular point on the earth's surface for a short point of time, generally less than 30 minutes.

(b) Geostationary Orbit

With the satellite in the same relative position in the sky all the time, continuous communications are possible. As the satellite is positioned over the equator a user in the UK needs to have an unobstructed view of the sky to the south. However, the satellite is 36000 km away from the earth at the equator and perhaps 45000 km away from the UK, and this distance requires higher powers for reliable communications. Higher powers are often achieved by directional antennas which require accurate positioning and stability.

Geostationary satellites are generally large and very much more expensive than LEO satellites. Due to various influences the satellite has to be continuously manoeuvred to maintain its relative fixed position to the earth and this requires rocket motors and fuel, a finite resource in space, which increase the cost of maintaining the system. High infrastructure costs generally mean that the operators expect revenue from the users and the cost to the casual or occasional user are usually significant. The technical requirements of the equipment needed to use this type of satellite generally puts its use beyond the reach of small organisations.

2.1.2 Satellite Alarm Units

There are several satellite based units available all designed for specific applications, but the majority for the maritime environment. The size, functionality and cost of these alarm units depends upon the service for which they have been designed. They tend to be bulky so that they can float and function for extended durations in water. This product has now become market driven with a trend amongst the manufacturers for size reduction and the need to make them "personal" alarms thus increasing the production volume and reducing cost.

Most of the world's regulatory organisations providing communications and rescue services require that the alarm units used on the system are built to fixed specifications before use is permitted. This limits the possibilities for individual organisations who require small numbers to have specific features or performance requirements.

2.2 SATELLITE SYSTEMS AVAILABLE

Previous reports [1][2] have highlighted two possible systems; COSPAS/SARSAT and Inmarsat. These and other systems have been further investigated and discussions instigated with the appropriate authorities and service providers. For convenience the different systems have been divided into existing and proposed satellite systems.

2.2.1 Existing Systems

There are numerous satellite based communications systems but only those systems designed to work with hand held equipment have any application as Lone Worker Alarms. Of these systems the most suitable have polar orbiting satellites. Systems with geostationary satellites have limited application; the reasons for this have been detailed in Section 2.1.1(b).

(a) COSPAS/SARSAT

The COSPAS/SARSAT system is owned and operated by an international consortium of space agencies, with its headquarters in the UK.

The system was designed from the outset as a Global Emergency Alerting and Location System. The system uses polar orbiting satellites and with its constellation of 5 satellites provides at best a location fix to approximately 1km with a maximum delay in receiving and sending the message to earth of 45 minutes, anywhere on the earth's surface.

Initial contact with the COSPAS/SARSAT organisation provided a very positive response. However, initial approaches to the Department of Transport (DoT), the UK regulatory agency, resulted in considerable caution. Subsequent discussions with the DoT have resulted in a more receptive response.

(b) Argos

The Argos system is a commercial global positioning system owned and operated by CEIS TM France.

The system is used extensively on the Continent for the location of vehicles and rail rolling stock. The system has other uses such as tracking wildlife movements on land and at sea.

Investigation as to the system's practicality for a LWA have as yet not produced any positive indication from CEIS although they have provided some sketchy details on uses of the system and basic operating modes. The basic performance is thought to be the same as COSPAS/SARSAT as it uses the same satellites. Specific information on the response time for the system and location accuracy is still awaited. An additional issue is the possibility of licensing the unit for use in the UK and this, together with the lack of detailed performance data, has made the system difficult to evaluate for potential LWA use.

(c) Inmarsat

Inmarsat is an international organisation made up of national telephone and communication companies, which owns and operates a number of communication satellites. These satellites have several different operating modes with different characteristics. However, the satellites currently used are all in geostationary orbits.

(i) Inmarsat A

A maritime voice and data system requiring a large dish antenna (>1.5 m dia).

(ii) Inmarsat B

A maritime voice and data system requiring a small dish antenna (approx ≈0.7 m dia)

(iii) Inmarsat C

A non-real time portable data system utilising very small antennas (typically 0.3 m dia).

(iv) Inmarsat M

A portable voice (and data) system designed to fit into a briefcase.

(d) Satlife

Satlife is an American based medical charity. The system uses a small low earth orbit satellite to provide non-real time (store and forward) data links primarily for medical information transfer between third world countries and medical institutions worldwide.

Although not primarily suitable for a LWA system the satellite system is based on a single low cost satellite providing worldwide geographic coverage and high performance communications links. The satellite system may have spare communications capacity which could be used as a very basic LWA facility.

The system would require more satellites to give the required response time as the one satellite only provides two short communication windows of approximately 20 minutes, every 24 hours.

2.2.2 Future Systems

Currently there are a large number of proposals for satellite based communication systems. Some of these systems may be suitable as the basis of a LWA system.

(a) Iridium

A proposal by Motorola in 1990 to provide a handheld telephone system working directly to 66 polar orbiting satellites and thus providing worldwide 24 hour coverage. Iridium is now an international consortium of private companies. As the proposal is based on polar orbiting satellites good performance is expected in the more mountainous regions and this may be a suitable candidate for LWA. Current expectations are that the system will be operational in 1998.

(b) Inmarsat P

A proposal by Inmarsat as part of their Project 21 to provide a world-wide, go anywhere, pocket sized satellite voice and data service by the end of the decade. The satellite configuration has not yet been determined so the coverage for LWA purposes is not yet known. Planned to be operational by 2001.

(c) Ellipso

A proposal by an American consortium operating very similarly to the Iridium system but with 24 satellites in an elliptical orbit, however, full technical details not yet available. Stated use is for USA only. Planned to be operational by 1997.

(d) Constellation Communications

A proposal by an American consortium operating very similarly to the Iridium system but using 48 satellites, however, full technical details not yet available. Planned to be operational by 1998.

(e) TRW Inc

A proposal for a hand held system with applications for Airlines. Likely to be 12 satellites in elliptical orbits. Full technical details are not yet known, and thus application for LWA cannot be determined at this stage. Planned to be operational by 1997.

(f) Orbcom

A proposal from an American consortium for a data only system, using low earth orbit satellites and hand held terminals. The system is planned to have a facility for emergency alerts and location as standard. Current expectations are that the system will be available in 1996.

(g) Others

There are several proposals from different organisations, such as Odyssey and Globalstar, but these seem to be in the conceptual stage rather than the systems design stage detailed above.

2.3 LWA OPPORTUNITIES

Satellites have until recently been the exclusive preserve of the military and other governmental and large international organisations. The cost of providing and maintaining a communications system meant that only these organisations could afford them, typical costs of a satellite being approximately £100M and cost of the launch being around £65M. The advent of small low cost satellites being launched, effectively as ballast, to a large expensive satellite has opened up a new approach for users and satellite builders.

Of all the satellite based systems investigated, only systems designed to work with hand held equipment have any application as potential Lone Worker Alarms. Of these systems those which have polar operating satellites give the required coverage and can have inbuilt location potential. This limits the current systems to very few, only one of which has all the required attributes and potentially available for LWA applications. A comparison of the different satellites investigated is shown as a table in Appendix A.

2.3.1 Major Satellite Systems

With only very few exceptions, large satellite systems are owned and operated by either the military, governments or international organisations. Of the existing non-military systems COSPAS/SARSAT remains the only system currently known to provide the potential availability and performance suitable for LWA applications. Future large systems such as those proposed by some American Consortia for LEO constellations may have potential but these are many years away from implementation. These organisations have been approached in a bid to get some sort of LWA facility designed into their systems from the onset. Copies of correspondence is included in Appendix B.

2.3.2 Low Cost Satellite Systems

Low cost tends to mean low functionality and low performance. The majority of these systems have specific aims which normally do not include communications to low power hand held equipment. There are various systems which have this capability but none are designed to give continuous or reliable coverage and they are thus unsuitable for LWA applications.

SECTION 3

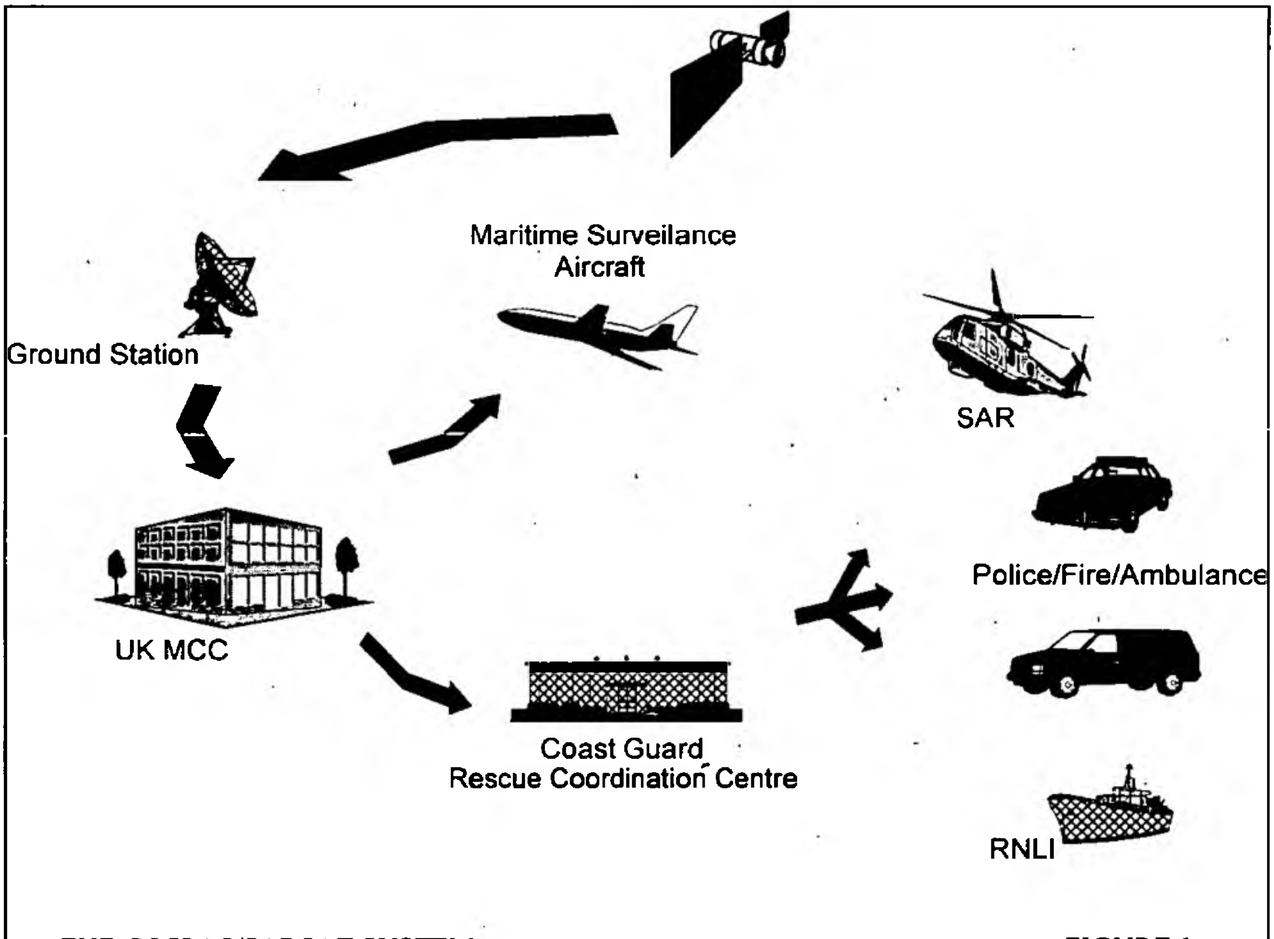
COSPAS/SARSAT

3 COSPAS/SARSAT

Previous reports [1] [2] have highlighted the COSPAS/SARSAT satellite system as a potential solution for providing a LWA facility. The system currently provides alerting and location facilities worldwide for users which, due to legislation, have predominantly been in the maritime or aeronautical environment.

3.1 THE SYSTEM

As would be expected, the system can be split into two; the space segment and the ground segments.



THE COSPAS/SARSAT SYSTEM FIGURE 1

3.1.1 Space Segment

The COSPAS/SARSAT system currently consists of four satellites (2 COSPAS, 2 SARSAT) in low altitude, polar orbit. The satellites at a height of approximately 1000 km are either USA weather satellites or Russian earth resource satellites. These satellites have been equipped with additional equipment (or payloads) from Canada and France for search and rescue purposes and thus form the COSPAS/SARSAT system.

This part of the system is provided as a "free service" by the hardware suppliers and operators.

3.1.2 Ground Segment

This part of the system consists of three major elements:

(a) ground receiving stations, termed Local User Terminals (LUTs) which process the satellite downlink transmission, extract distress beacon signals and compute their position. These receiving stations are normally owned and operated by individual countries.

(b) a network of Mission Control Centre (MCCs) for exchanging worldwide, COSPAS/SARSAT alert and location data. These centres are normally owned and operated by individual countries.

(c) a number of Rescue Coordination Centres (RCCs). These centres are used for coordinating individual emergencies. There may be several RCCs in an individual member country depending upon the area to be covered and the level of service provided.

3.2 COSPAS/SARSAT SECRETARIAT

The Secretariat, with its headquarters in London, is concerned with the overall planning and operation of the system. It is an international organisation and primarily represents the system users and providers on regulatory matters and user forums. In conjunction with the relevant international bodies, the Secretariat determines the use of the system and the coordination and operation of the space segment.

KDSC has approached the Secretariat as the "owner" of the system, with a view to using the system with land based Personal Locator Beacons (PLBs). The Secretariat's view is that operation of this nature is within the overall "charter" for the use of the system and that provided the appropriate "type approved" equipment is used they have no objections to its use with land based PLB's (LWAs). The Secretariat has confirmed that national bodies must licence the individual units and that the appropriate radio licensing body for the county covered must be approached and their approval sought. A copy of the correspondence is include in Appendix B.

3.3 UK REGULATORY BODIES

The COSPAS/SARSAT system is essentially regulated in the UK by the Department of Transport, (DoT) Maritime Directorate. As use of the system has been predominantly by the maritime community this body is the main coordinating agency within the UK and represents UK interests on international matters. Other organisations involved are the Home Office (Police), the Ministry of Defence (MoD) and the Department of Trade and Industry (DTI).

3.3.1 Department of Transport

The Department of Transport had until recently indicated concern about the use of PLBs in the UK. With other countries considering the introduction of land based PLBs and with the prospect of the Maritime Division of the DoT becoming a self financing agency, the use of PLBs on land in the UK is being considered. Several representations have been made to this department on the use in the UK of PLBs by KDSC on behalf of the NRA and this has led to the department taking a more receptive approach.

Within the DoT, the day-to-day operation of maritime search and rescue organisations is controlled by the Marine Pollution Control Unit, the main coordinating body for civilian maritime search and rescue within the UK waters and designated areas.

3.3.2 Home Office (Police)

Search and rescue within the UK mainland comes under the auspices of the National Committee on Search and Rescue on which the Police in England and Wales are represented by the North Yorkshire Constabulary.

The view of the police representative until recently was that use of PLBs on mainland UK would seriously dilute the usefulness of the system for maritime and aviation users. These concerns remain, but with increased capacity of the system and the consideration by other countries that PLB's use on land should be permitted, the police view may be changing to a "control and regulation approach" to prevent potential abuse and mis-use of the system.

3.3.3 Ministry of Defence

In the UK the Mission Control Centre is operated by the Ministry of Defence (MoD), and is also the aeronautical Rescue Coordination Centre. Originally the ground station, where the signals are received from the satellite, was operated by the MoD primarily for the reception of weather satellite pictures. It is currrently operated by the Defence Research Agency (DRA) on behalf of both the MoD and DoT but still primarily for the reception of weather satellites pictures with regular schedules for monitoring the COSPAS/SARSAT system.

3.4 TECHNICAL CONSIDERATIONS

The primary goal of the NRA is for the system to provide LWA facilities in the mountainous regions of the UK. The system, designed for maritime use, and using low earth orbit satellites, may achieve lower performance in UK as extrapolating performance on land from that at sea involves a number of uncertainties.

Primarily, investigations by COSPAS/SARSAT and the Canadian Government indicates that the performance of the system on land will be adequate for most purposes. This study however was carried out in the North of Canada, a different type of terrain to that in the UK. The technical performance of the system indicates that the system will achieve a very similar performance to that published if it is used on land within Europe and thus KDSC expect the system to be suitable for use as a LWA in the UK.

3.5 ORGANISATIONAL CONSIDERATIONS

As the COSPAS/SARSAT system has been set up in the UK primarily for maritime use, utilisation of the system by land based PLBs will require some effort to integrate the required infrastructures needed for land use with the existing organisation and governmental bodies.

To progress further there is a need to liaise with various government departments to ensure that the organisations with influence on all aspects of search and rescue also agree with the introduction of land based PLBs in the UK.

The registration of PLBs and the setting up of an NRA Rescue Coordination Centre will involve liaison with 3 different government departments all of which must be involved with the introduction of land based PLB if the system is to be used by the NRA.

The use of PLBs on land is a new area and the precise responsibilities and influence of the various governmental and non governmental bodies have yet to become clear. The main participants are however:

- Department of Transport, Maritime Division; UK governmental agency with overall coordinating role for COSPAS/SARSAT.

- National Search and Rescue Committee; to advise the various governmental agencies on such matters.

- Department of Trade and Industry; overall responsibility for control and liaising of the radio spectrum within the UK.

- Association of Chief Police Officers (ACPO) (Represented by N. Yorks Police); to advise the various governmental agencies and committees on Police involvement and capabilities in search and rescue.

- Ministry of Defence; operation of the MCC in the UK and control and operation of military resources such as search and rescue aircraft and ships.

- Defence Research Agency; operating on behalf of the MoD and DoT of the only UK ground receiving station for the COSPAS/SARSAT system. Information from the ground station is sent to the UK MCC for processing and onward transmission.

For a responsible body such as the NRA and in light of the uncertainty of roles of the individual bodies detailed above, KDSC recommend a twin track strategy for gaining approval for the use of PLB's. This strategy should seek to win the co-operation and approval of each party involved, but also generate a momentum to the project to bring consideration higher on each party's agenda.

For the DoT issues likely to increase co-operation are on the indication that the NRA's objective in using satellites for LWA's are not primarily to reduce the NRA's costs; that the DoT's costs are unlikely to significantly increase, and that a reasonable charge to cover the registration of the beacons would be acceptable to the NRA.

For the MoD the increasing workload due to the NRA will need to be quantified and shown to lie within the capabilities of the system and the established infrastructure.

The police have indicated their concern that licensing satellite LWA could lead to unacceptable pressure on their resources in responding to alarms, especially if permitting use by the NRA "opened the flood gates" to a much wider use of PLB's. It has been pointed out to the police that for the NRA, satellite PLB would form a minority of LWAs, with most being based on Private Mobile Radio. Police co-operation is therefore likely to be maximised if protocols and procedures are agreed for LWA response - including the principle of filtering and first response by the NRA. The establishment of such protocols could have the advantage to the police of providing a high standard model which other organisations might be required to match before being approved to operate LWA's.

SECTION 4

TRIALS

4 TRIALS

The technical issues on performance of the COSPAS/SARSAT system outlined at the end of the last section need resolution before a significant amount of effort is expanded in organisation issues.

K&D consider that the simplest way to resolve the technical issues on system performance is to undertake field trials. The two key technical issues that need resolution by the field trials are:

(a) response time

(b) location accuracy

It is expected that both of these issues can be resolved by a single series of field trials.

4.1 PREPARATION

To ensure that the field trial obtains meaningful results and that the trial relates to the actual working practices of the NRA, detailed trial arrangements will need to be prepared.

The following organisation will need to be contacted to gain agreement or be involved in the trials:

- COSPAS/SARSAT Secretariat
- DoT, Maritime Division
- DRA Lasham (Ground Receiving Station)
- MoD MCC Plymouth
- Grasby Nova
- NRA

COSPAS/SARSAT as "owners" of the "system" would need to agree to the NRA's use and be advised of the results of tests etc.

DoT, Maritime Division's agreement is needed if any use of the system is to be permitted within the UK. Licensing and registration of beacons and the operation of "user" RCC's will be part of the DoT's involvement.

Trials will need to be coordinated with DRA Lasham to ensure that the performance of the system is not distorted by operational needs of other users and to ensure that worst case and general case scenarios are fully explored.

MoD MCC Plymouth has the responsibility on ensuring that alarms from UK registered beacons are actioned. Plymouth will need to be advised to ensure that the international community is aware of the trials in the UK and do not respond unnecessarily to received beacon alarms.

Grasby Nova have offered the loan of PLB for use in the trials. The performance of this equipment will need to be determined and the beacon code for advising the MCC of the trial PLB's identification code.

The locations chosen for the field trials will need to be determined by the NRA. This information will need co-ordination with DRA Lasham to produce test schedules and theoretical predictions. Personnel to undertake the trials will also be required.

4.2 LOCATION/TERRAIN

Because COSPAS/SARSAT uses LEO satellites, the length of time the satellite is visible from any point on land depends on the height of the horizon to the north and south of the user's location. To test this effect locations in valleys which run east/west will need to be identified. As a reference for checking the results of the "valley" locations, tests conducted, from open rural sites will also be required.

Locations in mountainous areas which have high mountains north and south of the valley and areas which have rivers in deep gorges will need to be identified. In each case it will be desirable that telephone and fax facilities be available nearby to permit the results to be sent to the trial teams.

4.3 TRIAL FORMAT

The duration of the trials in each of the areas will depend upon the results of the prediction planning exercise to be conducted in conjunction with the ground station in the UK (Lasham LUT). K&D's initial estimate is however, thought that 2 days is most likely to be sufficient in each of the three areas. A trials programme based on this approach is shown in figure 2.

Provisional Trials Programme

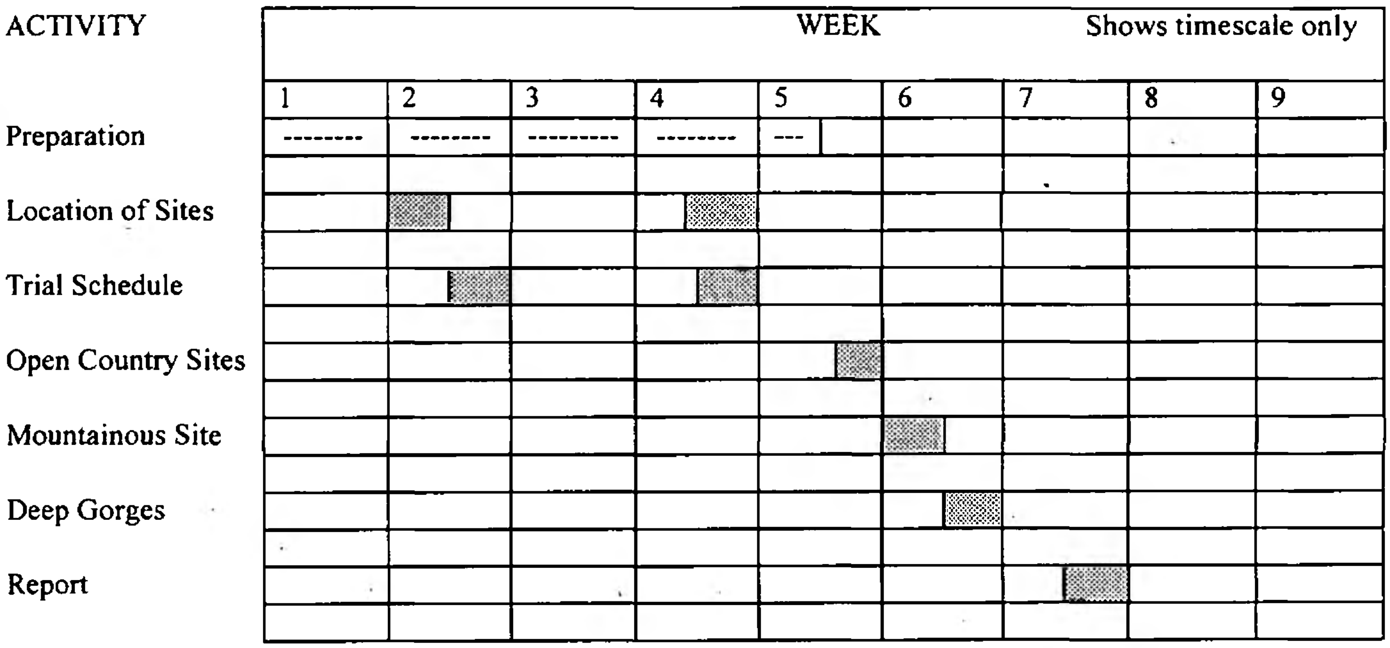


Figure 2

Weather conditions will effect the performance of the system by changing the propagation conditions between the alarm transmitter on the ground and the receiver in the satellite, above the atmosphere. However, to take account of these variations the trial duration would need to be at least one solar cycle, 21 years; not a practical proposition. Significant variations are also noted every year, but in practice, as the receiver is above the atmosphere, the effects of yearly variations on propagation conditions are unlikely to have any material affect in this application. Daily variations in weather will mainly affect the trial personnel not the equipment performance!

SECTION 5

RECOMMENDATIONS

5 RECOMMENDATIONS

Use of the COSPAS/SARSAT system on land within the UK now seems likely. However, before implementation will be permitted there are various procedures and regulatory obstacles to be overcome. Ongoing involvement with different procedural and regulatory bodies will be required to ensure a smooth path to success. The following course of action is recommended.

(a) Immediate

Undertake field trials to demonstrate technical feasibility and NRA commitment to the use of the system.

(b) Short Term

(i) Circulate the field trial results to interested parties.

(ii) Establish a procedure with the regulatory bodies for use of PLBs on land within the UK.

(iii) Establish operating agreements with police and other rescue organisation

(iv) Establish liaison between UKMCC and NRA nominated national rescue control centre.

(v) Determine PLB standards for UK land use.

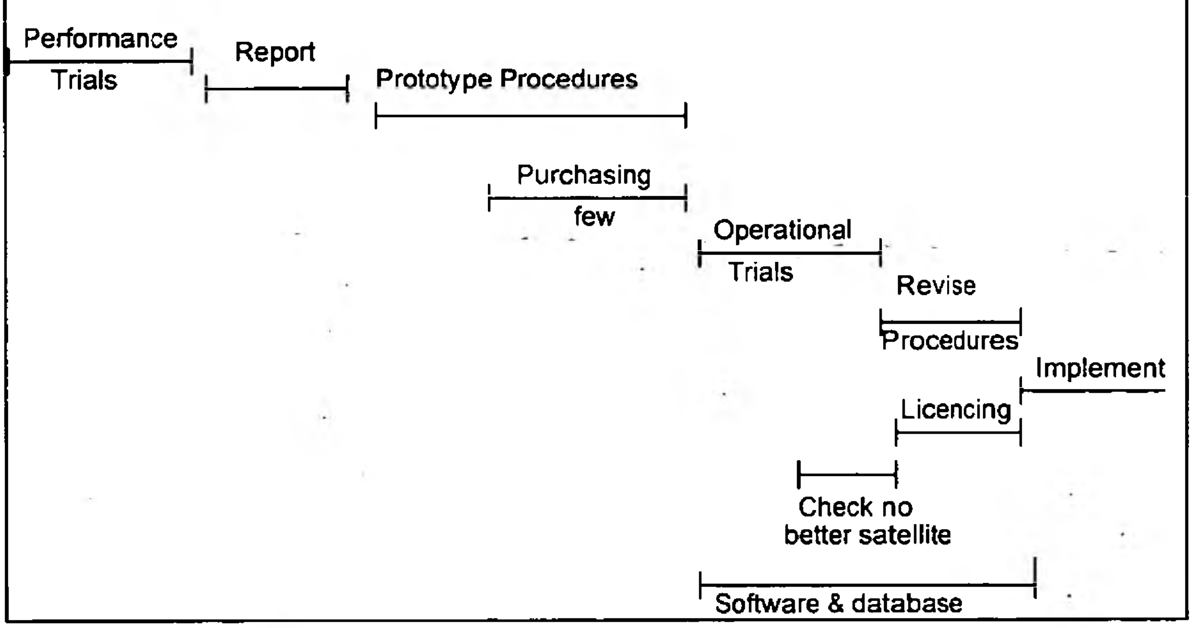
(vi) Generation of a Central NRA database of PLBs and users.

(vii) Establish a procedure within the NRA for the use of PLBs.

(c) Overall

Figure 3 gives an overall plan for the implementation of PLB's for use as LWA's by the NRA. Timescales will be dependent upon the results of the various discussions detailed previously in this report.

Proposed Implementation Plan - Figure 3



APPENDIX A

COMPARISON OF SATELLITE SERVICES VERSUS FACILITIES

APPENDIX A
COMPARISON OF SATELLITE SERVICES VERSUS FACILITIES

Service \ Facilities	LEO	Geostationary	Eliptical	Voice	Data	Alarm Messages	Position Determination	Public Services	Commercial Service	Continuous Service	Time Delay
COSPAS / SARSAT	✓				(✓)	✓	✓	✓		(✓)	45m
Inmarsat A		✓		✓	✓				✓	✓	Nil
Inmarsat B		✓		✓	✓				✓	✓	Nil
Inmarsat C		✓			✓				✓	✓	Store & Forward
Inmarsat M		✓		✓	✓				✓	✓	Nil
Inmarsat P	(✓)	(✓)	(✓)	✓	(✓)				✓	✓	Nil
Argos	✓				✓	(✓)	✓		✓	(?)	
Iridiam	✓			✓	✓				✓	✓	Nil
Episat	(✓)		✓						✓	(?)	
TRW inc	(✓)	(✓)	✓	✓	✓				✓	(?)	
Constellation				✓	✓				✓		
Commsat		✓		✓	✓				✓	✓	
Ilusat		✓		✓	✓				✓	✓	
Elusat		✓		✓	✓				✓	✓	
Orbcomm	✓				✓	✓	✓		✓	(?)	

(✓) = Dependent upon facilities available
(?) = Unknown, awaiting information

APPENDIX B

COPIES AND CORRESPONDENCE

45ω.

KENNEDY & DONKIN

KENNEDY & DONKIN SYSTEMS CONTROL LIMITED

WESTBROOK MILLS
GODALMING
SURREY, GU7 2AZ
ENGLAND
TELEPHONE 0483 425900
TELEX 859373 KDHO G
FAX 0483 425136

Our Ref: CNC/ACH/NJG/65901/P89

16 April 1993

Department of Transport
Marine Directorate
Sunley House
90/93 High Holborn
LONDON
WE1V 6LP

For the Attention of Mr K Fisher

Dear Sirs

We would like to thank you and your colleague for your hospitality and for your time in explaining the operation of the COSPAS/SARSAT system to us at our meeting on the 26 February 1993.

As we detailed during our visit Kennedy and Donkin Systems Control (KDSC) have been commissioned by the National Rivers Authority (NRA) to investigate the feasibility of using a satellite based radio system to provide an emergency alerting beacon for use by their employers when working alone in the remote parts of the UK. The NRA have approximately 2000 + employers working alone but it is not envisaged that there could be a requirement for 2000 satellite based location beacons. The number required will depend upon the coverage achieved by a terrestrial based system, for which prototype development is currently being tendered. At this stage approximately 100 is thought to be the potential requirement for satellite based beacons.

To enable identification of a user the system would need to have beacon identification information and it is anticipated that the satellite system and infrastructure would forward this information to the NRA control room. The NRA have several control rooms around the country which are manned 24 hours every day of the year and the NRA would then be responsible for any further action taken upon receipt of the beacon identification.

Continued

As detailed the intended use for the beacons is by personnel in remote areas of the country. The majority of these remote areas will be mountainous regions, some with very deep valleys. From the information we have it is not clear as to the feasibility of using the COSPAS/SARSAT system due to the satellite having a minimum time window for successful acquisition of the beacon signal.

Should future use of the COSPAS/SARSAT system by the NRA be a possibility, and before proceeding with detailed discussions on the use of the system, it seems appropriate that a short trial be undertaken to evaluate the systems suitability. If agreed we envisage that this trial would be a day exercise in two or three locations around England and Wales. The format of the trials would be to operate the unit at pre planned times and for a pre determined duration, thus assessing the systems response to user situations in mountainous areas.

The NRA appreciate that there are costs associated with the operation of the COSPAS/SARSAT system and any costs associated with the NRA use of the system such as registration of Owner/User of beacons identities, additional message handling facilities etc, would have to be recovered. We believe that this issue might be more appropriately discussed in the future after the majority of the technical and operational issues have been resolved.

If the above avenue of approach is agreeable to the DoT, then we would welcome further discussions on the various issues raised.

Yours faithfully
for KENNEDY & DONKIN SYSTEMS CONTROL LTD

CN Cheek

C N Cheek
Assistant Engineering Manager

cc File 65901/01

FILE NOTE

To: AQH/File 65360/NRA/1 Copies: Mr R Vivash (NRA)

By: C N Cheek Date: 26 June 1991

MEETING WITH DEPUTY CHIEF CONSTABLE F MORRITT - 21 JUNE 1991

This meeting concerned possible use of COSPAS/SARSAT for LWA, was held at North Yorkshire Police Headquarters and followed Mr Morritt's letter to CNC dated 12 April 1991 and Mr R Vivash's (NRA) letter of 10 June 1991. Attendees were RV, CNC and Graham Davidson of Caltronic Systems.

Mr Morritt chairs the Communications Committee and the Emergency Procedures Committee of the Association of Chief Police Officers (ACPO) and represents the police on a number of relevant national committees. In theory every Chief Constable can make separate decisions for his own force, but with that proviso ACPO coordinates a common view on matters relevant to LWA.

Mr Morritt stated that the 121.5 frequency now has 95% false alarms and only 5% genuine calls and is therefore no longer responded to. His main concern was that the 406 system should not become similarly degraded. He was therefore against the licencing of EPERB/PLB's for land use.

Other factors in this opposition were:

(a) The very high expense to the police of responding to the alarms. He believed (and was supported by GD) that the international rules on COSPAS/SARSAT would only allow alarm messages to be related to the police, the coastguard or the military.

(b) The police would be unwilling to maintain the registers of user.

(c) The international agreements on COSPAS/SARSAT limit their use on land to 'remote areas' and FM doubts if anywhere in the UK falls within this definition.

(d) FM believes UK legislation would be necessary to allow licencing for land use.

(e) A Rescue Coordinating Centre (RCC) would need to be established and funded. FM saw this as a minor cost and problem compared to (a) above.

(f) FM believes that current users (eg. coastguard, CAA, RNLI etc) would be opposed to land use (even though the COSPAS/SARSAT people might well be in favour) for fear of degradation.

(g) Hill walkers/climbers etc are seen as a major problem. FM thinks one could not allow an NRA person access to the system and yet deny it to a hill walker. He pointed out in response to a comparison with gun licences, that all such legislation restricted to certain individuals the use of dangerous items - none restricted the use of safety devices.

(h) FM did not see a strong need for satellite LWA. He thought that other means such as cellular phone and PMR should be explored, that radio black spots could be covered by other in-fill techniques, and that anyway the total number of incidents for the NRA in each year would be very low.

We explored the possibility that regulatory agreement might be reached for say a consortium of users to run (or part found) an RCC, receive alarms from say the coastguard, and undertake the rescue themselves in the first instance. FM conceded that this would then be 'no concern' of the police. He doubted the possibility of the scenario however, and later added that the police would wish to vet the rescue organisation, as they do for mountain rescue organisation. This was to reduce the need for the police to rescue the rescuers. (The vetting rules for mountain rescue seem pretty stringent). The police would oppose the proposal if the NRA (or others) intended to subcontract the rescue process to any third party.

FM expressed the view that if the NRA or others wished to make a case for COSPAS/SARSAT LWA then it should cover:

(a) the need, and the limitations of possible alternatives.

(b) avoidance of degradation, but without unjustifiable discrimination against other potential users.

(c) arrangements for funding/undertaking rescue, especially in adverse weather conditions.

FM would then see it as his responsibility to present such a case to his APCO committee(s).

Following the meeting RV, GD and CNC discussed approaching the coastguard, MoD and Dept of Transport, COSPAS etc to see further views, before formally pursuing licencing enquiries.

C N Cheek

C N Cheek
Assistant Engineering Manager

GE6460

098640

CEIS TM

TELECOPIE / FAX

DATE : 11/3/1993 REF. : ThP/II/3/11/2 NBRE DE PAGES : 1

EMETTEUR / FROM
Thierry PORTES

ETABLISSEMENT/PLANT: CEIS TM
SERVICE: DES / IR

DESTINATAIRE/TO
Mr A.C. HEWAT

SOCIETE / COMPANY: KENNEDY & DONKIN
N° FAX: 19 44 483 425136

Dear Sir,

I acknowledge receipt of your fax dated March 4th and thank you very much for your interest.

Please find enclosed the general characteristics of our UHF 88 transmitter.

Before communicating you the prices of the equipment and use of the system I should appreciate to have a description of your application by return of fax. Many thanks for this.

We are not supplier of GPS equipments, we can communicate you the names of ROCKWELL COLLINS and TRIMBLE as GPS manufacturers.

Waiting for your reply,

I remain

Yours Sincerely

Thierry PORTES,
Sales Engineer

65901/01
2581
ACH 16/3
MO

MAR 1993

16/3
fax 232
7/3/93

Z.I. Thibaud - 6 rue des Frères Boude - 31084 TOULOUSE Cedex - Téléphone : (16) 61-44 39 31 - Fax : (16) 61 41 01 30
En cas de mauvaise réception, veuillez nous contacter au n° (16) 61 44 39 31

KENNEDY & DONKIN

KENNEDY & DONKIN SYSTEMS CONTROL LIMITED
WESTBROOK MILLS
GODALMING
SURREY, GU7 2AZ
ENGLAND
TELEPHONE 0483 425900
TELEX 859373 KDHO G
FAX 0483 425136

Date: 11 March 1993

CNC

Our Ref: ACH/SS/65901/S89

Iridium
17 Place de la Resistance
F92445
Issy-les-Maulineaux Cadex
France

For the Attention of Mr P Wade

Dear Sirs

SATELLITE COMMUNICATIONS

Thank you for the information you have sent us on the Iridium system.

Our interest in this Iridium system is to provide alarm messages and safety communications for personnel working alone in remote areas. In some cases these areas have deep valleys which prevent the use of conventional terrestial communications or communications via geostationary satellites. We would be interested in the capabilities of the Iridium to provide this type of communications or the possible potential to develop a facility of this type.

Yours faithfully
for and on behalf of
KENNEDY & DONKIN SYSTEMS CONTROL LTD

A C Hewat

cc File 65901/01

KENNEDY & DONKIN

KENNEDY & DONKIN SYSTEMS CONTROL LIMITED
WESTBROOK MILLS
GODALMING
SURREY, GU7 2AZ
ENGLAND
TELEPHONE 0483 425900
TELEX 859373 KDHO G
FAX 0483 425136

Date: 16 March 1993

Our Ref: ACH/NJG/65901/S94

Inmarsat
Land Mobile and Special Services Division
40 Melton Street
London
NW1 2EQ

For the Attention of Anver Anderson

Dear Sirs

SATELLITE COMMUNICATIONS

Thank you for the information you have sent us on the Inmarsat system.

Our interest in the Inmarsat system is to provide alarm messages and safety communications for personnel working alone in remote areas. In some cases these areas have deep valleys which prevent the use of conventional terrestrial communications or communications via geostationary satellites. We would be interested in the proposed capabilities of the Inmarsat-P system to provide this type of communications or the possible potential to develop a facility of this type.

Yours faithfully
for and on behalf of
KENNEDY & DONKIN SYSTEMS CONTROL LTD

A C Hewat

cc **File 65901/01**

KENNEDY & DONKIN GROUP
KENNEDY & DONKIN POWER
KENNEDY & DONKIN TRANSPORTATION
KENNEDY & DONKIN SYSTEMS CONTROL
KENNEDY & DONKIN BUILDING SERVICES
KENNEDY & DONKIN QUALITY ENGINEERING

KENNEDY & DONKIN SYSTEMS CONTROL LIMITED
REGISTERED IN ENGLAND NO. 1571131
REGISTERED OFFICE
WESTBROOK MILLS, GODALMING,
SURREY, GU7 2AZ

Certificate No 13041

KENNEDY & DONKIN

KENNEDY & DONKIN SYSTEMS CONTROL LIMITED FAX COVER SHEET FAX **0483 425136**

TO NAME	Technical Sales	**FROM** NAME	A C Hewat
COMPANY	CEIS TM	PAGE 1 OF	1
LOCATION	France	DATE	16 June 1993
FAX NO.	010 33 61 41 01 30	REFERENCE	ACH/NJG/65901/Z20
COPIES TO		CHARGE NO.	65901
		COMMUNICATIONS NO.	071549

1135

Subject: **SATELLITE BASED LOCATOR BEACONS - ARGOS**

Thank you for your fax giving brief details of the Argos PTT UHF 88 transmitter. Further to our telephone conversation I have detailed below our proposed usage for the system.

Our interest in the Argos system is to provide alarm messages and location information for personnel working alone in remote areas. In most cases the areas where personnel will be located are valleys and mountainous areas which would prevent the use of conventional terrestrial communications and communications via geostationary satellites.

I understand that the Argos system has alarm transmission and positioning capability and look forward to further details and budget costs.

Regards

A C Hewat

cc: File 65901/01

KDSC	FILE No.	65901 / 1	
GROUP	W	CA No	56CW
FOR ACTION	FOR INFO	COPY TO	DATE COMP
CNC			18/6
DATE REC'D	17 JUN 1993		
DATE ANS'D			
ANSR REF			
DATE REG COMP	24-6-93		

IF YOU DO NOT RECEIVE THE FAX IN FULL, PLEASE TELEPHONE **0483 425900**

REGISTERED IN ENGLAND NO: 1578139, REGISTERED OFFICE, WESTBROOK MILLS, GODALMING, SURREY, GU7 2AZ

KENNEDY & DONKIN

1700

81159

KENNEDY & DONKIN SYSTEMS CONTROL LIMITED FAX COVER SHEET FAX **0483 425136**

TO NAME	R W Kelly	**FROM** NAME	N Warren
COMPANY	Orbcomm	PAGE 1 OF	1
LOCATION	Virginia, USA	DATE	1 June 1993
FAX NO.	0101 703 406 3504	REFERENCE	NW/SS/Z98
COPIES TO		CHARGE NO.	65901/06
		COMMUNICATIONS NO.	**070729**

Subject: **SATELLITE DATA COMMUNICATIONS NETWORK**

Having read your company's 'Vital Communications Absolutely Anywhere on Earth^{sm}' brochure I would like to request more information on the system.

I am particularly interested in more detailed technical information on the P^2C^2 equipment, including response times, data rates, interface protocols, frequency of operation, receiver sensitivity and power requirements. Any further functional and technical information on the proposed services, particularly SecurNet^{sm} would be greatly appreciated.

Thank you for your assistance.

Regards

N Warren

N Warren

cc: 65901/01

KDSC	FILE NO.	65901/01
GROUP	C	C1768-wr
NW		3/6/93
	CNC	7/6/93
		3.6.93

IF YOU DO NOT RECEIVE THE FAX IN FULL, PLEASE TELEPHONE **0483 425900**

COSPAS-SARSAT

International Satellite System for Search and Rescue
Système International de Satellites pour les Recherches et le Sauvetage
Международная Спутниковая Система Поиска и Спасания

Ref: CS/CR91/203/JK

Mr. C.N. Cheek
Project Manager
Kennedy & Donkin Systems Control
Westbrook Mills
Godalming
Surrey GU7 2AZ

10 April 1991

Dear Sir,

Subject: COSPAS-SARSAT Personal Locator Beacons

Thank you for your letter dated 5 March 1991 informing us of your intention to explore the use of COSPAS-SARSAT System as a Lone Worker Alarm for the UK National Rivers Authority.

The meeting we had a few weeks ago with your Mr. A. Hewat was most useful to understand the programme your company is undertaking. We did provide him with relevant COSPAS-SARSAT documentation.

In 1989, the COSPAS-SARSAT Council authorized the use of the 406 MHz COSPAS-SARSAT System for terrestrial applications, using 406 MHz Personal Locator Beacons, provided that administrations implementing the service adhere to the following conditions, which are given in more detail in the enclosed document C/S R.003:

a) a national Search and Rescue point of contact is identified;
b) a beacon register is maintained;
c) the beacons satisfy the COSPAS-SARSAT technical requirements of document C/S T.001.

The plans you outlined in your letter to us appear to fulfil these conditions, and we therefore invite you to coordinate with the UK Department of Transport as you proceed with further developments.

Please find enclosed some COSPAS-SARSAT brochures that might of interest to you and do not hesitate to contact us again if we can be of any further assistance.

Yours faithfully,

J.V. KING
Technical Officer
COSPAS-SARSAT Secretariat

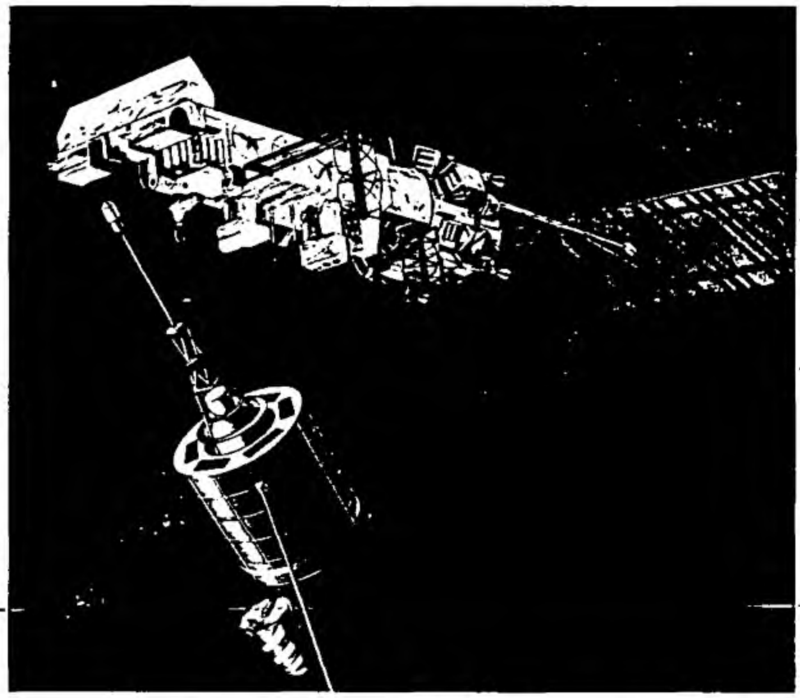
cc: Mr. D. Benyon, DoT

Encls. - 3 brochures
- C/S R.003

APPENDIX C

TECHNICAL LITERATURE

COSPAS/SARSAT



NASA

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Emergency Transmitters ... 8-9
Space Segment [illegible] ... 10-11
[illegible] ... 12-13
[illegible] ... 14
[illegible] the Future ... 15
For Additional Information ... 16
[illegible] ... Inside Back Cover

USA · CANADA · FRANCE · CCCP

SARSAT КОСПАС

Satellites Save Lives

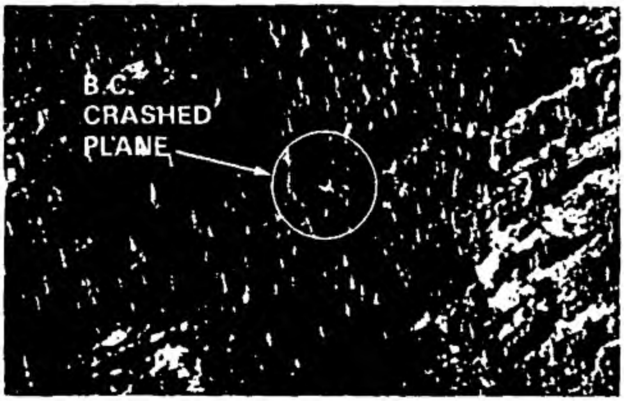
The antennas of the COSPAS/SARSAT satellites are aimed toward the Earth to detect signals of distress. The signals are transmitted to space from downed airplanes, capsized boats, and other emergency situations. The COSPAS/SARSAT system aids worldwide rescue centers in locating the sources of the signals to speed search and rescue efforts.

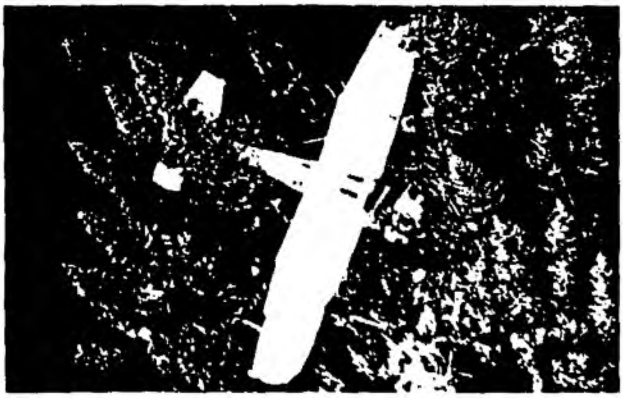
COSPAS (a Russian abbreviation of Space System for Search of Vessels in Distress) and SARSAT (Search and Rescue Satellite-Aided Tracking System) represent a model program of international cooperation. The United States, Canada, France (SARSAT), and the Soviet Union (COSPAS) are the founders of the program. As of mid 1986, other participating countries are Bulgaria, Denmark, Finland, Norway, and the United Kingdom. Additional countries (e.g., Brazil) are involved in negotiations for their participation.

Since COSPAS/SARSAT program inception, the National Aeronautics and Space Administration (NASA) has provided ongoing research and development to create space and ground systems. NASA has collaborated closely with the U.S. Air Force, the U.S. Coast Guard, and the National Oceanic and Atmospheric Administration (NOAA) from the early phases through the ongoing enhancement activities. NOAA directs the current operational system within the United States. The U.S. Air Force, the U.S. Coast Guard, and their respective auxiliary organizations are performing the actual search and rescue tasks. The U.S. Air Force serves as the central communications point for the United States search and rescue activities and as a link to the international community.

COSPAS/SARSAT is divided into two systems to detect emergency beacons. The first system broadcasts on the 121.5/243 MHz frequencies and works with Emergency Locator Transmitters (ELTs) and Emergency Position Indicating Radio Beacons (EPIRBs) at those frequencies. This system is limited to a circular area within a 3,220 km (2,000 miles) radius of a ground station. A new system on the 406 MHz frequency provides monitoring for the entire Earth.

In the first 3 years of the program, COSPAS/SARSAT has been instrumental in saving over 500 lives. In the future, the expansion of COSPAS/SARSAT will provide increasingly accurate locations worldwide, improve distress detection, and provide enhanced data handling to help speed up life-saving activities.





Dramatic Rescues

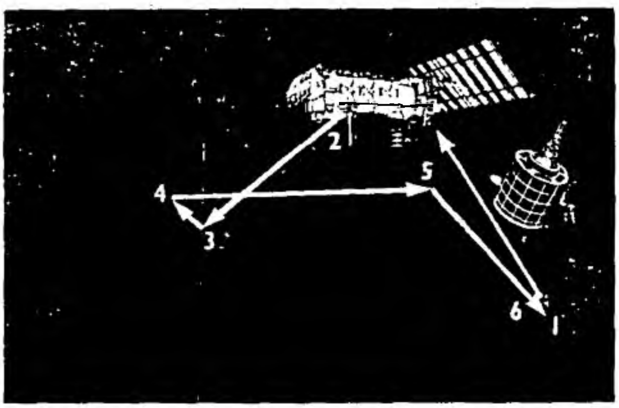
The First Rescue .

The would-be rescuers had been looking for the young couple. The couple's plane went down in British Columbia 2 months earlier in July 1982 and was never found. The Canadian government mounted an extensive search, costing almost $2 million before it was stopped. The young man's father did not give up hope. The father, a pilot, and a friend had embarked on their own airborne search and rescue mission.

During the search, their plane had crashed and they were injured and stranded in the midst of 50 foot trees and 7,000 foot mountains. The Victoria Rescue Coordination Center (RCC) in Canada received a report that the plane was missing in British Columbia. The crashed Cessna 172 was inoperable, but the occupants were alive and the ELT was working. It was broadcasting emergency signals up and out into space.

Canada had just become an international partner in a new space-based search and rescue network. The RCC contacted the network's ground station in Ottawa. As the Soviet COSPAS I satellite passed over the Cessna crash site, it detected the emergency beacon and repeated the data to the Trenton Ontario Air Rescue Station. The crash location was determined and the RCC sent a search aircraft. The location was within 22.5 km (13.9 miles) of the crash site. The father, pilot, and friend became the first individuals to be rescued with the aid of a satellite.

If only the COSPAS/SARSAT system had been available for the first crash, search risks and costs would have been reduced and the couple's lives might have been spared.



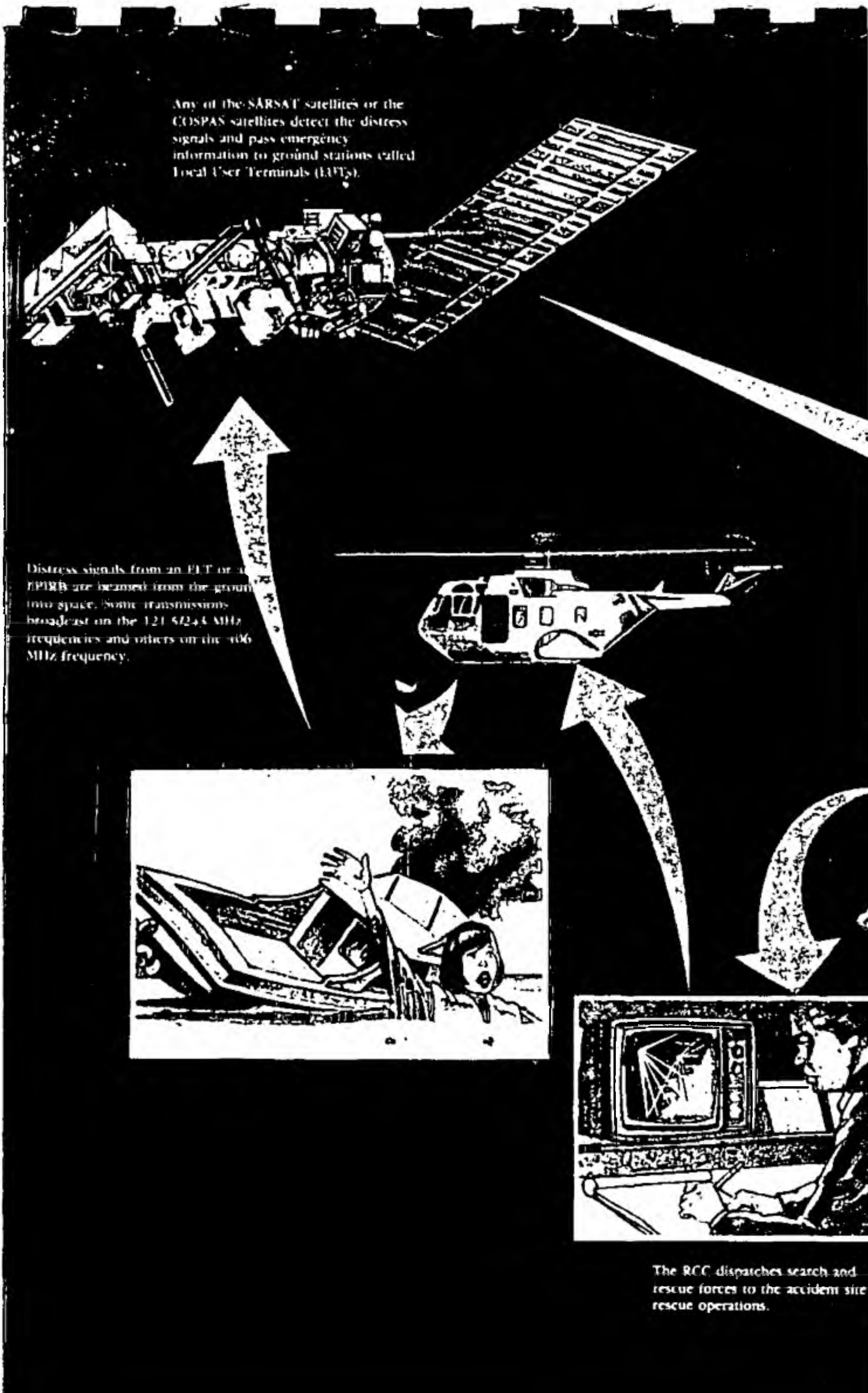
Global 406 System Rescue

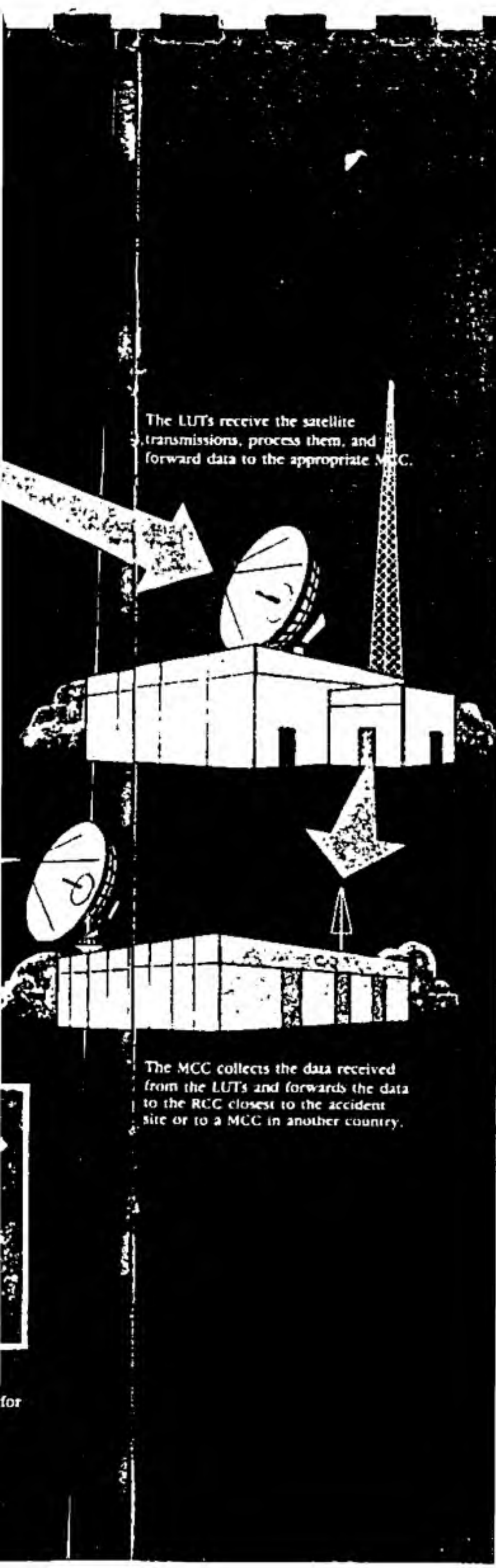
An unlikely turn of events . . . until the COSPAS/SARSAT 406 MHz system was created.

A Belgian race car driver and his codriver were racing through Somalia, Africa in their Citroen. The competition was to take them a total of 30 weeks from Cape Town to their goal of Tierra del Fuego at the tip of South America. They were to drive through Africa to Saudi Arabia, India, and China; by boat from Tokyo to Canada; drive through the Western United States, Mexico, South America, and into Argentina. The race was a chance of a lifetime.

On New Year's Eve, anticipation turned into fright as the car crashed and rolled over and over. The driver was thrown from the car and his skull was fractured. In the midst of remote Africa, there was neither a phone nor medical help. The codriver flipped on an experimental transmitter to start broadcasting its 406 MHz emergency beacon into space. Someone, somewhere, might hear the call for help

The 406 MHz frequency, still in the experimental stage, allowed global reception of data that was unobtainable with the old system. The signal was first detected by SARSAT. The 406 MHz signal was stored in SARSAT and "dumped" at the next U.S. ground station that came into view. The U.S. Air Force notified the French government, whose diplomats in Africa arranged for a doctor to be flown to the injured driver. The driver was then evacuated to a hospital in Belgium where he recovered and later rejoined the race.


Any of the SARSAT satellites or the COSPAS satellites detect the distress signals and pass emergency information to ground stations called Local User Terminals (LUTs).
Distress signals from an ELT or a EPIRB are beamed from the ground into space. Some transmissions broadcast on the 121.5/243 MHz frequencies and others on the 406 MHz frequency.
The RCC dispatches search and rescue forces to the accident site
rescue operations.



The LUTs receive the satellite transmissions, process them, and forward data to the appropriate MCC.

The MCC collects the data received from the LUTs and forwards the data to the RCC closest to the accident site or to a MCC in another country.

What Is the System?

As soon as the first satellites were placed into Earth orbit during the late 1950's, the concept for a satellite-aided search and rescue project began to take shape. NASA began to experiment with "random-access Doppler tracking" on the Nimbus satellite series in the 1970's. These experiments served to locate and verify transmissions from remote terrestrial sensors (weather stations, buoys, drifting balloons, and other platforms). The first operational random-access Doppler system was the French ARGOS on the NOAA TIROS satellite series. The 406 MHz search and rescue system has evolved from this ARGOS system.

The COSPAS/SARSAT program became an international effort in 1976 with the United States, Canada, and France discussing the possibilities of satellite-aided search and rescue. Joint SARSAT testing agreements in 1979 stated that the United States would supply the satellites, Canada would supply the space-borne repeaters for all frequencies, and France would supply space-borne processors for the 406 MHz frequency. The Soviet Union joined the program in 1980, agreeing to equip their COSMOS satellites with COSPAS repeaters and processors. Norway added their participation in 1981, representing Sweden as well.

The year 1982 marked the beginning of the COSPAS/SARSAT experimental operations. The first COSPAS launch took place and the initial operations of four North American ground stations began. The first satellite-aided rescue occurred not long after that launch. The United Kingdom joined the program. The first SARSAT satellite was launched in 1983.

By 1984, the system had a constellation of two COSPAS and two SARSAT satellites and operationally used the 121.5/243 MHz frequencies. Bulgaria and Finland joined the program. At this point, NASA turned over the United States SARSAT leadership to NOAA, the agency responsible for operational U.S. civilian satellites. NASA continued its leadership role in the areas of research and development.

The operational use of the 406 MHz system, designed for global coverage by satellite, was initiated in 1985. The ground system is undergoing continual expansion of its data analysis and distribution capabilities.

Emergency Transmitters

The transmitters are the links from the point of emergency to the point of rescue. The transmitters are built to survive crashes, hazardous terrain, and extreme weather. They are designed to send emergency alerts and provide location information through satellite measurements. Signals sent on the 121.5/243 MHz frequencies allow for location determination within 20 km (12 miles) of the transmission site; signals sent on the 406 MHz frequency allow for location determination within 5 km (3.1 miles) of the transmission site. The ability to locate the precise signal point of origin will improve even more as the transmitter technology and operational efficiency evolve over the next few years.

Emergency Locator Transmitter (ELT)

The ELT became a vital component of United States general aviation aircraft in the early 1970's under congressional mandate. Upon impact, the automatic activation of an emergency radio beam alerted aircraft flying overhead. This marked the initiation of emergency search and rescue activities. Frequently, however, no airplane was overhead and the signal was not heard. The need for an ever-present listening and positioning system became apparent. Consequently, the COSPAS/SARSAT satellite system was developed to monitor the ELT transmissions. The system was designed to alert the ground stations in the event of an ELT signal and to provide location information (not obtainable via overflying aircraft). Today, more than 250,000 ELTs are in operation by private and commercial aircraft in the United States.

Different types of ELTs are now being used, but all transmitters include a stable frequency source, modulators, radio frequency amplifiers, and batteries. An omni-directional antenna, crash activation sensors, on/off/reset switch, cables, and mounting hardware are standard equipment. During operation, the batteries will last between 24 and 48 hours at minus 20 degrees Fahrenheit or lower.

The first ELTs broadcast a characteristic audio signal on 121.5 MHz and 243 MHz frequencies. Although these transmitters had been designed for interaction with airplanes, they could also be used with satellites. Later, a more sophisticated ELT transmitting at 406 MHz was designed specifically for satellite interaction.

Use of the 406 MHz system will enhance the ability of the COSPAS/SARSAT to locate the position of the distress site. The 406 MHz beacon contains a message format that provides identification data, nationality, type of user, and sometimes, the type of emergency.

Emergency Position Indicating Radio Beacon (EPIRB)

Known as the "floating beacon," the EPIRBs are employed by over 7,000 commercial or private marine vessels that venture into open seas. The greatest expansion in usage of COSPAS/SARSAT is expected from the EPIRB users. Weather related dangers and accidents, mechanical disabilities, or medical help requirements are among common marine emergency situations.

EPIRBs operate on the same frequencies and have the same signal characteristics as ELTs. The EPIRBs transmitting on the 406 MHz frequency will sometimes include within the message the "instant position listing" from the vessel's latest update. The EPIRB is self-activated by contact with water or it can be activated manually. The EPIRB is waterproof and it floats. During operation, the batteries will last between 24 and 48 hours at 20 degrees Fahrenheit or lower.


CENTIMETERS


UNITED STATES

Successes/ Improvements

Saves and Assists

As of May 1986, COSPAS/SARSAT has provided distress locations aiding in the rescue of:

- 244 persons rescued in maritime incidents
- 311 persons rescued in aircraft incidents
- 22 persons rescued in terrestrial incidents

The total number of persons rescued as of May 1986 using COSPAS/SARSAT locations is 577.

False Alarms

The COSPAS/SARSAT program is now directing its efforts toward a smooth transition into the next decade. One area requiring improvement is the COSPAS/SARSAT "false alarm rate." A COSPAS/SARSAT false alarm is a signal received from an ELT or EPIRB beacon transmitting in a nondistress situation. False alarms are caused by unintentional activation of the beacon through improper handling, equipment failure, or incorrect mounting, disposal, testing, or shipment.

The performance of the present COSPAS/SARSAT system is directly affected by the time that the rescue forces must spend in tracking down false alarms. Each distress signal must be tracked down—whether it is an actual emergency or a false alarm. No other method of validation is possible. When a false alarm beacon is located, it is turned off. Many times, a real distress beacon then can be heard and located. The 121.5/243 MHz false alarm rate is very high, hampering the timely location of victims by diverting search resources. False alarms interfere with individuals using the 121.5/243 MHz frequencies for emergencies. False alarms waste expensive resources required to search for real distresses.

Present solutions under examination are:

1. Enforce laws governing the use of emergency frequencies.
2. Implement redesigned ELTs and EPIRBs, including revised testing procedures and regulations.
3. Educate pilots and mariners to:
   - Add an ELT/EPIRB check to all "shut-down" procedures lists.
   - Monitor the 121.5/243 MHz channel before leaving the craft to ensure that the ELT/EPIRB is not transmitting a signal.
   - Limit the time duration of tests to only a few seconds at authorized times.
   - Avoid unnecessary use of the emergency channel for voice transmissions.
   - Remove the battery before storage, shipment, or disposal of an ELT or EPIRB. All ELTs and EPIRBs have the potential for sending a false alarm. Removal of the batteries eliminates this potential.

Expanding Into the Future

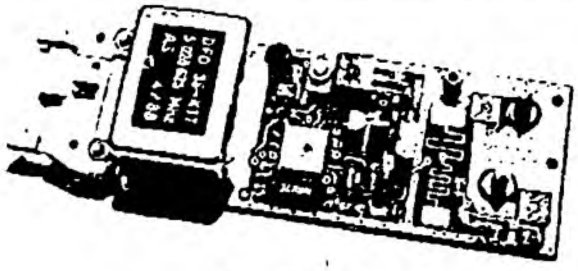
NASA is a leader in the development of space and ground systems technology, which are operated for the benefit of all. Some examples are communications by satellite, weather and environmental monitoring by satellite, remote scientific data collection by satellite, and now, search and rescue by satellite. Research and development that began around 1970 at NASA/Goddard Space Flight Center, together with research performed by Canada, France, and the Soviet Union, led to the COSPAS/SARSAT satellite system. The U.S. Air Force, U.S. Coast Guard, U.S. contractors for NASA, other U.S. agencies, and international scientific and industrial concerns were vital to the implementation of the system.

NASA recognizes that emerging technologies have a great potential to aid the search and rescue activities of the future. Therefore, NASA is presently engaged in research and development efforts to help shape this future.

These efforts are expected to provide:

- Reduced cost 406 MHz beacons.
- The feasibility for two-way communication links between ELTs/EPIRBs, satellites, and ground systems.
- New methods of distress detection and location.
- Faster and even more accurate locations of distress beacons.
- New satellite methods to support ongoing rescues with information on the distress environment.

New technological developments currently foreseen are the use of the Space Station and polar orbiting platform technology, new remote sensing capabilities, advanced communications, artificial intelligence, and laser communications. These developments portend exciting space-supported additions to the future of search and rescue efforts.



UHF 88

ARGOS PTT

Mini-Argos PTT:
- *Location-type*
- *HF output power: 2 to 5 W*
- *Unregulated 12-V power supply*
- *RS 232 or binary input*
- *Message storage*
- *Dimensions: 140 x 45 x 35 mm*
- *Weight: 70 g*

DESCRIPTION

The UHF 88 Argos Platform Transmitter Terminal (PTT) is extremely compact and lightweight, and provides exceptional performance. In particular, power consumption is extremely low relative to the radiated power.

The transmit frequency is synthesized by a phase-locked loop (PLL) using a frequency reference signal generated by an ultra-stable oscillator (USO). The carrier is modulated using a digital phase comparator, providing extremely high temperature performance.

The board is produced entirely from surface-mount, hybrid technology.

OPERATION

The UHF 88 has two types of inputs:

- Synchronous, serial input, for message transmission at the instant the transmission occurs, without storage,
- RS 232 serial link, for data acquisition, storage and transmission. When this channel is used, the data remains in memory and is transmitted until being refreshed by the unit upstream.

The size of the PTT and its low power requirements are such that it can be easily integrated into compact platforms or existing equipment.

The PTT power can be adjusted at the factory for levels up to 5 W; this permits configurations with considerable distances (20 m or more) between the PTT and antenna, with no degradation of system performance.

STANDARDS

The UHF 88 PTT meets Argos system specifications and has been certified by CNES.

CEIS TM

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C98711

TECHNICAL CHARACTERISTICS

- Dimensions: 140 x 45 x 35 mm
- Weight: 70 g
- Power supply voltage: 12 V (10.8 to 24 V)
- Radiated power: factory-set: 33-37 dBm (2 to 5 W)
  nominal: 2 W
- Current drain:

On standby: 460 µA (typically)	
3 seconds before transmission:	6 mA
During transmission: 33 dBm version:	600 mA
During transmission: 37 dBm version:	950 mA

- Interface: RS 232

Speed:	1200 bps
Format:	1 start bit, 8 data bits, 1 stop bit
Levels:	logic (0-5 V)
Protocol:	No control signals: the protocol uses the XON and XOFF codes.

Synchronous, serial input

The transmitter issue a 400-Hz clock signal and a gating signal. It acquires the data through an input ("Z") on the rising edge of the clock.

ENVIRONMENTAL CHARACTERISTICS

- Temperature: operating: -40°C to +60°C
  storage: -55°C to +70°C
- Relative humidity (RH): 0% to 80 %
- Shock: 50 g for 23 ms, six bumps on each of three axes
- Vibration: 0.6 mm_{p-p}, 10-55 Hz for 15 minutes

Characteristics subject to change without notice

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Please contact us for any information you may require

Project 21

The Development of Personal Mobile Satellite Communications

The Development of Personal Mobile Satellite Communications

Inmarsat has embarked on a major programme, using advances in mobile satellite services and technology to introduce a range of affordable, personal mobile satellite communications services throughout the decade.

The programme, known as Project 21, will have far-reaching impacts on one of man's ultimate dreams — the ability to communicate instantly and effortlessly to and from anywhere on earth. The impact will be felt in developing countries and the developed world alike and by businesses, organizations, government administrations and travellers the world over.

Project 21 is Inmarsat's overall vision and strategy for the development of personal mobile satellite communications systems from now into the 21st century.

Project 21 is an evolutionary programme. Building on its existing technology assets and strengths, Inmarsat will introduce and expand these new personal services, provide increasing connectivity between mobile satellite and terrestrial services, and is planning the satellite systems and networks to support advanced new services, including a hand-held satellite phone — Inmarsat-P — before the end of the decade.

This paper provides a broad overview of Inmarsat's Project 21.

1. **Personal mobile satellite communications: an inevitable development 3**
2. **Inmarsat Project 21 . . . . 7**
3. **Inmarsat-P: The hand-held satellite phone 13**
4. **Inmarsat as a personal mobile satellite communications system operator 17**

1 Personal mobile satellite communications: an inevitable development

At Inmarsat, we regard the development of global personal mobile satellite communications as inevitable and necessary. Here is why:

1.1 The shrinking globe

The globalization of human activity is one of the key trends of the late 20th century. Industry, business, trade and transport are increasingly transcending national frontiers to operate globally. The explosion in business and personal travel underlies this trend.

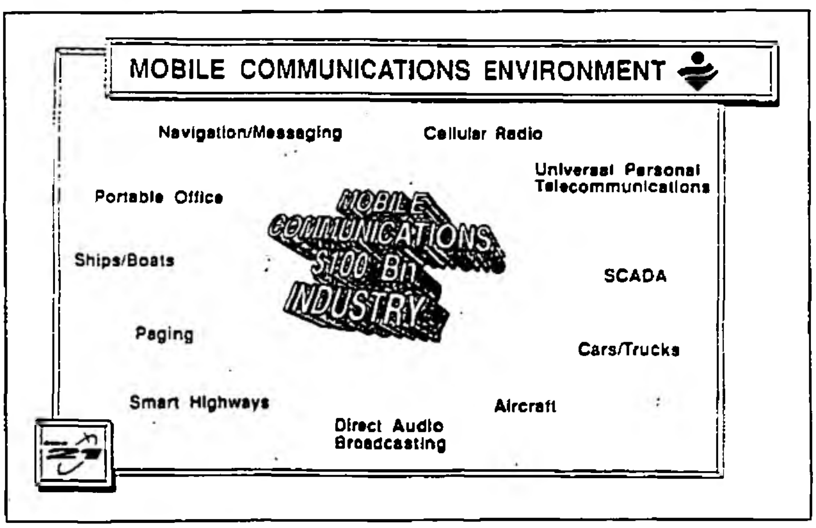
Globally-accessable telecommunications services are an essential requirement as the trend expands.

The mix of terrestrial telecommunications networks and services — fixed and mobile — now spanning the earth meets many of the modern demands for communications. But it is only through satellite services that the demand for total, worldwide mobile communications can be fully met. Satellites are the only technology that can reach every part of the globe.

Small, portable and affordable mobile satellite terminals provide the means to satisfy the growing demand for globally-accessible telecommunications services.

1.2 The mobile communications explosion

The explosion in mobile communications markets over the past decade vividly demonstrates the enormous demand for communications mobility.



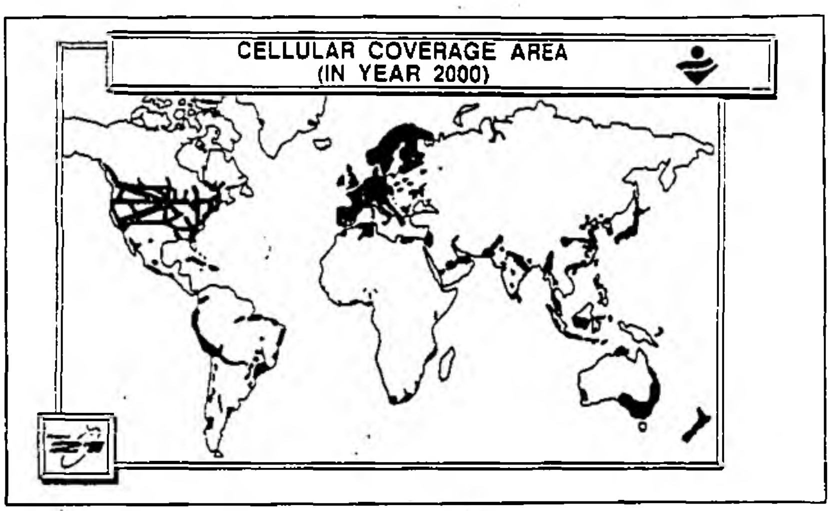
Today, the number of cellular users worldwide is about 15 million. By the year 2000, this may increase to more than 400 million, including cellular, paging, private mobile and personal communications network users. By then, mobile communications will have become a $100 billion industry.

This extraordinary growth has led to a fundamental change in expectations. More and more, people demand communications services no matter where they are, whether on the move or at rest, whether for voice or for data.

In many parts of the world and for many applications, the demand for communications mobility can only be met effectively through mobile satellite services.

1.3 The limitations of terrestrial services

Although cellular and personal communications networks are expanding and will continue to do so, economics prevents their spread much beyond populated areas. Rural areas, regions of low population density within industrial countries and large parts of the developing world are destined to be underserved or to remain out of reach of terrestrial mobile services altogether.



Global mobile satellite services are particularly suited for extending the reach of cellular services, filling in gaps in terrestrial mobile coverage and providing the means for travellers to remain in contact no matter where on earth they roam.

Global personal mobile satellite services provide the missing link, overcoming the inherently local or regional nature of terrestrial mobile services.

1.4 The miniaturization of mobile satellite equipment

Since 1982, Inmarsat, the international mobile satellite communications partnership, has provided global mobile satellite services for the benefit of thousands of customers. It now reaches a worldwide community of more than 20,000 users on land, at sea and in the air.

Until recently, however, mobile satellite communications have been a premium priced service and customer equipment has simply been too large and heavy to be classed as "portable" or "personal." These factors have limited the market largely to corporate, institutional or government customers.

Low-cost, lightweight and increasingly portable mobile satellite terminals are the keys to providing true global personal mobile communications and to opening up the benefits of mobile satellite communications to mass markets. In much the same way that advances in computer technology have led to small, inexpensive portables, laptops and palmtops, mobile satellite terminals are shrinking dramatically in size and weight and are becoming cheaper to buy and use.

Inmarsat is pioneering the miniaturization of mobile satellite equipment.

Miniaturization now makes the further development of portable, cost-effective personal mobile satellite equipment and services both technically possible and economically feasible.

1.5 A favourable regulatory climate

Inmarsat's convention already provides the institutional flexibiliy to offer maritime, aeronautical and land-mobile satellite communications and international radiodetermination services.

Regulatory agencies in countries around the world increasingly recognize the advantages of mobile satellite services in serving business, trade and industry and in providing support for many public services and socially beneficial applications. Many are taking steps to ease restrictions on the use and transport of satellite terminals, opening up the possibilities for widespread use.

Inmarsat is avtively involved in international regulatory developments.

The decisions at WARC 92, which allocated additional spectrum for mobile satellite services, and growing support by national regulators in many countries demonstrate tangible international backing for future mobile satellite growth.

1.6 Rapidly accelerating market growth

Together, these dramatic communications, technology and regulatory developments will rapidly accelerate the growth in worldwide markets for mobile satellite communications.

Preliminary market forecasts indicate that the number of personal mobile satellite communications customers worldwide will likely rise to well over one million by the year 2000 and could approach several million by early next decade.

This is an exponential increase from the 20,000-strong mobile satellite customer base today.

Analysis to date suggests that personal mobile satellite services will benefit a number of key market sectors:

- International business and personal travellers, particularly those who roam in areas where cellular coverage is poor or non-existent, or who travel through areas of incompatible cellular systems
- Those who would benefit from services which extend cellular systems or fill in the gaps between terrestrial service coverage areas
- Commercial and private vehicles which roam outside of cellular service areas
- Quasi-fixed communications, particularly in developing countries where there are no terrestrial alternatives.
- Fishing boats, yachts and other small maritime craft
- Small private or commercial aircraft.

The worldwide market will be large enough and growth will accelerate quickly enough to support the investments necessary to operate profitably hand-held satellite phone and other personal mobile satellite communications services.

1.7 Developing country applications

In many developing countries, where terrestrial systems are underdeveloped or non-existent, advanced mobile satellite services will be particularly effective.

Small, low-cost mobile terminals could deliver nationwide, thin-route telephone coverage for about the same investment cost as that of providing cellular service for a single mid-sized city. This could bring closer the realization of national mobile coverage which has so far eluded developing country telecommunications planners because of the high investment costs of terrestrial solutions.

Mobile satellites are already used widely to help coordinate disaster relief or aid efforts and to extend government services and communications in developing and other countries. Increasingly portable terminals and lower cost will provide even greater benefits in these applications in the future.

Portable, lower cost mobile satellite services will lead to many applications for the benefit of developing countries.

2 Inmarsat Project 21

Under Project 21, Inmarsat is introducing a family of personal mobile satellite communications services throughout the 1990s, designed to fulfil the growing demand for global communications mobility.

The family will include four main services:

1. **Inmarsat-C, for portable mobile data, introduced in 1991**
2. **Inmarsat-M, a briefcase telephone, to be introduced from late 1992**
3. **Satellite paging to pocket receivers in 1994**
4. **The global hand-held satellite phone, Inmarsat-P, by the end of the decade.**

2.1 Building blocks to the future

As the world leader in mobile satellite communications, Inmarsat already has a portfolio of global services designed for applications at sea, in the air and on land.

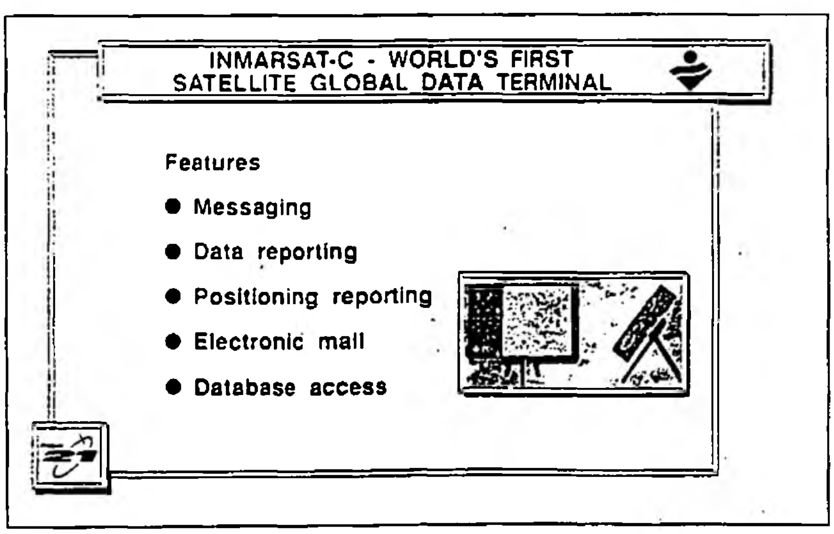
Under Project 21, the evolution of personal mobile satellite services will build upon Inmarsat's strong base of existing technology, satellite systems, networks, services and experience. This building block approach has a number of advantages and will benefit the mobile satellite community by reducing costs, minimizing technical and financial risk, and capitalizing on economies of scale.

2.2 The personal mobile satellite communications family

Inmarsat-C: global portable data

In 1991, Inmarsat introduced Inmarsat-C, a data messaging service which uses small, relatively inexpensive terminals. It is the first personal mobile satellite communications service which can be used anywhere in the world.

Inmarsat-C offers two-way global mobile satellite data



messaging using terminals that weigh only a few kilos and are the size of a briefcase. Two-way text or data messages of up to several pages in length can be sent and received between fixed telecommunications installations and mobiles anywhere in the world. The system uses store and forward techniques, operating at 600 bps.

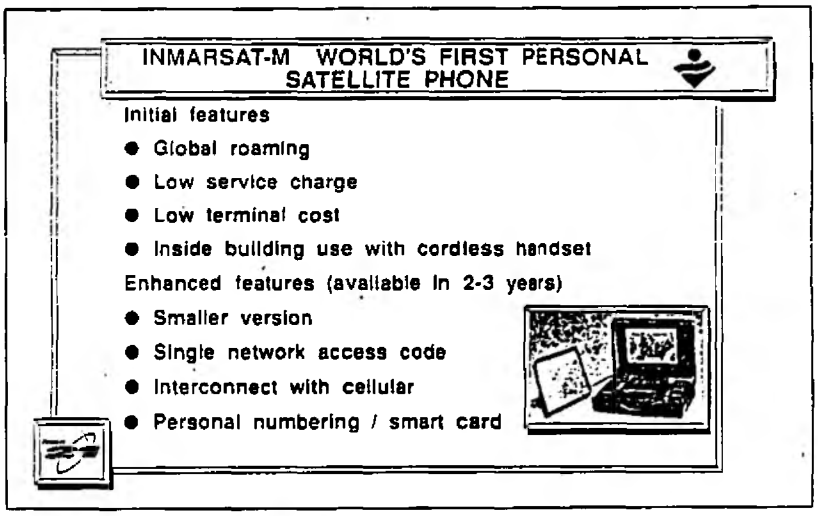
Inmarsat-C is used for land mobile applications in increasing numbers. Mounted in vehicles, it is improving efficiency in transport industries. A briefcase version of Inmarsat-C is used by international business travellers to send and receive messages and files from anywhere on earth from portable computers.

Connections to the international communications networks are made through hub earth stations located in countries around the world operated by national telecommunications service providers.

More than 4,000 Inmarsat-C terminals are currently in use worldwide. Thirty-five models from 21 manufacturers have already been type approved by Inmarsat and more are under development.

Inmarsat-M: briefcase satellite phone

The world's first personal, portable, mobile satellite phone - Inmarsat-M - begins commercial operations in the second half of 1992, with coverage extending globally by early 1993. For the first time ever, phone, Group III fax, data and group call (narrowcasting) services become available virtually anywhere on earth from portable, relatively inexpensive equipment.



Inmarsat-M's all-digital telephony at 4.8 kbit/sec and 2.4 kbit/sec data and facsimile services will appeal to both maritime and land customers in applications where voice communications, a high degree of portability and lower cost are important.

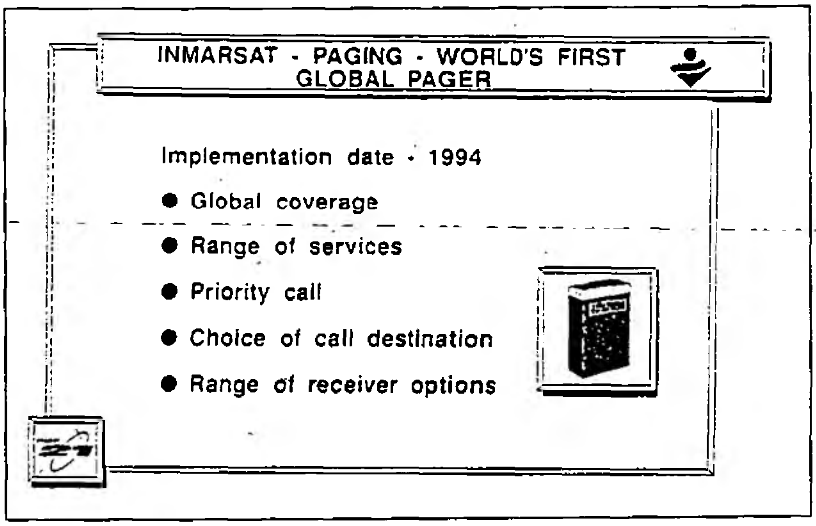
Inmarsat-M will be available in a number of versions, including carry-anywhere, briefcase models, some with cordless handsets.

Inmarsat-M is already highly integrated with the existing worldwide telecommunications infrastructure. It can reach and be reached by any phone or fax machine connected to the worldwide public switched telephone network, as well as any other Inmarsat-M, simply by dialling.

The cost of Inmarsat-M equipment will initially be $10,000 to $15,000, but is expected to decrease with volume production. Inmarsat-M usage costs are about half that of Inmarsat's traditional Inmarsat-A service and should decrease significantly over time.

Global satellite paging

Also under development at Inmarsat is the world's first global personal pager. Scheduled to be introduced in 1994, the proposed service will be a natural extension of terrestrial-paging services. The global pager will benefit a wide range of users - business executives, journalists, salesmen, couriers and travellers, who can be contacted no matter where they are.



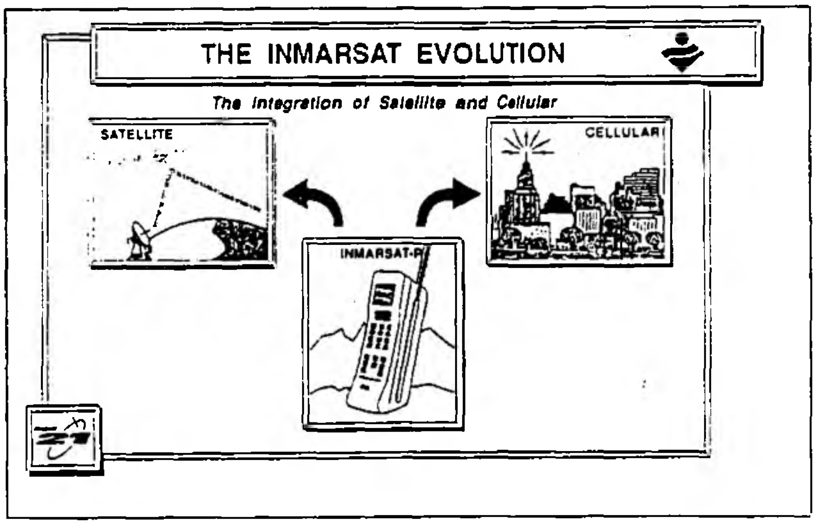
Customer equipment will include either pocket-sized or vehicle-mounted satellite pager units. The service will provide a degree of penetration within buildings.

Inmarsat-P: the hand-held satellite phone

The Inmarsat-P programme is outlined in Section 3.

2.3 Satellite/ terrestrial services integration

As the web of global fixed and mobile communications services continues to become increasingly interconnected, Inmarsat is working to ensure that personal mobile satellite communications services function with other existing and evolving communications systems as an integral part of the worldwide communications infrastructure.



Satellite-cellular interworking is under consideration for the briefcase Inmarsat-M and the hand-held Inmarsat-P. Features such as smart cards and single number access may be incorporated as they are introduced into the worldwide communications systems.

2.4 Enhancing the range

Inmarsat is planning a programme of continuous enhancements and improvements to the family of personal satellite communications services as technology permits. The emphasis is on enhancing convenience, reducing equipment size and weight, increasing portability, lowering costs and furthering satellite-cellular integration.

Even after the introduction of Inmarsat-M, service and network enhancements will continue to be introduced. The following features, for example, are under consideration to ensure that users can take advantage of technical developments as they become available:

- **The integration of Inmarsat satellite paging with an Inmarsat-M briefcase phone to provide supplementary services. Even if the termnal is switched off or a call is unsuccessful, the caller's number would be captured and stored for display, allowing the user to return the call**
- **With the subscriber's profile held in a smart card, regional and global roaming become possible. The smart card, holding a subscriber's unique identification, allows him or her to use any similarly-equipped terminal in the world**
- **Features such as call forwarding and caller identification.**
- **Single number access to the subscriber**
- **Capacity to allow interworking with cellular networks, subject to commercial interworking agreements. A dual-mode Inmarsat-M would provide service to a local cellular system if in range, or to the satellite if not.**
- **A more compact version of Inmarsat-M which will become possible with Inmarsat's more powerful third-generation spot beam satellites, scheduled for service in 1994/95**

2.5 The evolution to Inmarsat-P

The evolution of the Inmarsat-M features and communications networks will have an important part to play in the subsequent introduction of the Inmarsat-P hand-held satellite phone. It paves the way for Inmarsat-P by putting in place and acquiring operational experience with an advanced network infrastructure and mobility management and by increasing integration between satellite and terrestrial networks and services.

2.6 Complementary mobile satellite services

The development of personal mobile satellite communications services is in addition to, not a replacement of, Inmarsat's other mobile services such as those provided to the maritime and aeronautical communities and to specialized land-mobile markets. These communities will continue to be served with a growing range of systems designed to meet their specialized needs.

The advent of hand-held satellite phones will not satisfy the needs of the entire mobile satellite customer base. The interests of many users will be best served by other equipment and service options for applications such as remote area communications, high-volume transportable communications, high-speed data services, remote monitoring and control, news gathering and exploration. For these customers, Inmarsat will continue to provide and evolve a number of specialized mobile satellite systems, such as Inmarsat-A, Inmarsat-B and aeronautical services.

In addition, Inmarsat will provide a range of radiodetermination and navigation services, begining with the operation of its third-generation satellite system in 1994/95.

2.7 Mobile technology and standards

Over the next decade, the terrestrial communications networks will undergo significant evolution, increasingly incorporating ISDN capabilities, increased use and coverage of standard signalling systems and the introduction of new concepts such as Universal Personal Telecommunications (UPT). At the same time, the wide availability and expansion of digital cellular networks will confirm these systems as the benchmark for mobile communications.

Inmarsat is participating closely in fora such as the International Telecommunication Union (ITU) CCIR Consultative Committee FPLMTS (Future Public Land Mobile Telecommunications Systems) task group which could result in internationally accepted mobile communications standards.

3 Inmarsat-P: the hand-held satellite phone

3.1 Inmarsat-P

Inmarsat-P will expand the personal communications mobility frontier by providing users a hand-held phone useable around the world.

Inmarsat planning is governed by the expectations of the market for a low-cost, light-weight terminal and for reliable, high quality, low-cost service. The target introduction date — before the end of the decade — is determined by the need to be competitive in meeting the market demand for hand-held satellite phones and a realistic planning and development timetable.

The provision of hand-held satellite phone services requires extensive planning and development in three broad areas:

- **the terminal design and specifications**
- **an advanced satellite system to provide adequate power and coverage to support hand-held satellite services,**
- **a sophisticated, worldwide network infrastructure.**

3.2 Hand-held terminal design and specifications

The basic Inmarsat-P service objective is telephony to and from hand-held terminals with an unobstructed satellite view, with a voice quality similar to that of Inmarsat-M and digital cellular systems.

The Inmarsat-P design incorporates a dual-mode feature: operating as a normal cellular phone when within range of a cellular system or, otherwise, as a satellite phone.

Calls can be made to or received from any phone on the public switched telecommunications networks or other mobile satellite terminal.

INMARSAT-P TERMINAL DESCRIPTION

- Provides duplex voice, fax, paging, location and data services
- Weight less than 750g
- Volume around 500 cm3, excluding antenna
- Power output < 1 watt
- Rechargeable, clip-on battery
- Digital port for external devices
- Price in volume less than US$ 1,500

The Inmarsat-P design weight is equivalent to that of many full-sized cellular hand-helds on the market in 1992.

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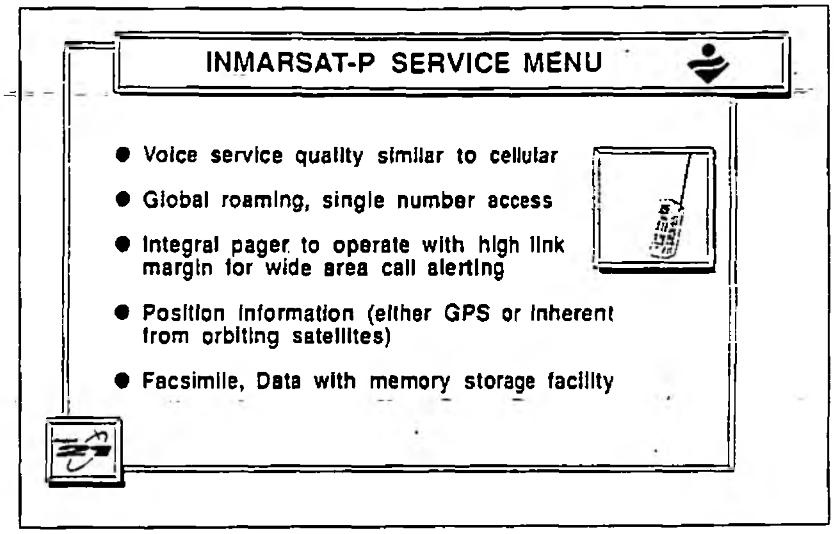
In addition to full duplex voice, Inmarsat-P will support Group III facsimile and data services at 2.4 kbit/s. It will also incorporate a high-penetration paging facility for services such as call or voice mail alerting or for displaying the number of a caller. Operational power is to be consistent with microwave safety requirements. An attachable rechargeable battery is designed for one-hour transmit and 24-hour receive times.



Inmarsat-P equipment will permit global roaming. With a smart card feature, a subscriber can use any smart-card equipped Inmarsat-P anywhere.

Inmarsat-P is expected to be priced at about US$ 1,500 (for the dual-mode model) with a satellite retail usage charge in the range of $2.00 a minute. A single-mode (satellite only) model is also planned which will be marginally smaller and cheaper.

3.3 An advanced mobile satellite system

To support Inmarsat-P services, a new generation of Inmarsat satellites will be required. This will be in addition to Inmarsat's second-generation satellite system (Inmarsat-2), now operational, and a third-generation satellite system (Inmarsat-3) which will come into service in 1994/95 to support Inmarsat's growing maritime, aeronautical and land-mobile satellite services.

Inmarsat has determined that a number of advanced satellite systems and orbit configurations are potential candidates to provide the required coverage and capacity for global hand-held satellite phone services.

Among the options under evaluation are:

- **an enhanced geostationary earth orbit (GEO) satellite system, similar in orbital configuration to but more powerful and with larger antennas than Inmarsat's existing satellites**
- **a low earth orbit (LEO) satellite system overlay**
- **an intermediate circular orbit (ICO) satellite system overlay**
- **a combination of GEO and non-GEO constellations, with inter-satellite links between the non-GEO and GEO satellites**

Each option has its own technical and operational characteristics, advantages and limitations and capital and operating cost structures. These are now under investigation and options are being evaluated from a technical, operational and financial perspective, a process which will lead to a recommended satellite system and orbit configuration for investor review before the end of 1992.

Although other potential operators have announced satellite system designs to provide similar services, Inmarsat considers that an exhaustive evaluation of available technology and options is a prerequisite to determining the best possible configuration to meet the precise needs of the Inmarsat-P service and markets.

A key evaluation criterion is that the space segment configuration must meet the service, capacity and coverage requirements of Inmarsat-P at the lowest cost in order to ensure a satisfactory return on investment.

3.4 The ground network architecture

Equally important to the global operation of Inmarsat-P is an advanced ground network architecture designed to support global hand-held satellite phone service.

As with other Inmarsat services, Inmarsat-P terminals will normally communicate, via the satellite system, to hub earth stations located around the world and, through them, to the public switched telecommunications networks. Because of the characteristics of the technology and the service, the requirement for cellular/mobile satellite interworking, and the large projected number of terminals, network design is a critical aspect of the Inmarsat-P system.

Inmarsat is currently investigating advanced network designs to support Inmarsat-P service features such as cellular-satellite interworking and mobility management. The investigation includes the possibilities for the evolution of existing Inmarsat ground segments to support Inmarsat-P and an assessment of the merits of using existing terrestrial network components (ISDN switch units, cellular base stations, routing plans, signalling systems, etc.) as much as possible.

Final network design will depend on the choice of the satellite system and orbit configuration. As with the satellite system evaluation, the investigation includes a detailed analysis of the technical, operational and economic trade-offs of various network configurations.

3.5 A worldwide, cooperative effort

The development of Inmarsat-P is a worldwide, international endeavour which relies on the cooperation and expertise of Inmarsat Signatories, the aerospace industry, telecommunications companies and organizations, equipment manufacturers and professionals around the world.

Signatories involved to date in technical or economic studies include Comsat (US), British Telecom (UK), KDD (Japan), Australia Telecom and Overseas Communications Ltd., Norwegian Telecom, Videsh Sanchar Nigam Ltd. (India), OTE (Greece) and Telespazio (Italy). Companies or other organizations include MPR Ltd., Italspazio, the Indian Space Research Organization (ISRO) and a number of leading telecommunications and aerospace companies in countries around the world.

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The development of Inmarsat-P is a worldwide, internationa cooperation and expertise of Inmarsat Signatories aeros tions companies and organizations, equipment manufacturers world.

Signatories involved to date in technical or economic studie Telecom (UK), KDD (Japan), Australia Telecom and C Norwegian Telecom, Videsh Sanchar Nigam Ltd (India) (Italy). Companies or other organizations include SPR Lt Research Organization (ISRO) and a number of leading tele companies in countries around the world.

Inmarsat has also signed Memoranda of Understanding (MOUs) or Mutual Non Disclosure Agreements (MNDAs) with other potential mobile satellite operators to exchange information and to better understand and evaluate each others' proposals for hand-held satellite phone systems.

In addition, Memoranda of Understanding and agreements have been reached with a number of the world's foremost mobile equipment manufacturers to draw on their expertise in terminal and network technologies, and with leading spacecraft manufacturers in the development and evaluation of satellite system technology.

3.6 The Inmarsat-P market

In close cooperation with its Signatories, Inmarsat has embarked on a major market research effort to obtain a deeper understanding of the scale of potential global markets for Inmarsat-P. Initial Inmarsat-P market forecasts were drawn up in the last quarter of 1991. The current studies are designed to broaden and deepen the base for the Inmarsat-P market projection through an intensive analysis of the key market segments. Signatory participation will lead to a better understanding of the potential markets within key countries.

The market research effort is being undertaken with the help of Schema, a specialist cellular market research firm, and Touche Ross, a leading management consulting company with an international network in more than 100 countries. Schema/ Touche Ross are preparing demographic and communications usage characteristics country by country which can subsequently be used by Signatories participating in the market research programme. The findings will assist in refining Inmarsat's assessment of the satellite system capacity, and the operational and economic performance required for viable hand-held satellite phone services.

3.7 Inmarsat-P planning and development

With a target introduction date before the end of the decade, Inmarsat-P planning and development is proceeding rapidly. The short term planning programme — to end of 1992 — involves efforts across many fronts including technical and operational analysis and concept design of the terminal, satellite system and ground networks; market research; and financial studies and evaluation.

The short-term programme will lead to investor review by the end of 1992.

4 Inmarsat as a personal mobile satellite communications system operator

4.1 A competitive environment

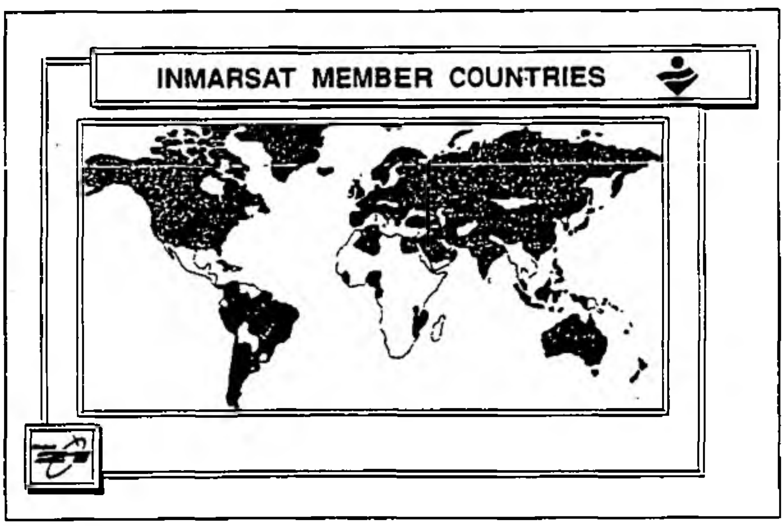
Although Inmarsat is the world's only global mobile satellite service provider today, mobile satellite services will develop in the future under a competitive environment. A number of satellite operators have announced their intention to provide personal mobile satellite services similar to those planned under Project 21, either regionally or globally.

Competition benefits the customer and the industry by spurring the development of innovative technology and services and by providing customer choice.

Inmarsat intends to retain leadership as a provider of worldwide mobile satellite communications and is in a unique position to develop and evolve advanced personal mobile satellite services.

4.2 A successful, global enterprise

Since it began operations in 1982, Inmarsat has built up and extended the world's only global mobile satellite service.



Beginning as a maritime satellite communications operator with 1,000 terminals, Inmarsat now serves more than 20,000 mobile customers worldwide.

Its maritime operations have been extended to include worldwide land-mobile and aeronautical services.

Inmarsat's traffic and revenue growth in recent years has far outstripped those of telecommunications services generally, resulting in a strong, financially robust organization.

The current Inmarsat system provides global mobile satellite services, reaching virtually all parts of the world.

4.3 Non-discriminatory, open to all

By international agreement, Inmarsat services are open to everyone for peaceful purposes on a non-discriminatory basis, subject only to domestic regulations in the countries of operation. A user need not be a national of a member country to benefit. Indeed, although 65 countries are Inmarsat members, more than 130 countries are represented in Inmarsat's customer base.

Any country in the world is entitled to become a member and the number of member countries is steadily increasing as more and more nations become aware of the benefits of global mobile satellite communications. Inmarsat services in the territory of any country remain subject to national laws and regulations.

Inmarsat's policy of openness extends further than its customer base or membership, however. All of its major procurements, such as for satellite systems and network control, are carried out by open, international tender. The open procurement policy allows Inmarsat to draw on the strengths of the best suppliers in the world and ensures internationally competitive prices.

Any manufacturer anywhere in the world can manufacture and sell Inmarsat mobile terminals, as long as they meet Inmarsat's internationally-accepted type approval requirements.

4.4 International strengths

Inmarsat benefits from its strong international character and ownership. The partnership's 65 member countries represent industrial and developing countries alike, each of which has a voice on the Inmarsat Assembly. Member countries designate a national entity, usually the international telecommunications or satellite service provider, as the Inmarsat Signatory for that country. The Signatory, in turn, participates in the ownership of Inmarsat through its investment share and benefits both from an annual return on investment and as an Inmarsat service provider. Some countries permit more than one national Inmarsat service provider. Ownership, control and decision making is therefore truly international.

The global Inmarsat system ensures common equipment standards around the world.

As an international organization, Inmarsat has also taken on important public service obligations, such as safety and distress services and support for disaster relief efforts in countries around the world.

Inmarsat's international stature benefits the mobile satellite customer in many other ways as well. In the development of Inmarsat-C, Inmarsat-M and the aeronautical services, for example, Inmarsat worked closely with the international user communities to determine needs, influence design decisions, and arrive at systems and services which meet the needs of the customer community.

In addition, Inmarsat is active in a number of international fora and thus participates in the development of international mobile communications standards and regulations.

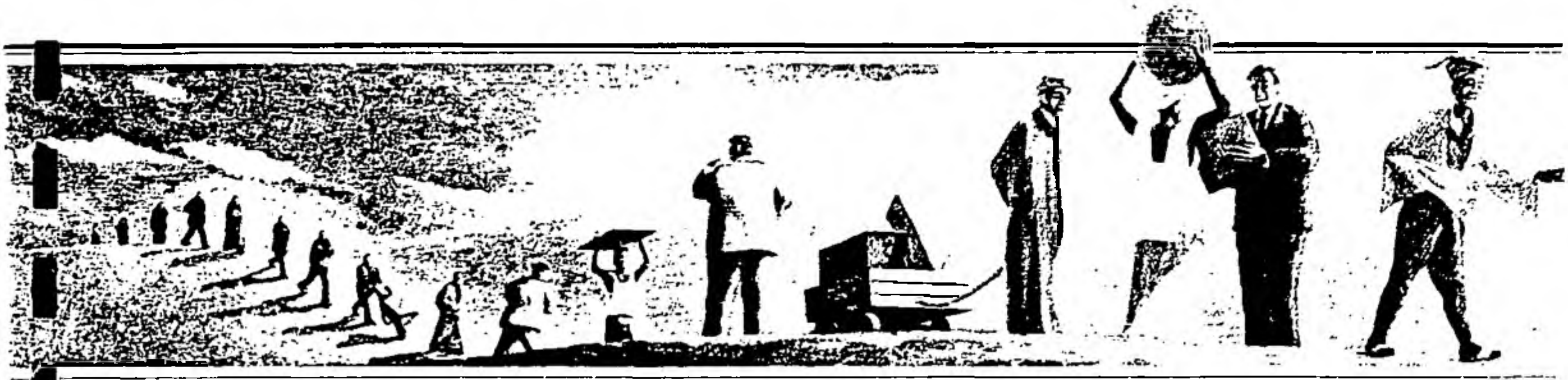
Inmarsat's strong international structure and global operations provide a powerful base from which to develop advanced global personal mobile satellite services.

Project 21

INMARSAT'S PROGRAMME FOR

PERSONAL MOBILE SATELLITE

COMMUNICATIONS



... the building blocks towards a global hand-held satellite phone...

Inmarsat

GLOBAL MOBILE COMMUNICATIONS

The world is in the midst of a major telecommunications revolution - the revolution to mobile rather than fixed communications for what has been termed "the final mile", the connection between the global telecommunications networks and the individual user.

The advent and rapid growth of cellular radio systems has allowed people to stay in touch even when roaming far from their homes or offices. Telephones are starting to become associated with people, rather than places.

But as the world becomes more reliant on mobile personal communications systems, users will need to have the assurance that communications will always be available, no matter where the caller or correspondent roams. Cellular systems, because of their essentially local - and sometimes - incompatible, nature cannot provide this assurance on a global, or even regional, basis. Total, anywhere, anytime, anyplace reliability can only be provided by a satellite system. And Inmarsat, the world's global mobile satellite operator, is the natural choice.

Two years ago Inmarsat started working on Project 21, a planned approach towards the evolution of a family of global personal communications systems. The building blocks of this evolutionary approach are already being put in place and are carefully designed to make the most of today's technologies, systems and investments as a sound basis in moving towards systems to meet the needs of the future.

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TOWARDS 2000

...Total, anywhere, anytime, anyplace reliability can only be provided by a satellite system. Inmarsat, the natural choice...

'Inmarsat has the infrastructure now, to underpin the satellite systems of the future.'

THE PRESENT

INMARSAT

A success story to build upon.

Inmarsat is the world's only successful global mobile satellite communications venture:

- it has more than 13 years of experience built upon the investment and cooperation of telecommunications operators and governments in more than 60 countries and providing service to well over 130 countries.
- it is an international partnership in enterprise, made up of hundreds of telecommunications organizations, equipment manufacturers and service providers all contributing to the range of services and products available to Inmarsat users.
- it provides an open global competitive market place where users can choose the best products or services to suit their needs, at the best price from a host of competing suppliers.
- it operates to more than 22,000 maritime, aeronautical and land mobile terminals, serving hundreds of thousands of customers. The largest proportion of terminals are maritime, but more than 25 per cent are now land mobile or transportable terminal users and this group is growing faster than any other. Hundreds of aircraft are also using the recently-introduced aeronautical services.

Inmarsat's success and experience provide a firm and equitable basis on which to build the world's future mobile satellite systems.

INMARSAT

A satellite system to build upon.

Inmarsat currently operates capacity on a total of 11 geostationary satellites. These are arranged in four operating regions giving overlapping global coverage, with the exception of the extreme polar regions. All four prime operational satellites are Inmarsat-2s, spacecraft that were designed and built specifically for Inmarsat and which are wholly operated by Inmarsat. Gateways to the satellite system are provided through more than 40 land earth stations, generally owned by the telecommunications operators of the countries where they are located.

Inmarsat has the infrastructure now to underpin the satellite systems of the future.

INMARSAT-3

A new generation of satellites to meet the demands of the 90's, and beyond.

- A new series of geostationary satellites is already under construction and will start service in 1994
- With 10 times the power and six

times the capacity of current models, Inmarsat-3 will enable Inmarsat to serve the expanded markets of the mid-'90s and to support even smaller, cheaper terminals

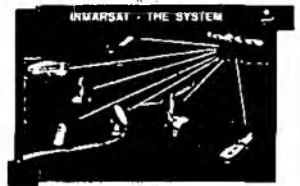
INMARSAT-C

The first step in the global mobile communications evolution.

Inmarsat, the world leader in mobile satellite communications technology, is already operating the world's first global personal mobile satellite communications system, Inmarsat-C, which provides a broad range of data messaging services for customers worldwide.

- Inmarsat-C means compact terminals that can be fitted to any boat or vehicle, or slipped into a briefcase, and a system that can provide text or data messaging communications to and from anywhere. Inmarsat-C has been in operation since early 1991; already there are many thousands of terminals in maritime and land mobile use. It's ideal for trucking companies trying to keep tabs on their international fleets, or for prime or back up communications for any vessel from supertanker to fishing boat, or for travelling businessmen to keep up with their electronic mail, or for international journalists with stories to file. Combined with GPS or other position determination information, an Inmarsat-C becomes a very powerful remote tracking and monitoring tool...the list of applications is almost endless.

In its portable, briefcase form, Inmarsat-C is the first truly global personal communicator and mobile office. It heralds Inmarsat's future range of personal communication systems.



...13 years of experience...investment and cooperation of more than 60 countries...service to well over 130 countries...

...it operates to more than 20,000 maritime, aeronautical and land mobile terminals, serving hundreds of thousands of customers...

THE NEXT STEPS

INMARSAT-M

The next big step towards the global personal telephone.

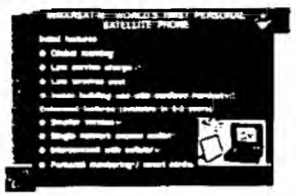
Inmarsat is now introducing Inmarsat-M, a system that will not only cater to the expanding demands of that period, but will also form a bridge towards the systems required in the 21st century.

• Inmarsat-M is a new system that will be on stream by the end of 1992. Like Inmarsat-C, it comes in a briefcase-sized terminal that can be hand-carried or fitted to any type of vehicle or vessel. It provides direct-dial, two-way telephone, fax or data links, from anywhere, to anywhere.

• The first Inmarsat-M gateway stations are already in preliminary operation. Global service will be available by early 1993. Several manufacturers are supplying personal, portable terminals.

• Inmarsat-M serves a wide variety of new business, institutional, consumer and leisure customers.

• Inmarsat-M could provide a one-step, nation-wide mobile thin-route phone service, with the option of direct international connection, for less than the cost of cellular systems for one city.



Development work is already under way on possible enhancement to Inmarsat-M terminals, including filofax or lunch-box-sized terminals for Inmarsat-3 operation.

DEVELOPING THE GLOBAL NETWORK.

As world network signalling systems advance, Inmarsat-M could soon offer single number access (dialling one number would reach an M terminal no matter where it is in the world) and inter-operability with cellular systems.

The infrastructure created for Inmarsat-M will be compatible with, and contribute to, Inmarsat's 21st century mobile communications systems. Inmarsat-M is the start of the mobile satellite telephone communications future

INMARSAT PAGING

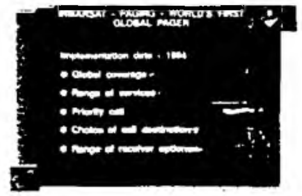
World-wide, direct satellite communications in your pocket!

• In 1994, Inmarsat will introduce the world's first global satellite paging system.

• The paging system will support stand-alone, pocket sized alpha-numeric receivers or can be integrated into Inmarsat-M transportable briefcase units to notify customers that calls are waiting.

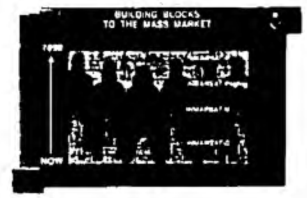
• Although they will operate directly with the satellite - without terrestrial relays - the pagers will be capable of receiving messages in cities and to some extent, within buildings.

• More than just beepers, the pager receivers will be capable of receiving, displaying and storing alpha-numeric messages of up to 100 characters.



• Several well-known international manufacturers are already committed to producing the user equipment.

A satellite communicator in your pocket - another step towards the complete global personal satellite communications systems.



...Inmarsat-M...forming a bridge towards the systems required in the 21st century...

...A new generation of satellites to meet the demands of the 90's and beyond...

"World spanning, hand-held satellite telephone services at consumer affordable prices."

TOWARDS 2000

A PERSONAL, HAND-HELD SATELLITE TELEPHONE

The next step in Inmarsat's Project 21 program.

The target is to provide world spanning, hand-held satellite telephone services at consumer affordable prices by the end of the decade. Studies in support of Project 21 have shown that a conservative estimate of the demand for mobile hand-held satellite telephone services worldwide -from business travellers, journalists or anyone whose work or leisure takes them beyond the reach of fixed or compatible cellular systems - will exceed one million users by the year 2005.

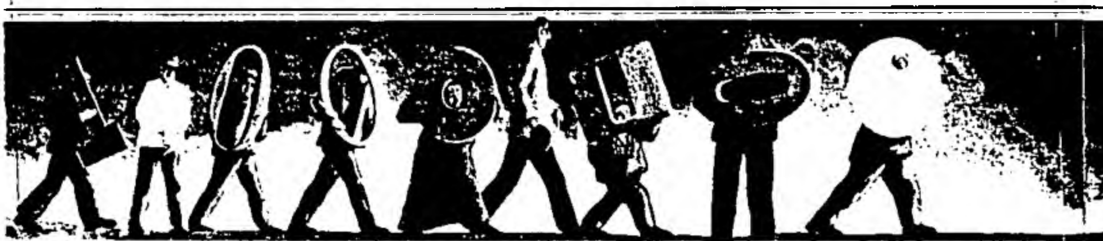
To achieve this goal, Inmarsat has put together a global team of communications operators, satellite manufacturers and mobile communications equipment manufacturers to help develop the optimal set of system features and network design parameters to serve this market.

SERVICE FEATURES

Hand-held satellite telephone services developed under Project 21 are being planned to incorporate a number of advanced features -

- **Voice service quality as good as cellular**

Based on low bit rate, high quality digital voice encoding, which will provide voice quality similar to that of digital cellular systems.



...Estimated demand for mobile satellite telephones will exceed one million by 2005...

• Cellular extension: Compatibility and interconnectability with cellular services.
Manual or automatic selection of satellite service, if cellular is unavailable.

• Global roaming with single number access regardless of location
Each terminal will have its own number which will operate anywhere in the world. In most cases, billing could be routed through one service provider.

• Integral pager for standby call alerting
As well as saving battery power for the main terminal, an integral pager will also receive short text messages, even inside buildings.

• In-built position determination and reporting facilities
An important safety security feature, and invaluable to such as trucking fleets and courier companies in coordinating deliveries and schedules. It also allows the system to know the location of terminals at all times, for call routing.

• Facsimile, data and memory storage capabilities
Interconnects that will give you virtually a pocket mobile office.

SATELLITE SYSTEM

To achieve the coverage, capacity and features required for hand-held satellite telephone services, new satellites will be needed. A number of different proposals are currently being considered by Inmarsat, including an examination of non-geostationary orbits.

Among the options under evaluation are:

• an enhanced geostationary earth orbit (GEO) satellite system, similar in orbital configuration to but more powerful and with larger antennas than Inmarsat's existing satellites

• a low earth orbit (LEO) satellite system overlay

• an intermediate circular orbit (ICO) satellite system overlay

• a combination of GEO and non-GEO constellations, with inter-satellite links between the non-GEO and GEO satellites.

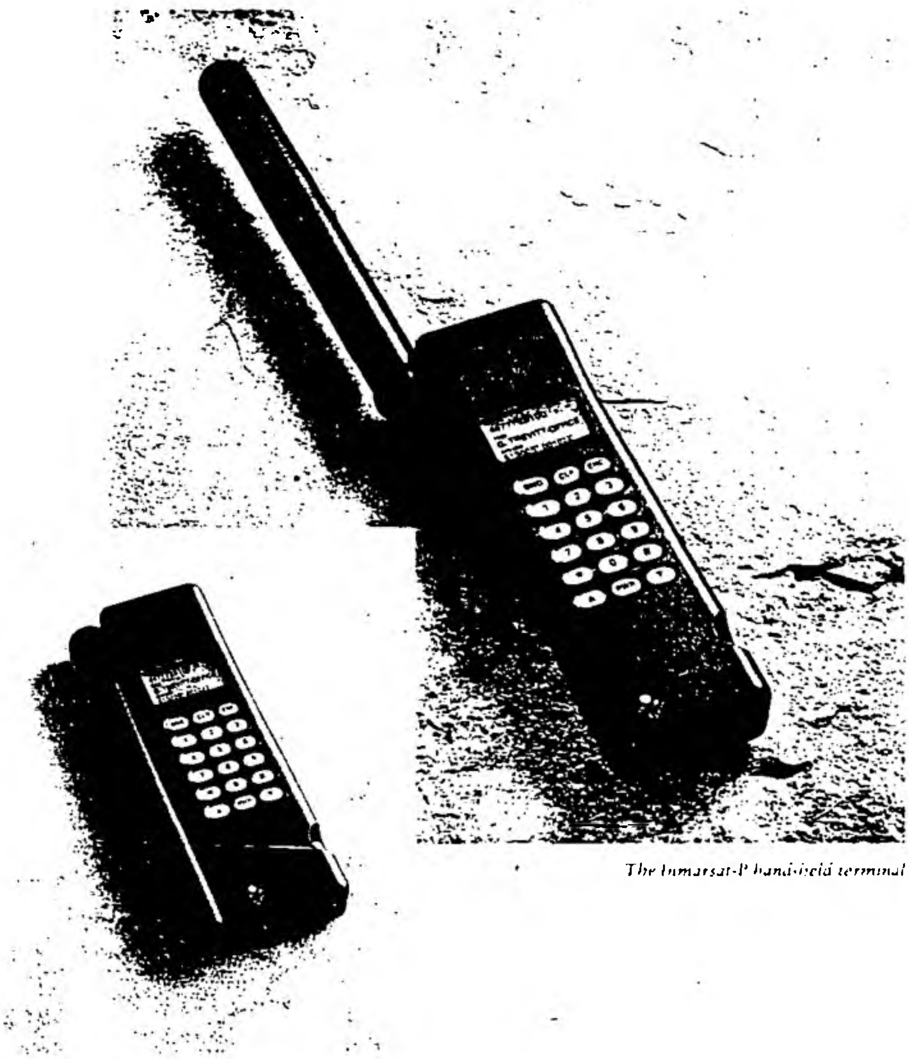
...A satellite system for a future of anywhere, anyplace communication for everyone...

INMARSAT-P
HAND-HELD TERMINAL

A hand-held mobile satellite telephone providing duplex voice, paging, location and data services

Weight	About 750 grams
Volume	About 500 cu.cm., excluding antenna
Power output	Less than 1 watt
Battery	Rechargeable. One hour operation, 24 hours paging standby
Attachments	Digital port for external devices
Price	About $US1500 in volume production

Specially-designed versions of the hand-held terminal, with similar capabilities, will be available for mounting in vehicles and small vessels.



The Inmarsat-P hand-held terminal

1 *Including battery*

2 *In 1992 US$*

...no matter where they roam...

NEWS NEWS NEWS

Inmarsat

40 Melton Street, London NW1 2EQ
United Kingdom.

NR91/32/P21

12 September 1991

INMARSAT ANNOUNCES PROJECT 21
DRIVE FOR POCKET SATELLITE PHONES

Inmarsat, the 64-member country mobile satellite communications organization, today announced its Project 21 initiative to plan and implement the systems needed to provide for the global mobile satellite communications requirements of the next century.

Explaining Project 21, Inmarsat's Director General Olof Lundberg, said that its basic aim was to provide a world-wide, go-anywhere, pocket-sized satellite phone service by the end of the decade.

"But, of course this could and will be extended to many more applications. For instance satellite voice, data and entertainment communications centres for your car, personal satellite navigation, position reporting and alerting services for your security," he said.

"Imagine the impact of tiny, multi-purpose communicators -- units that can be slipped into a pocket or handbag but that will work clearly and reliably anywhere in the world -- on our business and social lives."

"Of course, they will have to have an on/off switch," he mused.

The Project 21 initiative actually started about two years ago with an Inmarsat multidisciplinary team evaluating options for the future evolution of mobile satellite systems and services.

"Our vision of the future is based on our long-standing commitment to the evolution of satellite communications services to support global personal mobility," Lundberg said.

Throughout the 1990s Inmarsat will continue to introduce a range of new services, usher in lower equipment and satellite production costs and shrink the size of terminals.

Next year, Inmarsat will offer a new low-cost global phone service to brief-case sized terminals and the following year a global alpha-numeric satellite paging system. It is currently launching its Inmarsat-2 series satellites and has already contracted for larger Inmarsat-3 spacecraft, due to begin launching in 1994.

- MORE -

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component. Project 21's evaluations to date have shown, for example, that a combination of GEO and LEO systems with a constellation of satellites incorporating proven technology could provide good coverage and capacity.

* Such a future Inmarsat system would not bypass national telecommunications systems. The satellite system would provide the initial link between the mobile and the world-wide public switched telecommunications networks, via the Inmarsat earth station network.

* Future Inmarsat satellite systems will continue to include a strong global geostationary satellite component. Inmarsat has an obligation to its thousands of customers in the maritime, aeronautical and land-mobile communities, to continue to provide the services on which they have come to depend. These services require geostationary satellites.

* As is current Inmarsat practice, any manufacturer anywhere in the world will be able to supply equipment to work with the new Inmarsat system, as long as the equipment is type approved.

* Satellite and launch procurement will be carried out through world-wide competitive tendering processes, thus ensuring the best combination of price, quality and delivery.

For further information, please contact:
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United Kingdom.

NEWS NEWS

NR92/32/P21

11 November 1992

INMARSAT TO MOVE AHEAD RAPIDLY WITH GLOBAL HAND-HELD SATELLITE PHONE SYSTEM

Inmarsat is moving rapidly ahead with the development of a global hand-held satellite phone system, with the aim of introducing it commercially by 1998-2000.

Inmarsat's governing Council, meeting in London this week, has unanimously concluded that the advanced system, code-named Inmarsat-P, is technically feasible and is a promising business opportunity for the organization.

The Council has called for a number of urgent actions to resolve remaining technical and market issues as quickly as possible and to enable Inmarsat owners to take an investment decision by July 1993 on Inmarsat-P implementation.

A comprehensive research and development programme, to be undertaken during the next few months, will refine Inmarsat's knowledge base on key Inmarsat-P technical issues, including the global satellite system configuration, the terminal and the ground network required to support the delivery of hand-held satellite phone services.

Extensive Inmarsat studies carried out over the past year conclude that a number of different satellite system configurations could provide Inmarsat-P service, including geostationary satellite systems, intermediate circular orbiting systems and low earth orbiting systems. Each of these systems, however, has its own set of technical characteristics, advantages, costs, risks and trade offs.

Inmarsat, together with industry, will undertake further comprehensive space segment definition studies to conclude the analysis of the satellite systems and orbital configurations needed to deliver Inmarsat-P services, building on the analysis already carried out.

The focus will be to evaluate and verify critical technologies and to finalize cost and schedule assessments for Inmarsat-P implementation. Preliminary results are to be available by May 1993.

In parallel, Inmarsat will further refine its existing market forecasts for global hand-held satellite services and address critical market factors which have an impact on system design.

The Council underscored the urgency of the development effort by authorizing the formation of joint 'Tiger Teams' - on-going working groups with members from both Inmarsat and its owner organizations - to speed the analysis of the remaining key issues and to prepare the remaining groundwork for an early decision on Inmarsat-P investment

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-more-

Inmarsat-P will provide global satellite voice communications to inexpensive hand-held phones and other services such as facsimile, data, paging and positioning. Coverage will be available globally and services will interface to the international public switched telecommunications network. Inmarsat-P handsets will be 'dual-mode', operating through the local cellular system when in range and, when not, through the global satellite system.

This week's Council actions were taken after an evaluation of technical, market and financial studies carried out over the past year by Inmarsat. The studies have been supported by substantial efforts undertaken by a number of telecommunications and space industry organizations worldwide. In addition, many of Inmarsat's national shareholder organizations have undertaken specific market and technical studies related to the provision of global, 'personal' satellite services.

To further accelerate the development of Inmarsat-P, Inmarsat will, in parallel, prepare a 'functional service' request for proposals (RFP) for the Inmarsat-P satellite system design, as an alternative to the traditional Inmarsat RFP approach, which would be ready soon after the completion of the space segment definition studies and which could go out to industry as soon as Council takes a positive investment decision.

Inmarsat Director General Olof Lundberg said he considers it "extremely important to undertake comprehensive analytical studies and to have the benefit of further industry participation before selecting the preferred satellite configuration."

"It is absolutely crucial that the chosen system configuration is the right one. The selection of the satellite configuration will be based on the needs of the customer." he said

The development of Inmarsat-P is part of a broad Inmarsat strategy known as Project 21, aimed at making available a range of 'personal' satellite communications services between now and the 21st century, with an emphasis on the introduction of smaller, more portable and cheaper satellite communications equipment and lower-cost services as technology permits.

As part of Project 21, Inmarsat is introducing, before the end of 1992, the world's first briefcase satellite phone - Inmarsat-M - useable virtually anywhere on earth. Inmarsat-M is an important part of the evolutionary strategy since it brings the power of mobile satellite communications to small, lightweight voice terminals and is expected to capture large and growing worldwide markets.

The evolution of these 'personal' mobile satellite services over the decade will provide the basis and the building blocks for the more advanced Inmarsat-P service.

Inmarsat is a 65-member country cooperative which operates a system of satellites to provide mobile communications to ships at sea, aircraft in flight and to land-based markets. About 25,000 Inmarsat terminals are currently in use in more than 135 countries providing telephone, telex, facsimile, electronic mail and data communications to mobile users.

# # #

For more information:
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IRIDIUM

IRIDIUM™ BACKGROUND INFORMATION

Motorola Satellite Communications, a Motorola, Inc. affiliate, is engineering a personal communications system called Iridium designed to provide global voice, data, paging and radiodetermination satellite services to hand-held, wireless telephones anywhere in the world. Subscribers will use small, hand-held, "pocketable" telephones to communicate with any other telephone on earth. The system will track the location of handsets as they move with their users, providing global one-person, one-number service to subscribers.

The System:

The purpose of the Iridium system is to allow subscribers to operate pocketable telephones anywhere in the world. The Iridium system includes a constellation of low earth orbit satellites, located approximately 420 nautical miles above the earth. The satellites will be small, light-weight, and interconnected to provide continuous line-of-sight coverage between all points on the globe. Each satellite will project beam patterns onto the earth's surface, and the entire constellation will provide ubiquitous coverage. The Iridium telephone will communicate directly with satellites overhead and will interface with public switched telephone networks (PSTNs) through terrestrial gateways. These gateways will store customer billing information, keep track of user locations, and interconnect with terrestrial carriers. Service will be available on a country-by-country switched basis as negotiated with individual governments, telecommunications authorities and service providers.

Like terrestrial cellular systems, the orbiting Iridium system antennas will be interconnected as one switched network. Their proximity to earth will permit real-time global communications to hand-held telephones, comparable in size to existing cellular phones.

The Telephone:

The Iridium system has been designed to complement, not compete with terrestrial cellular and wired systems. The telephone will be capable of utilizing both terrestrial cellular systems and the Iridium system. When placing a call, a subscriber will have the ability to choose to utilize the local terrestrial cellular system. If no terrestrial cellular system is available, the call can be dispatched over the Iridium network. This Dual-Mode function will provide flexibility to the travelling subscriber by allowing the user to choose among network alternatives according to cost and availability. The phone will be designed with a data port for transmitting facsimile and computer files.

The Iridium system is expected to be an international undertaking and presents several attractive business opportunities. Cellular telephone operators and International Maritime Satellite Organization (Inmarsat) members should be able to enhance their service offerings by providing the efficiencies of LEO satellites on a per-minute basis to existing and future customers. These operators may join Iridium as equity shareholders or they may offer Iridium system services as an addition to their existing services. Equipment manufacturers and vendors may participate through hardware and software development and satellite launches.

The first year of Iridium system service is anticipated in 1998.

IRIDIUM, Inc. • 1350 I Street, NW • Washington, DC 20005 • Tel: (202) 371-6880 • Fax: (202) 842-0006

IRIDIUM

FOR IMMEDIATE RELEASE

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Iridium, Inc. Announces System Enhancements

(Washington, D.C. -- August 12, 1992) Iridium, Inc. announced enhancements to the planned Iridium system which are designed to improve significantly the performance of subscriber units operating in real world environments. As a result of these enhancements, individual satellites will cast forty-eight beams onto the surface of the earth, an increase of eleven beams per satellite over the original design. These enhancements are designed to enable the system to concentrate capacity where demand is most required, as well as reallocate channels in response to specific consumer demand for voice or paging services. In addition, the enhanced satellite beam pattern should reduce the potential for interference. The system enhancements have been designed by Motorola Satellite Communications to improve service to the pocket phone.

Last week, Iridium, Inc. signed a contract with Motorola, Inc. for construction and delivery in orbit of the Iridium system for the commencement of commercial service in early 1998. The contract amount for the total system including the constellation and assorted control facilities is U.S. $3.37 billion.

-more-

Robert W. Kinzie, chairman, Iridium, Inc., said, "We are extremely pleased with the results of our recent and continuing review of the technical characteristics of the Iridium system and the contract with Motorola Satellite Communications." He continued, "Our ultimate goal is to provide the customer with the highest quality, global, wireless, hand-held communications services available, and we believe the enhanced Iridium system will accomplish that goal."

The enhanced design should allow for dynamic reallocation of voice and paging services to accommodate respective market demand. The ability to reallocate capacity dynamically should allow the system to respond to regional market demand -- concentrating channels over densely populated regions. The enhanced Iridium system design has a greater number of total beams and will enable a reduction in size of the active constellation from seventy-seven to sixty-six low earth orbit (LEO) satellites in six planes with eleven satellites in each plane.

At the World Administrative Radio Conference (WARC '92), delegates from around the world allocated 1610 to 1626.5 MHz and 2483.5 to 2500 MHz frequency bandwidth on a global basis for land-mobile satellite services. The enhanced Iridium system proposes to utilize 10.5 MHz of spectrum between 1616 and 1626.5 MHz. The Federal Communications Commission (FCC) has awarded an experimental license to Motorola Satellite Communications for construction and launch of five Iridium satellites.

Kinzie said, "Customers will be attracted to the service which provides superior quality at reasonable rates and we believe that Iridium will be the service that will attract and retain subscribers and win in the marketplace."

The Iridium system is a proposed global personal communications system which combines Motorola's space technology with its terrestrial wireless communications expertise. The Iridium system intends to offer high quality, global, voice, paging, facsimile, data and radiodetermination satellite services (RDSS) to its subscribers.

Iridium, Inc. is an affiliate of Motorola, Inc., one of the world's leading providers of electronic equipment, systems and services for worldwide markets. Motorola products include two-way radios, pagers, cellular telephone systems, semiconductors, defense and aerospace electronics, automotive and industrial electronic equipment, computers, data communications and information processing and handling equipment.

###

IRIDIUM

FOR IMMEDIATE RELEASE

FOR MORE INFORMATION CONTACT:
John M. Windolph
202-371-6889

Iridium System Granted Experimental License by Federal Communications Commission

(Washington, D.C. -- August 6, 1992) Iridium, Inc. said the Federal Communications Commission awarded Motorola Satellite Communications, Inc. an experimental license to construct and launch five satellites to demonstrate the feasibility of the Iridium system, a planned global, digital, wireless communications network. The action taken by the Commission will permit plans to implement the Iridium project to move ahead, subject to receipt of full construction authorization. Launches of the experimental satellites are planned for 1996.

Robert Kinzie, chairman, Iridium, Inc. said, "We are delighted to have received authority from the Commission to move forward with our program and prove the innovative qualities of the Iridium system in real world environments."

The experimental license will permit the company to launch five satellites in two planes -- with two satellites in one plane and three in the other. The satellites will be placed in polar orbit approximately 420 nautical miles above the Earth.

-more-

"We very much look forward to demonstrating the capabilities of the Iridium system", said Kinzie. "With the Commission ruling, we will be permitted to exhibit the quality of service the consumer should ultimately expect to receive from Iridium", he continued.

The Iridium system is a proposed global personal communications system which combines Motorola's space technology with its terrestrial wireless communications expertise. The Iridium system intends to offer high quality, global, voice, paging, facsimile, data and radiodetermination satellite services (RDSS) to its subscribers.

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FINANCIAL TIMES SURVEY

INTERNATIONAL TELECOMMUNICATIONS

SECTION III Thursday October 15 1992

Star connections: the heart of Motorola's Iridium system is a "constellation" of 66 satellites: the system aims to offer high-quality voice, paging, fax, data and radio determination services

Motorola's Iridium system will span the globe

High-powered ideas

COMMUNICATION satellites do not respect national boundaries. Consequently, they have a vital part to play in international communications.

However, while those in use orbit the globe at a height of 22,000 miles, Motorola and a number of the other leading telecommunications companies such as Alcatel and TRW have proposed networks of satellites in low earth orbit (Leo) that would enable subscribers to use small hand-held telephones when even in the remotest parts of the globe. This technology will complement existing terrestrial cellular and wired systems and could meet the need of remote areas where it is too expensive to provide communications.

However, even in the long term it will not be a low-cost option. Because the cost will run into billions of dollars, a limited, experimental system will be launched initially. In the longer term, the potential market is huge.

Motorola, which is taking this market very seriously, hopes to find 2m customers by 2002. While most will be voice, Motorola expects that this figure will include about 700,000 paging users. In addition, there will be users who transmit data but, as this will be over a normal voice channel to or from a laptop PC it will be impossible to quantify these numbers.

In the US, Motorola Satellite Communications Inc has been awarded an experimental licence to construct and launch five satellites to demonstrate the feasibility of its Iridium system. The name Iridium was chosen for Motorola's global, digital, wireless communications network because the original concept required 77 satellites to span the globe – and 77 is the atomic number of the element Iridium.

The Iridium system intends to offer high-quality, global voice, paging, facsimile, data and radio determination satellite services to its subscribers.

The Iridium telephone will be a dual-mode portable instrument designed to work in conjunction with existing cellular systems. This function will provide flexibility for the travelling subscriber by allowing the user to choose among network alternatives according to cost and availability. The phone will be designed with a data connection for transmitting fax and computer files. Furthermore, the dual-mode approach will enable Iridium to enter partnership agreements with the existing cellular networks, avoid head-on competition, and sidestep much of the large outlay of setting up its own sales infrastructure.

By the time Iridium is in place, the GSM pan-European digital cellular network will have rolled out to encompass a good proportion of Europe and will also have been adopted in other parts of the globe.

Hence, a businessman who feels that his work may take him out of the reach of GSM, could well consider that Iridium is of significant benefit.

Iridium satellites will be small, lightweight, and interconnected to provide continuous line-of-sight coverage between all points on the globe and within an altitude of 100 miles. Each satellite will project cell patterns on to the earth's surface, and the constellation of satellites will provide global coverage.

The 77 satellites called for in the original concept have been reduced to 66 by further development of the concept. As well as reducing overall costs it should allow system capacity to be re-allocated to respond to regional market demand so as to concentrate channels over densely populated regions.

In operation, the telephone, having checked that it cannot get a channel on the local terrestrial network on which it is registered, will interface with the satellites overhead and, in turn, with the public switched telephone network via terrestrial gateways.

These gateways will store customer billing information, keep track of user locations, and interconnect with the terrestrial carriers.

Service will be available on a country-by-country switched basis as negotiated with individual governments, telecommunications authorities and service providers. One of the critical issues will be the attitudes of the various national authorities.

Countries may see Iridium as a threat in that it could cream off revenue from network to remote areas which are inherently expensive to service, frequently inadequate, and generally unprofitable because of the cost of having to install vast amounts of cabling to support just a few subscribers who probably make little use of phones anyway.

Where these countries take a fresh look, they will see that Iridium will be able to provide the infrastructure to meet the communications needs of their remote communities cost-effectively, by taking advantage of the economy of scale that results by serving users from the developed countries.

Adrian Morant

The Economist

MARCH 28TH-APRIL 3RD 1992

Phones into orbit

World-spanning satellite telephones are just around the corner. As long as governments do not get in the way

STANDING on a rocky strip of land, somewhere in the middle of the lone and level Pacific, you pull a chunky little telephone from an inside pocket, extend an aerial, and dial a number. Soon the radio signals bearing your call are dancing direct from your telephone to a necklace of satellites 500 miles or so above the earth, and thence back down to where your great-aunt Madge sits on the other side of the world dispensing sensible advice. Desert islands will never be the same again—and nor will political dissidents, remote third-world villages or peripatetic businessmen.

Larger in scale, but in essence not much different from conventional, terrestrial, mobile networks, satellite-telephone systems are nearing reality. Various consortia, technical specs at the ready, are already vying for the finance they need to start building (see page 69). The engineering and financial problems such systems have to overcome are large, but the political ones are even larger. Global mobile satellite systems—call them global phones—offend regulators. Instead of fitting into the neat patchwork of unified, nationally defined operators that provide most telephony today, global phones have the ability to fashion their services and geographical coverage to whatever shape will make them money.

Global phones leapt their first big political hurdle in early March, when delegates to the World Administrative Radio Conference (a talking-shop for radio-wave regulators) agreed to reserve a chunk of the worldwide radio spectrum for their systems. Since the chunk is big enough to support only two or three systems, consortia are now lobbying the Federal Communications Commission for one of the two or three licences it will issue towards the end of this year or early in 1993 for the systems' use in America. That will be the easy part. Persuading other governments to approve the phones will be far harder.

For whom Bell's invention tolls

Though global phones could in theory evade control, in practice they need government support if they are to build a large base of subscribers, collect their bills and fulfil their potential. They need licences to sell services in each country, and rules to set the terms on which they can compete with local monopoly operators. They deserve such support, despite the widespread reluctance of governments to provide it.

The main reason that governments worry about letting private companies into their telephone markets is that the newcomers would take business away from the state-owned operators. In the developing world, these are a useful source of hard currency, since telephone companies earn fat fees from foreign operators for doing the work of receiving incoming calls. And engineers with exclusive powers to dispense new lines can fill their own pockets, too: when Telefonica Argentina was privatised last year, thousands of unregistered black-market lines were discovered. To allay those fears, global phone companies are promising to give licensing countries a slice of revenue on calls leaving their territories, and exclusive rights to market the handsets and collect bills themselves.

Rather than reluctantly accepting bribes to let global phones into their markets, governments should be welcoming them. Telephones are as much a form of infrastructure as roads or electricity, and competition will make them cheaper. Losses from lower prices will be countered by higher usage, and tax revenues will benefit from the faster economic growth that telephones bring about. Most important of all, by cutting out the need to install costly cables and microwave transmitters, the new telephones could be a boon to the remote and poor regions of the earth. Even today, half the world's population lives more than two hours away from a telephone, and that is one reason why they find it hard to break out of their poverty. A farmer's call for advice could save a whole crop; access to a handset could help a small rural business sell its wares. And in rich places with reasonable telephone systems already in place, the effect of new entrants—the replacement of bad, overpriced services with cleverer, cheaper ones—is less dramatic but still considerable.

The most sceptical governments will be those that like bullying their citizens. For them, control over the flow of information is a vital way of controlling society as a whole. In the old Soviet Union, a closed "key" system linked favoured apparatchiks. Only owners of keys to unlock sets could place calls; directories were a prized rarity. Once publicly available, however, telephones give dissidents the power to organise, persuade and publicise. The student organisers of 1989's momentous demonstrations in Eastern Europe put some of their success down to university fax machines, which they used to drum up support. By 1991 the break-down of Soviet control meant that faxed plaudits from presidents and pop stars were steeling Boris Yeltsin's nerve when he was holed up in Moscow's parliament after the coup. A reason to ban global phones? Perhaps, but a futile one: they are as easy to smuggle as radios. Only a hermetically sealed North Korea (and perhaps not even that) could ban satellite telephones entirely.

Global phones are not going to deliver all these benefits at once, or easily. Indeed, if the market fails to develop, it could prove too small to support the costs of launching satellites. Still, that is a risk worth taking. And these new global telephones reflect a wider trend. Lots of other new communication services—on-line film libraries, personal computers that can send video-clips and sound-bites as easily as they can be used for writing letters, terrestrial mobile-telephone systems cheap enough to replace hard-wired family sets—are already technically possible. What they all need is deregulation. Then any of them could bring about changes just as unexpected and just as magical as anything that Alexander Graham Bell's telephone has already achieved.

ORBCOMM℠

Orbital Communications Corporation

An OSC Company

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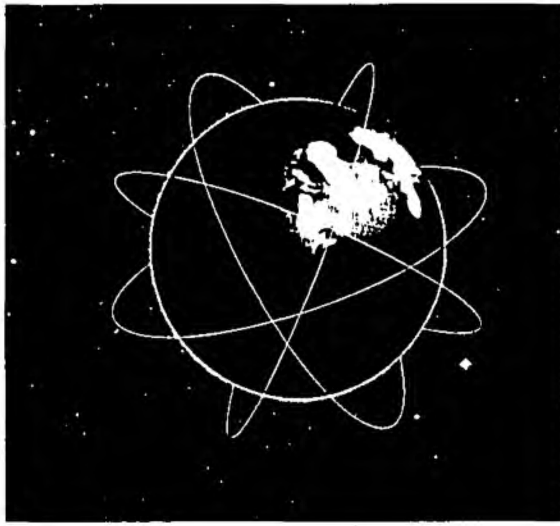
Phone: 1-800-ORBCOMM • FAX: 703-406-3504

ACH.

ORBCOMM℠



Vital Communications Absolutely Anyplace On Earth℠

OVERVIEW

The ORBCOMM data communications and position determination system will bring low-cost mobile data communications to users throughout the world. The system uses a constellation of small satellites in low-Earth orbits to give global geographic coverage without the need for thousands of tower-mounted transmitters. Through ORBCOMM, remote users can communicate with the worldwide telecommunications network from any location on Earth.

ORBCOMM is a subsidiary of Orbital Sciences Corporation. With the creativity and commitment of over 1,100 of the top engineers, scientists and other professionals in the space industry, Orbital is recognized as the worldwide market leader in small space systems.

APPLICATIONS

ORBCOMM is a robust, full featured two-way data communications system. Applications for this technology are found in all segments of business, industry, government and personal communications. To fully understand ORBCOMM applications and capabilities, two example applications are described and illustrated below.

TRANSPORTATION

User A operates a fleet of long-haul trucks, shown as A1 and A2 below. The subscriber needs to send and receive information to the trucks enroute, and also needs to know their location at any given time.

STATUS AND CONTROL

User B is a municipal water board which needs to acquire information from remotely located sensors (B1) which collect information on snow depths, rainfall and water levels. Based on this information, commands will be sent to operate reservoir gates (B2).

In each case, the customer requires that information be transmitted to and from hard-to-access remote locations where conventional communications systems are unavailable. In the past, telephone lines, terrestrial radio systems and geostationary satellites have all been used to address the mobile and data communications needs of a broad spectrum of users. These approaches typically are very costly and provide only partial geographic coverage.

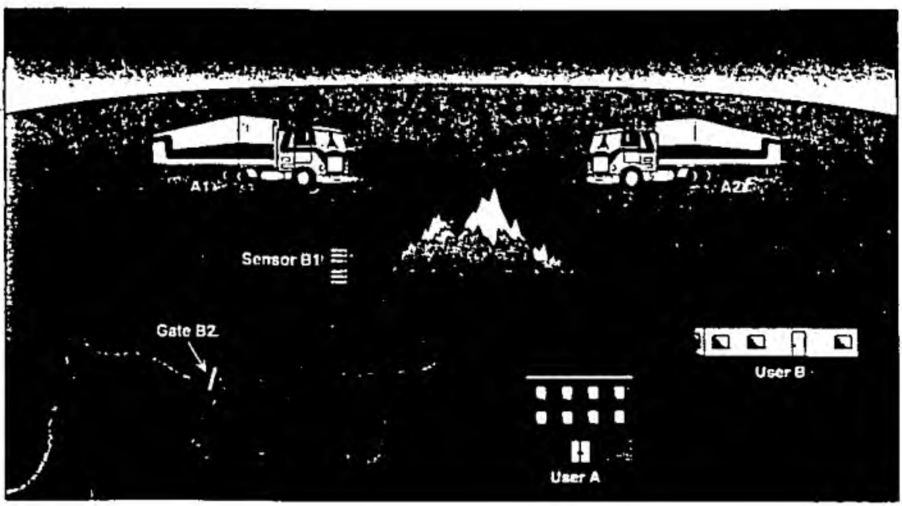


Figure 1. ORBCOMM example applications; transportation and status and control.

THE ORBCOMM SOLUTION

The advent of small satellite technology, combined with the low-cost launch systems developed by Orbital Sciences Corporation addresses the shortcomings of existing wide area mobile data communication systems. Now, users can have the flexibility and control of transmitting and receiving messages and data to and from low-cost, pocket-sized communicators at any location.

ORBCOMM will deploy a constellation of up to 34 small communications satellites in orbit 425 miles (785 km) above the earth, two of which are illustrated in **Figure 2** below. These satellites will be used as relays between ORBCOMM users and the worldwide telecommunications network. On the ground, Gateway Earth Stations (GES) link the satellites with the Network Control Center (NCC), the nerve center of the ORBCOMM system.

A message can be sent by a user to a remote subscriber communicator through any personal computer using standard communication protocols (X.400, X.25, dial-up). The user simply connects to the NCC and sends a message using the computer keyboard. The NCC routes the call to the GES using leased circuits, which in turn relays the message to the appropriate satellite and on to the remote subscriber communicator.

For example, User A may wish to send re-routing instructions to truck A1, or User B may wish to close a sluice gate at B2. The user connects to the NCC using his PC and enters the message or instruction. The data is relayed to the nearest GES by the NCC, and in turn uplinked to the satellite. The satellite then transmits the information to the subscriber. Upon receiving confirmation of message receipt, the user disconnects from the system.

Inbound messages from remote subscribers follow the same route, but in reverse. These messages may be delivered via an active circuit, or can be stored in memory at the NCC for retrieval at the customers convenience.

The ORBCOMM system also has the unique capability to determine and report the position of remote communicators to users. ORBCOMM communicators are designed to measure the Doppler shift on the signals downlinked from the satellite. Each satellite determines its own position using the Global Positioning System. By combining the Doppler measurements with satellite GPS data, a communicator is able to determine its own position, generally with an accuracy of between 100 and 1000 meters depending on terminal specifications.

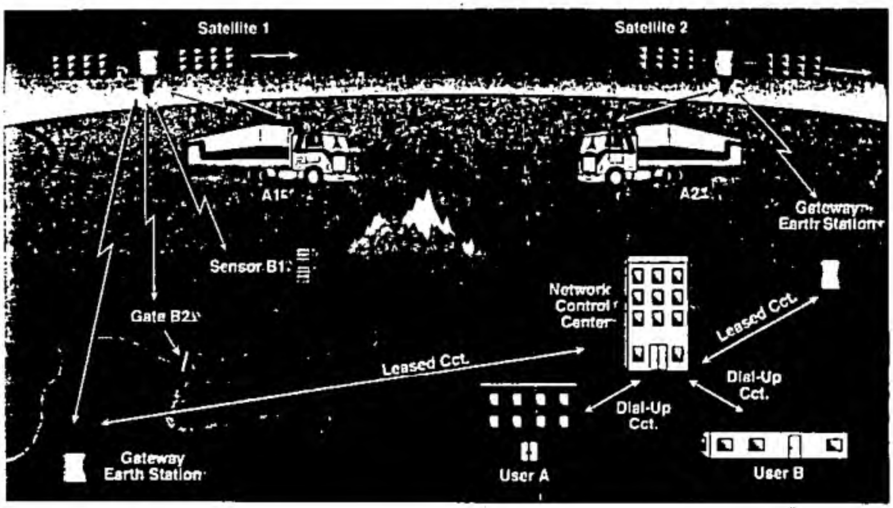


Figure 2. ORBCOMM – Extending the reach of the worldwide telecommunications network.

THE SYSTEM

SPACE SEGMENT

ORBCOMM satellites are very small yet extremely capable. The first two satellites will be launched into a near-polar orbit. These will be followed by 24 more, with 8 equidistantly placed in each of three planes inclined at 45 degrees to the equator. The satellites will be in a circular orbit at an altitude of 425 nautical miles (785 km).

Thus, the half-beamwidth will be approximately 60 degrees resulting in a footprint diameter of 2500 nautical miles (4600 km). The antenna pattern will be designed to increase gain away from the center of the beam so as to compensate for the longer distances to terminals near the edge of the footprint. As market demand grows, a further 8 satellites will be launched into a fourth inclined plane to increase capacity and coverage.

ORBCOMM's extensive satellite constellation provides users near-continuous communications avaliability throughout the world. Figure 4 on the following page shows the "footprints" on Earth of the 24 inclined orbit satellites, depicting global coverage patterns at an instant in time. The pattern of footprints for a constellation of LEO satellites is constantly changing. To better reflect average communications availability to a user in the U.S., geographical time availability contours are computed (Figure 5). The availability of an ORBCOMM link requires that one of the satellites have simultaneous sight of the ORBCOMM communicator and a Gateway Earth Station. As can be seen, most of the region has availability times well in excess of 95 percent.

GROUND SEGMENT

The Gateway Earth Stations are unattended and located where they have unobstructed views of most of the horizon. The two VHF antennas at each GES are steerable. Each one tracks one satellite as it crosses the sky. Thus, there is no outage when communications from a GES are transferred from a rising satellite to a setting one. The Gateways are fully redundant and will have uninterruptable power supplies.

COMMUNICATIONS AVAILABILITY

There is another important piece of information which the availability contour charts do not show; that is, the statistics of the outage periods. For

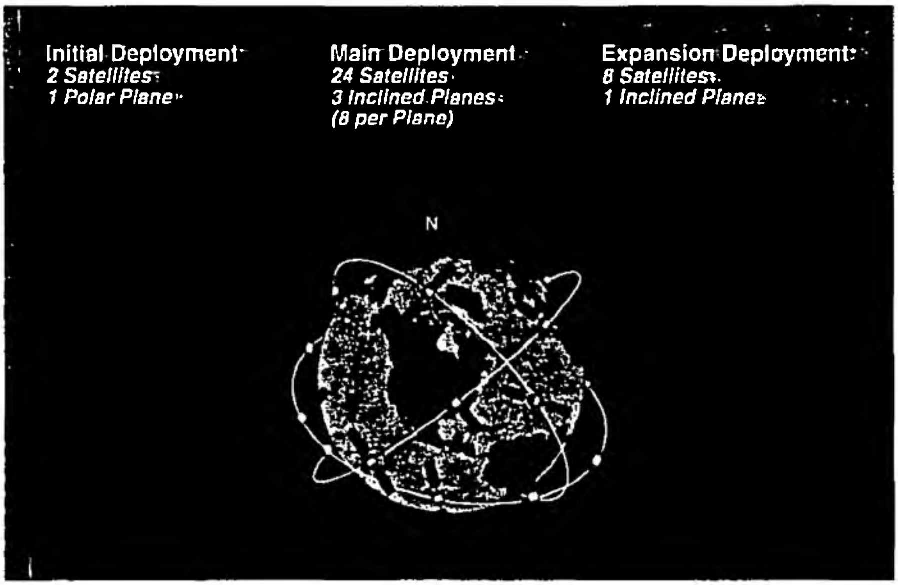


Figure 3. By 1994, ORBCOMM plans to have 26 satellites circling the Earth.

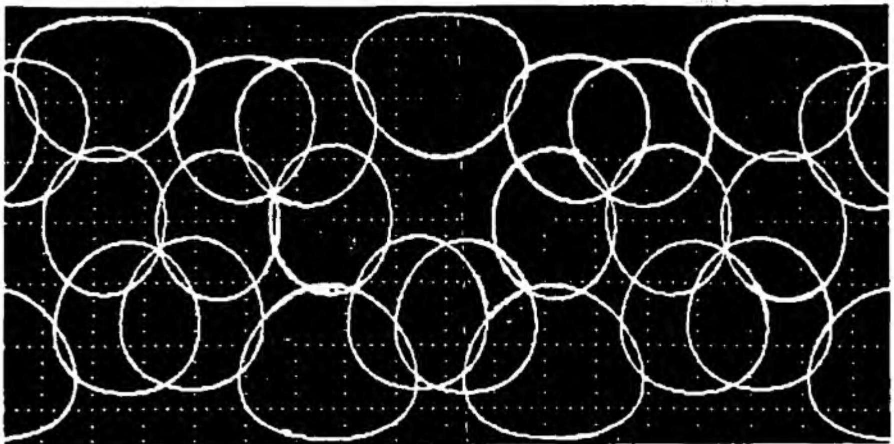


Figure 4. By launching the ORBCOMM satellites to precise locations and maintaining spacing between satellites, ORBCOMM will obtain extensive frequency reuse and achieve high levels of communications availability worldwide.

example, an availability at a certain remote terminal location of 97 percent means that, on average, there will be a communications outage for only 3 percent of the time, or for 43 minutes in each 24 hour period. This does not mean that there will be a single outage every day lasting 43 minutes. On the contrary, the outages will be frequent, short in duration and fairly uniformly distributed in time. Other calculations show that, for the example depicted in **Figure 5**, 90 percent of the outages will last for less than 2 minutes.

SUBSCRIBER EQUIPMENT

Compact, light-weight, low-cost ORBCOMM subscriber equipment will make two-way messaging affordable to millions of customers around the world and opens the door to many new applications. The ORBCOMM system will be accessible through a variety of data processing devices, including personal and palmtop computers.

Leading electronics manufacturers are developing ORBCOMM hand-held communicators. These powerful communicators are fully self-contained with battery, keypad and LCD screen combined in a single ergonomically designed package (Figure 6). The pocket-sized units weigh 10 oz. and are expected to sell for less than $400.

SERVICES

ORBCOMM will provide a broad range of emergency, data acquisition and messaging services.

SecurNet℠	*Emergency Alerts*
MapNet℠	*Position Determination*
DataNet℠	*Remote Data Collection*
VitalNet℠	*Personal Communications*

The first service is **SecurNet℠**, providing emergency alerts. By pushing a button, or by sensing an external switch closure, the remote communicator will send a short emergency message inbound to the user's hub station. The unit will continue to send the alert until it receives confirmation of its receipt. Applications for this simple service include advising central station alarm systems of an intrusion into protected property, or sending immediate reports that a pressure or temperature in remote machinery or a pipeline has exceeded tolerances.

The second service is **MapNet℠**, which transmits the position of the remote subscriber unit. MapNet℠ service has applications in tracking and monitoring the location of ocean buoys and in locating stolen vehicles or misplaced high value assets. MapNet units can be discretely

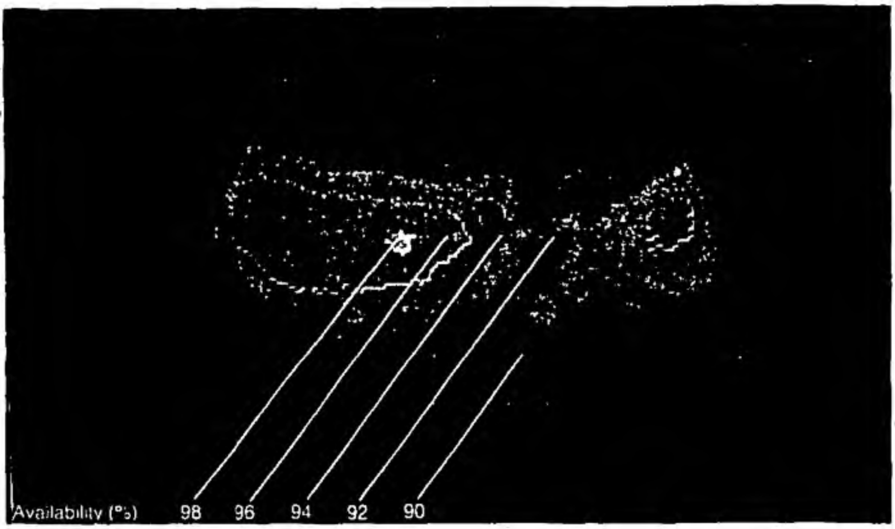


Figure 5. With only four Gateway Earth Stations located in the Continental United States, ORBCOMM will provide communications availabilty approaching 97% of the time over most of the lower 48 states.

mounted on a car and connected to the standard entertainment radio antenna. Thus, it can be remotely instructed to transmit its position without a thief being aware of its existence.

The third service is **DataNet℠**, the communication of digital data from or to a remote unattended sensor. Data can be stored in a memory and read out at the time of transmission, or they can be sampled from the sensor at that time. On the outbound route, the data could be in the form of commands to operate machinery or to reconfigure a remote controller. DataNet terminal units will have an RS 232 dataport for connection to other equipment. There are also many instances of the ORBCOMM unit hardware being integrated into the design of other remote equipment.

Finally, **VitalNet℠** service combines the full spectrum of ORBCOMM capabilities into a single, powerful service offering. VitalNet subscribers have the flexibility, convenience and safety of two-way messaging, data communications, emergency alert and position determination in one package. Thus, the long-haul trucking company of our earlier example can send and receive messages to and from drivers, know the location of the truck at any given time, monitor critical performance indicators of the truck itself, and receive instantaneous notification in event of an accident.

Figure 6. ORBCOMM's low-cost VitalNet Personal Portable Communications Center (P^2C^2) serves as a wireless E-mail terminal, pager, emergency signalling device and calculator.

USER COSTS

ORBCOMM has designed a communications system designed around user needs with the most advanced small satellite technology and launch system available. The result is the most cost-effective wireless data communications and messaging network ever conceived.

The cost of ORBCOMM communicators varies depending upon the service capabilities they are designed to provide. Prices may range from as little as $100 for units with limited capabilities, up to approximately $400 for full capability VitalNet units. No special equipment is needed at the customer's base other than a general purpose personal computer and telephone modem.

Service charges are based on a monthly service charge for access to the system, plus usage charges. These charges are tailored to applications and features and vary depending on the type of service and total volume of traffic. Superior system design and the most advanced technology assure that ORBCOMM is the most cost effective alternative available.

THE WORLD

Orbital Communications Corporation will build, launch, operate and, when necessary, replace the satellites. It will also build and operate the Network Control Center and the Gateway Earth Stations for the USA network.

Outside the United States, service will be available in any country where an approved ORBCOMM Service Licensee builds and operates an NCC and Gateway Earth Station(s) to interface with the satellite constellation. In each country, a private company or a government agency will operate the system under license. The licensee will procure, install and operate the NCC and gateways and use the satellites as they pass overhead. Typically, the cost to start the network to provide complete geographic coverage in a country is less than two million dollars.

REGULATORY ENVIRONMENT

In February 1992, the World Administrative Radio Conference of the International Telecommunications Union allocated the use of certain VHF and UHF frequencies for mobile satellite service. The frequencies can now be used, on a primary basis, for LEO mobile satellite services throughout the world. Each government can grant a license for an ORBCOMM network in its country in strict observance of the internationally agreed allocations. Service licensee agreements are being signed with communications companies around the world so that multiple national networks will be in operation within just a few years of the start of service in the U.S.

In the United States, Orbital Communications Corporation has been granted an experimental license to launch and operate the first 2 satellites to begin market development. Their launch in 1993 will mark the start of intermittent ORBCOMM service. Receipt of regulatory authority for the full system is expected late in 1993, providing for deployment of the full constellation of a total of 26 satellites in early 1995.

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CEIS TM

TELECOPIE / FAX

DATE : 11/3/1993 REF. : ThP/III/3/11/2 — N^BRE DE PAGES : 1

EMETTEUR / FROM: Thierry PORTES

ETABLISSEMENT/PLANT: CEIS TM — SERVICE: DES / IR

DESTINATAIRE/TO: Mr A.C. HEWAT

SOCIETE / COMPANY: KENNEDY & DONKIN — N° FAX: 19 44 483 425136

Dear Sir,

I acknowledge receipt of your fax dated March 4th and thank you very much for your interest.

Please find enclosed the general characteristics of our UHF 88 transmitter.

Before communicating you the prices of the equipment and use of the system I should appreciate to have a description of your application by return of fax. Many thanks for this.

We are not supplier of GPS equipments, we can communicate you the names of ROCKWELL COLLINS and TRIMBLE as GPS manufacturers.

Waiting for your reply,

I remain

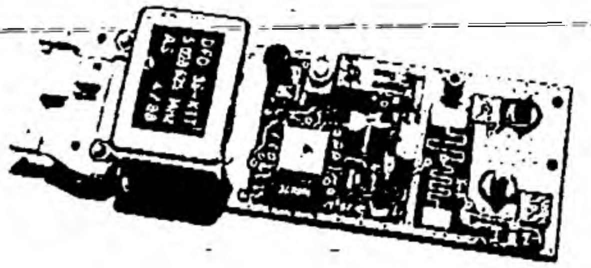
Yours Sincerely

Thierry PORTES,
Sales Engineer

65901/01
2581
ACH 16/3
MO
MAR 1993
16/3
Fax 232
7/3/93

Z.I. Thibaud - 6 rue des Frères Boude - 31084 TOULOUSE Cedex - Téléphone : (16) 61 44 39 31 - Fax : (16) 61 41 01 30

En cas de mauvaise réception, veuillez nous contacter au n° (16) 61 44 39 31



UHF 88

ARGOS PTT

Mini-Argos PTT:
- *Location-type*
- *HF output power: 2 to 5 W*
- *Unregulated 12-V power supply*
- *RS 232 or binary input*
- *Message storage*
- *Dimensions: 140 x 45 x 35 mm*
- *Weight: 70 g*

DESCRIPTION

The UHF 88 Argos Platform Transmitter Terminal (PTT) is extremely compact and lightweight, and provides exceptional performance. In particular, power consumption is extremely low relative to the radiated power.
The transmit frequency is synthesized by a phase-locked loop (PLL) using a frequency reference signal generated by an ultra-stable oscillator (USO). The carrier is modulated using a digital phase comparator, providing extremely high temperature performance.
The board is produced entirely from surface-mount, hybrid technology.

OPERATION

The UHF 88 has two types of inputs:

- Synchronous, serial input, for message transmission at the instant the transmission occurs, without storage,
- RS 232 serial link, for data acquisition, storage and transmission. When this channel is used, the data remains in memory and is transmitted until being refreshed by the unit upstream.

The size of the PTT and its low power requirements are such that it can be easily integrated into compact platforms or existing equipment.

The PTT power can be adjusted at the factory for levels up to 5 W; this permits configurations with considerable distances (20 m or more) between the PTT and antenna, with no degradation of system performance.

STANDARDS

The UHF 88 PTT meets Argos system specifications and has been certified by CNES.

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C98711

TECHNICAL CHARACTERISTICS

- Dimensions: 140 x 45 x 35 mm
- Weight: 70 g
- Power supply voltage: 12 V (10.8 to 24 V)
- Radiated power: factory-set: 33-37 dBm (2 to 5 W)
  nominal: 2 W
- Current drain:

On standby: 460 µA (typically)
3 seconds before transmission: 6 mA
During transmission: 33 dBm version: 600 mA
During transmission: 37 dBm version: 950 mA

- Interface: RS 232

Speed:	1200 bps
Format:	1 start bit, 8 data bits, 1 stop bit
Levels:	logic (0-5 V)
Protocol:	No control signals: the protocol uses the XON and XOFF codes.

Synchronous, serial input

The transmitter issue a 400-Hz clock signal and a gating signal. It acquires the data through an input ("Z") on the rising edge of the clock.

ENVIRONMENTAL CHARACTERISTICS

- Temperature: operating: -40°C to +60°C
  storage: -55°C to +70°C
- Relative humidity (RH): 0% to 80 %
- Shock: 50 g for 23 ms, six bumps on each of three axes
- Vibration: 0.6 mm_{p-p}, 10-55 Hz for 15 minutes

Characteristics subject to change without notice

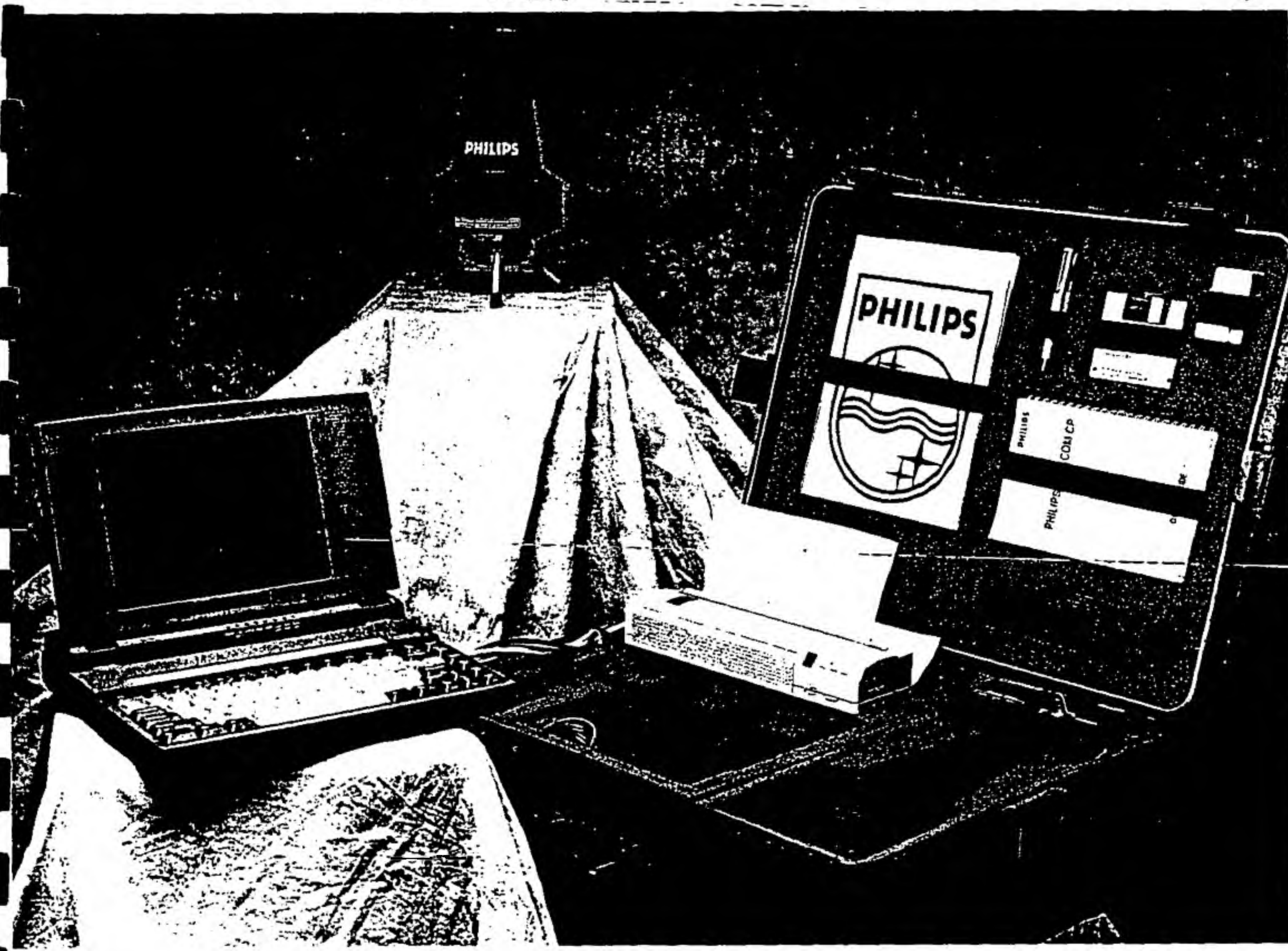
CEIS TM

Z.I. Thibaud - Rue des Frères Boudo - 31084 TOULOUSE Cedex - FRANCE - Téléphone : (16) 61 44 39 31 - Fax : (16) 61 41 01 30

Please contact us for any information you may require

PHILIPS

PHILIPS SAFECOM CP



From anywhere on earth, the portable Philips Safecom CP communication terminal puts you in touch with civilization, independent of the local means of telecommunication.

The Safecom CP is specifically designed for use with the worldwide Inmarsat-C system, operated jointly by the telecommunication authorities of more than 100 countries. Coverage is truly global, stretching from 80° North to 80° South, or from Pole to Pole.

The system offers explorative organizations, news agencies, commerce etc. a fast, reliable, two-way means of communication for text messages and other data by telex or data network (X.25), at any time 24 hours a day, 365 days a year. A telefax (ASCII text only) feature is provided by certain Land Earth Stations.

Furthermore, thanks to a powerful laptop personal computer housed in the Safecom CP terminal, the system is easy and logical to use. No assembling or wiring is needed - just take out the antenna, place it on the tripod and start the communication.

The Safecom CP will allow secure communication: interception of a message is virtually impossible due to the structure of the Inmarsat-C system, where each user is provided with a unique identification number.

It is possible to run and charge the Safecom CP system from a number of power sources. All the units in the system can be supplied from the mains or via the cigar lighter socket of most vehicles. Additionally, operation and charging is possible from a stand-alone generator.

A rechargeable maintenance-free battery allows up to 8 hours of receive stand-by mode or 1 hour transmit mode.

The Safecom CP is supplied in a waterproof and shockproof case for transportation.