Safety first

PROTECTING NGO EMPLOYEES WHO WORK IN AREAS OF CONFLICT

Second Edition

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Save the Children

Chapter 7

RADIO & SATELLITE COMMUNICATIONS

INDEX

Good communications are vital for the safety of your staff. But armed conflict can make poor communications even worse: local roads that are inadequate at the best of times can be rendered completely unusable by shell-fire or land-mines - and the same could be true of the local telephone service. So if you need to send messages to remote sites, or to mobile phones, you will need to use radio or satellite systems.

The use of any radio or satellite communications equipment is subject to national and international regulations. Your equipment must be of a type that is approved by the host country, and you may only use those frequencies that are licensed. Some countries do not allow radio traffic across borders, and others forbid radios that can be reprogrammed for different frequencies by the user.

English is the standard language for international high-frequency (HF) radio communication. Some countries do, however, allow local languages; for example, Sudan permits both Arabic and English. You must comply with license and operating conditions if you wish to avoid conflict with the local authorities.

1. CHOOSING THE RIGHT SYSTEM

The type of system you use will depend on:

- The distance you need to cover.
- The method of exchange you require: voice, fax or messaging.
- Whether the exchange is between your organisation's sites only, or whether you need to connect into international telephone, telex or datacomms networks.

The most practicable options available at present are:

Short Wave Radio

This allows voice communication over medium to long range. You can use it between your organisation's sites and mobile phones (direct connection), and it also allows you to connect into the international telephone network. Peripheral units can be fitted to enable connection with the international telex network via short-wave radio stations such as Portishead (see Appendix F).

These systems can now provide selective calling of other stations, links with Global Positioning Systems, e-mail and fax between stations. It is also possible to set up local radio-to-telephone links that in the medium to long term are cheaper to run than using the ground stations at Portishead (see Appendix F).

It is also possible to link VHF and HF radio systems, allowing access to HF systems at a lower cost. This is useful where a user normally only needs local access to radio, but on occasions may require access to the wider HF network.

However, you will need an operator who is reasonably experienced in setting up and operating short-wave radio systems. The equipment can be installed at base stations or fitted in vehicles, using a simple "whip" antenna or a more effective wire array. Short-wave radio equipment normally requires local mains, generator or battery power supply.

VHF Radio

A short-range system for "line of sight" links, suitable for voice communication between mobile or hand-portable transceivers over limited distances, and between mobiles and permanent sites (direct or via relay stations). There is generally no access to the international telecommunications networks. However, setting up and operating a VHF system requires very little prior knowledge. The transmitters use little power and can be operated from a vehicle battery; base stations may be connected to the local mains or generator supply.

Satellite communications

The INMARSAT constellation of satellites is used to provide high-quality direct-dial voice, fax, and telex communications to and from the international public telecommunications networks. All calls must go via Land Earth Stations (LES), and apart from some operator or technical assistance calls, they are chargeable. These charges are based upon the duration of the call, the system used and the destination, with minimum charge unites of between one and sixty seconds, depending upon the LES used.

Calls may also be made from mobile to mobile; but as this involves two satellite 'hops', the quality will be reduced and the charges will be higher. There are several types of Inmarsat mobile terminal, varying in size, function, power, rquirements, and ease of operation.(see section 8)

2. HOW SHORT-WAVE RADIO WORKS

The short-wave band is referred to as the High Frequency (HF) band, and covers frequencies in the range 2 - 30 MHz.

Successful HF radio communications depend on:

- The time of day.
- The frequency used.
- The distance between radio stations.

HF radio waves are reflected back to earth by the *ionosphere*, whose ability to reflect depends on its electron density. This density fluctuates around dawn and dusk, so avoid sending HF radio messages at those times of day. The ionosphere is, however, reasonably stable during daylight hours. In East Africa, use the following rule of thumb to calculate the best frequency for radio links between 6 am and 6 pm:

- For ranges up to 800 km, use 7 MHz.
- For every 160 kms range above 800, add 1 MHz to the frequency, e.g.:

Kms	Frequency in MHz
800	7
1120	9
1600	12

Frequencies below the "best" ones may also be usable.

3. RECOMMENDED RADIO EQUIPMENT

In situations where the repair facilities for radio equipment are rudimentary or non-existent, you should use the simplest system that will meet your needs. In areas of conflict - where the warring parties may be nervous about having their own communications intercepted - free-tuning multi-frequency radios, for example, can often provoke hostility.

Wherever possible, standardise the radio equipment used in a given country or programme. Transceivers and microphones should be robust and dust-proof, particularly if you are going to install them in vehicles; CODAN and MOTOROLA make some of the most durable equipment.

Most modern radios offer a digital selective call encoding facility (Selcall) that allows you to programme in the frequencies of several other stations; if you enter the identity number of any of these stations, the radio at the receiving end will ring like a telephone. In situations where there is no time to make a report - for example, when an armed band is trying to steal your vehicle - the Selcall feature can be used in conjunction with an emergency button: if you press the button, a distress call is automatically sent to all the numbers programmed. Always choose equipment fitted with Selcall.

In remote locations, difficulties with power supply can often mean that FM radios are ineffective. Recently, however, genuinely portable radios have become available, running off battery units that weigh only about 7 kg, have a solar panel for recharging and are compatible with Selcall.

4. POWER SUPPLY

Communications are a vital part of your security measures, but they cannot function without an adequate power supply. Solar panels are an obvious choice, but you must take some precautions:

- Be sure to buy the type that can be repositioned during the year to keep track of the changing elevation of the sun.
- Many people put solar panels on their roof and then forget about them; to guarantee effective charging of batteries, you should clean the panels regularly.
- Where the length of cable between the panel and the battery exceeds 8 metres, the cable itself must be at least 4 sq mm in cross-section and well insulated; significant loss of power will occur if it is thinner than that.
- Position solar panels well away from shade. Even if only 10 per cent of the cells on a panel are partially shaded, this can cause power losses of more than 25 per cent, as the shaded cells because resistors rather than contributing to power output.
- Bird droppings on a panel can also cause significant power loss.

In areas where mains power is available, you can use rechargeable batteries with a charging kit to provide reliable power to your radio. The radio power supply should be set to charge the batteries, which means that the ratio takes its power from the batteries at all times. In this way, when the lights go out you do not need to switch cables around to access the batteries. You can obtain appropriate cabling for this from your radio supplier.

5. ERECTING AN AERIAL

Dipole aerials

The horizontal half-wave dipole aerial is the most commonly-used HF aerial. It is simple, cheap, requires no earth system or additional circuits, and is easy to erect. However, it is usually only suitable for use with one frequency.

The length of a dipole aerial must be equivalent to half a wavelength of the frequency in use, although you can use the aerial at frequencies up to 2 per cent above and below this frequency, e.g. a 10 MHz dipole is usable for frequencies from 9.8 MHz to 10.2 MHz. The length of the aerial can be calculated by the following formula:

$$\text{Total length in metres} = \frac{142.6}{\text{Frequency in MHz}}$$

So a frequency of 6 MHz would require an aerial of $142.6 \div 6 = 23.77$ metres.

The dipole consists of two pieces of wire each a quarter of a wavelength long, i.e. half the aerial's total length. One piece of wire is connected to the centre conductor of a coaxial cable and the other piece to the outer conductor. The other end of each piece of wire is connected to its own insulator, which need not be anything more elaborate than a nylon supporting

rope. Pre-stressed wire is used to prevent the aerial stretching. The connections between the coaxial cable and the aerial wires must be both mechanically strong and waterproof.

A horizontal dipole transmits and receives most energy at right angles to the wire. So a dipole erected in a north-south direction would be suitable for communicating with stations to the east and west, but would be less effective for stations to the north and south.

The height of a dipole above the ground will determine the *vertical directivity*, that is, the direction in which power is both transmitted and received. The height is calculated in units of the wavelength of the frequency at which the aerial is designed to operate. For short ranges, up to 150 kms, power has to be transmitted at a steep angle up the ionosphere. So the dipole should suspended one-quarter of a wavelength above the ground. For distances of 1000 or 1500 kms, half a wavelength would be more suitable.

The ideal is to have two dipoles, one for short and one for long ranges, but this is not always practicable. Take a frequency of 7 MHz, for example: one-quarter of a wavelength is 10.7 metres and half a wavelength is 21.4 metres. Erecting an aerial 21.4 metres high would demand supporting towers, a costly exercise even if you could find the materials.

In practice, therefore, you should compromise between the ideal and the practical by suspending the aerials as high as possible, between trees and poles or between a tree and the top of a building. Remember that, for better communication over long distances, you should place the dipole as high as possible.

Inverted-V aerial

This is simply a dipole supported in the middle and with each arm sloping down to some two metres above the ground, thus forming an inverted V. This type of aerial transmits energy in most available directions, and so provides more all-round coverage. Some of the transmitted power is vertically polarised and some horizontally polarised, making the inverted-V suitable for communicating with fixed stations with horizontal dipoles as well as with vehicles using vertical aerials.

Vertical aerials

Another simple HF aerial is the quarter-wavelength vertical which, as the name suggests, is a vertical conductor one-quarter of a wavelength high, insulated from the ground at its base and connected to the inner conductor of a coaxial cable. This type of aerial must be given a good earth, which can be done by connecting three or more quarter-wavelength-long pieces of wire to the outer braid of the coaxial cable at the base of the aerial; these wires should be laid out radially and spaced an equal distance apart. A vertical aerial will transmit power equally in all horizontal directions and at low vertical angles (below 45 degrees). It is therefore a good choice for a central station with a network spread out at various angles and at long distances.

Mobile aerials

Practicality dictates that most mobile HF aerials will be vertical but not a full quarter of a wavelength long; for example, one-quarter of the wavelength at 5 MHz is 15 metres! So most vertical aerials tend to be only two or three metres long. They can either be tuned to any frequency with an Aerial Tuning Unit (ATU) or they will have been pre-tuned to a single frequency using a coil. The coil forms part of the aerial and will be fitted either at its base or half-way up; the further the coil is away from the base, the more efficient the aerial.

Another form of mobile aerial is the helical whip. Here the aerial wire is twisted around and sealed into a fibreglass rod. If this is tuned to a specific frequency, you may also use it at other frequencies by employing an ATU.

Multi-frequency aerials

As we have seen, an individual dipole is only suitable for a single frequency. But most transmitters will be operated at several frequencies, and will thus require an aerial system suitable for all of them. Several configurations meet this requirement.

Multi-dipole: This consists of several individual dipoles, the length of each one being appropriate to its particular frequency. The advantages of this type of aerial are that only one coaxial feeder cable is needed, and that the aerials can be accommodated in a smaller space than is required by several individual ones. The frequency of each dipole should differ from that of its neighbours by at least 15 per cent. A maximum of four dipoles can be connected to one piece of coaxial cable. However, the dipoles can sometimes be difficult to tune because they interact with each other.

Broad band aerials: A single broad band aerial can cover all the frequencies in the range stated by its manufacturer, e.g. 3 to 30 MHz. These aerials use special frequency-compensating networks, so you will need to buy matching circuits ready-made. The aerials can be erected horizontally or in inverted-V form, and should be at least five metres above the ground, 10 if possible. A broad band aerial will receive all transmissions - wanted and unwanted - equally well, which means that strong transmissions, such as short-wave broadcasting, can cause interference when the station you are listening to is weak.

Long-wire aerials: A long piece of wire, e.g. longer than 10 metres, can be hung up as an aerial, but must be tuned for each frequency with an Aerial Tuning Unit. You can use this set-up in temporary situations, but take care to insulate the wire from whatever you use to support it.

Single dipole for two frequencies: It is possible to design a single dipole and its coaxial feeder cable so that it operates at two frequencies, thus giving you "two aerials for the price of one". But you may need the help of a radio engineer to do this.

6. VHF RADIO

Very High Frequency (VHF) systems operate in the 30 - 300 MHz region. VHF can be a more reliable form of communication, as it does not depend on the fluctuations of the ionosphere, but its range is limited; networks using 25-watt transmitters can only cover up to about 80 kms. Ultimately, however, the range depends on local topography; if there is a "line of sight" between the two VHF aerials, then communication is possible.

The range of VHF can be extended beyond the horizon and around intervening hills by unattended automatic repeater stations located on hills or high buildings. Even though VHF transceivers may not be visible to each other, there can be a line of sight from them to the elevated repeater stations. This can make it possible for all transceivers within a 80-km radius of the repeater to communicate with each other.

The problem with automatic repeater stations, however, is that they are costly and vulnerable to theft. Moreover, it is not always possible to supply power to an automatic repeater in remote or insecure areas.

7.INTERNATIONAL LINKS

You can use HF radio to link into the international telecommunications system by calling a Coast Radio Station (CRS), such as Portishead Radio in the UK, Scheveningen Radio in the Netherlands and Bern Radio in Switzerland.

Although primarily used for maritime communications, these stations can connect calls from land-mobile HF radios. Each CRS maintains watch on specific radio frequencies, examples of which are given in Appendix F. Calls are connected by the CRS radio operator and are normally charged on a per minute basis for end-to-end connection; it is often possible to reverse charges.

8. WHICH SATELLITE TO USE

The Inmarsat constellation uses four satellites in "geostationary" orbit above the Equator to cover the whole of the earth's surface except the extreme polar regions (Fig 1). Mobile satellite terminals can operate through any of the satellites "in view" from where they are located; in East Africa, for example, a mobile could work through the Atlantic Ocean Region-East (AOR-E) or the Indian Ocean Region (IOR) satellites. In West Africa, the Atlantic Ocean Region-West (AOR-W) satellite could also be used.

Around thirty Land Earth Station (LES) operators provide access through one or more of the satellites. Larger operators offer a global service, normally with partner stations that host their services. For example, BT provides services via the Atlantic Ocean satellites through its LES at Goonhilly in England, via the Pacific Ocean satellite using its earth station in New Zealand, and via the Indian Ocean satellite using the Norwegian earth station at Eik (see Appendix G)

[Fig 1: The Inmarsat four-ocean region constellation not available]

Except for mini-M terminal, which may be restricted to using predefined earth stations, most mobiles can make calls through any LES. As charges vary widely and most operators offer volume-related discounts to regular users, your first choice should always be to place calls through the LES operator(s) with which your NGO has established billing or discounting arrangements.

There are five distinct types of Inmarsat mobile satellite terminal - designated Inmarsat-A, B, C, M and Mini-M (Inmarsat-phone)- which between them offer direct-dial access to the world's telephone, telex, fax and data networks.

Mobile terminals vary considerably in size, weight, power, consumption and function The smallest can fit easily into a briefcase and are suitable for truly portable operation, whereas the larger terminals offering more functions are, although portable up to a point, only suitable for semi-permanent installations.

Here is a summary of terminal types and their main features:

Inmarsat-A. Analogue satellite channels providing voice, telex, data and fax. Some terminals can be enhanced to provide High-Speed Data, which allows broadcast quality sound, video-conferencing and transfer of high-volume data files. Size: one suitcase weighing 20-30 kg. Antenna: 0.9 metre collapsible dish, which must remain stationary and pointed at the satellite when the terminal is in use. Runs on AC mains / generator. This type of terminal currently provides the best all-round facilities, but is expensive and not really mobile; it is most suitable for semi-permanent sues such as field stations.

Inmarsat-B. The digital successor to Inmarsat-A, and providing the same range of services at much-reduced call charges. It is of similar size to its predecessor, and has the same type of aerial and power supply; consequently, it too is more suitable for semi-permanent sites such as field stations.

Inmarsat-C. Simple messaging system that connects with telex, data, e-mail (some LES only), polling and data reporting. Available in hand-portable and vehicle versions; portable model is the size of a briefcase and weighs about 20 kg. Antenna: 0.1 metre omni-directional - which means the terminal can be used on the move. Runs on AC mains / generator or DC from vehicle-type battery. This terminal is highly portable and cheap to use - but it is only a messaging system.

Inmarsat-M. Digital satellite channels providing voice (communications quality only), data, e-mail and fax, but at relatively slow speeds. Size: briefcase weighing about 9 kg. Antenna: 0.3 - 0.5 metre planar (often in briefcase lid), which must remain stationary and pointed at the satellite when terminal in in use. Easily set up and dismantled, the briefcase version is suitable for temporary use almost anywhere. Runs on AC mains / generator; internal rechargeable battery; CD from vehicle-type battery. This model is being replaced by:

Inmarsat-phone (mini-M). Digital satellite channels providing voice, data, e-mail and fax, but at relatively slow speeds. Size: lap-top PC. Antenna: 0.25 metre planar. Suitable for personal communications, temporary locations or semi-permanent site. Runs on mains adaptor, internal rechargeable batteries or DC from vehicle-type battery. This model makes use of the 'spot-beam' technology on board the new Inmarsat satellites, which reduces the power requirements of

mobile terminals. The terminals can thus be made smaller and cheaper and using less battery power, but still providing a good-quality signal.

For added security of use, Inmarsat-phones are designed to work with Subscriber Identity Module (SIM) cards similar to those used in mobile phones. Inmarsat-phones are being offered by service providers as a complete package which includes equipment and airtime under a specific brand name.

9. SAFETY PRECAUTIONS

All radio and satellite equipment can pose a safety hazard, either because of its bulk or because of the danger of electrical and radiation burns. The larger satellite terminals (A and B) can weigh more than 40 kg, and so must be lifted with care. When in transit, all equipment must be properly secured to prevent it injuring people or itself sustaining damage.

You can minimise the electrical hazards by ensuring that all equipment (including the power-supply) is switched off when electrical connections are being made. Power lines, plugs and sockets must be maintained in good order and securely connected before power-up. Power lines should be kept as short as possible, and should not be placed where they can be snagged by vehicles or people.

Touching a radiating antenna - such as a short-wave wire antenna or the radiating part of a satellite antenna - when it is in use can cause burns. The more powerful the transmitter, the more severe the burn.

Less obvious is the danger from electro-magnetic radiation, the severity of which is directly related to:

- The power output of the antenna.
- The proximity of the person.
- The length of time for which they are exposed.

Satellite antennae (except for C which, like the short-wave wire/whip antenna, is omni-directional) are all directional. They therefore concentrate the power into a "beam", making the area directly in front of the dish the most hazardous; there are also back and side lobes of much lesser strength.

Inmarsat recommends that you measure the radiation levels around the antenna. Alternatively, ask the equipment supplier to state the directions and distances at which radiation levels of 100W/m², 25W/m² and 10W/m² will occur. If you cannot obtain that information for a specific terminal, use the figures below as a guide.

[Fig 3: Inmarsat-A Antenna: Radiation level on beam axis not available]

[Fig 4: Inmarsat-C Antenna:Radiation level outside dome not available]

You should post hazard warnings to prevent unsuspecting people from exposing themselves to radiation, especially if the antenna is out of sight of the operator. If you fence off the antenna, avoid using chicken-wire or similar material in the direct path of the transmission as it will reduce performance. Note also that the regulations about "safe" distances vary from country to country.

Antenna location

Site the antenna so that it has a clear signal path to the chosen satellite, and is not "shadowed" by buildings, trees, or hills. An elevated position can help to avoid this, and will also reduce the potential radiation hazards.

To avoid reducing performance, Inmarsat recommends that no obstacle extending over more than 5 degrees of arc should appear in the signal path within 10 metres of the antenna. For the omni-directional C-Sat antenna, no obstacle should extend over more than 2 degrees within 1 metre.

Appendix D

GUIDELINES ON INSTALLING & MAINTAINING RADIO EQUIPMENT

Installation

Locate the transceiver within 25 metres of the aerial and as close as possible to the battery (which will have a peak of about 20 amps flowing through the connecting cable). The solar panel should also be as close as possible to the battery it is charging, preferably within four metres.

Dipole aerials and long wire aerials should have some slack in the wire, to prevent it from stretching or snapping and to allow for the swaying of the supports. If you use trees as supports, fix the aerial to rigid parts of them, not to thin branches that will wave about in storms.

- If there is a risk of radio aerials attracting lightning, use correctly-earthed lightning conductors.
- Do not place the aerial parallel to electric power lines or other long pieces of metal wire.
- Do not suspend the aerial above a tin roof.
- Have some 20 metres of clear ground in front of the aerial, that is, in the direction the power is to be transmitted.
- If you are using thick coaxial cable with a horizontal dipole, install an extra pole to support the centre of the aerial. Do not let either of the aerial wires touch this pole, which should be attached to the central insulator.
- When routing the coaxial cable to the radio room, ensure that it does not rub against any rough surface or sharp edge, such as the edge of a tin roof. Do not put too much pressure on the cable when making a bend; let it describe a gentle curve instead.
- In Equatorial regions the solar panel should be mounted almost horizontally. Rain will clean the surface of the panel but there must be sufficient slope, at least 15 degrees from the horizontal, for it to run off. Panels installed north of the equator should slope southwards, and south of it northwards; a rough guide is to make the angle of the slope equal to the degrees of latitude of the panel's location. The panel should have an uninterrupted view of the sun, especially from 9 am to 3 pm.
- Locate the radio room in a cool, quiet place, and make it very secure, with iron bars over the windows if necessary.
- Make sure every radio room has a set of basic tools and spares, including at least one spare battery and one spare microphone.

Maintenance

- Keep the radio room clean and well-ventilated at all times.
- While the radio is in use, do not block the ventilation apertures around it. If necessary, place it on small wooden blocks to improve the ventilation.
- Keep the transceiver and microphone free of dust. If necessary, cover all the equipment with dust sheets when not in

use.

- Check the acid level of a vented battery at least once a week. If the level is down, fill with distilled water or a suitable substitute, such as rainwater collected in a plastic sheet.
- Measure the battery voltage regularly if you have a voltmeter. To preserve the life of a battery, avoid discharging it more than 30 per cent each day.
- Keep the battery lugs free from corrosion and covered with grease.
- Use proper battery connectors. Crocodile clips and other types of clip are not suitable for permanent use. They not only make a poor electrical connection, especially as their teeth erode, but also wear away the battery lugs, so preventing the future use of proper connectors.
- Check solar panels regularly to ensure that they are clean and that trees do not grow up and shade them.
- Always remove power cables and aerial cables at the end of contact.
- In the event of storms or possible lightning strikes, remove power and aerial cables.

Appendix E

THE TECHNIQUES OF RADIO TRANSMISSION

Make sure that the operating instructions for the radio equipment you are using (or photocopies of the relevant pages) are kept in the radio room at all times. Follow these instructions carefully.

- Keep a log-book or files at each station as a written record of all messages sent and received.
- If you are using radio operators, arrange to have one operator per radio with one person trained as a standby. (For base stations providing extended radio cover, two operators may be needed.)
- Do not allow unauthorised people to use the radio.
- Official written messages sent by a radio operator should include date, message reference number, name and organisation of sender, and name and organisation of the person to whom the message is addressed.
- Messages should be as clear and concise as possible. Stick to the essentials, especially if you know that others are waiting to use the frequency concerned.
- Most radio networks have one designated "calling channel" and various other channels for the transmission of messages. Do not transmit messages on the calling channel.
- The operator should begin by saying the call-sign of the station he wants to talk to, followed by his own.
- Every clearance should end with the word "over".
- Every transmission should end with the word "out" or "standby".
- Make sure that messages are clearly understood by both sides. If in doubt, the receiver should read back the message to the sender to check for errors in reception. When reception is difficult and noisy, this is

essential.

- If there are problems in understanding certain words, the operator should spell them using the standard phonetic alphabet.

Microphone technique

- Before transmitting, listen out on the frequency you intend to use to ensure that there is no interference from another station.
- Hold down the transmit switch on the microphone or handset for at least half a second before talking. This allows the radio to get up and running, and in the case of VHF allows the repeaters to activate. But do not do this until you are ready to speak.
- Do not turn your head away from the microphone whilst talking, or allow the distance between it and your mouth to vary. Do not touch the microphone with your lips or talk too close to it, as this often results in distorted speech.

Voice control

Use a normal conversational tone, speaking clearly and distinctly. When reception is difficult, articulate the words with particular care. Shouting will not help.

- Maintain an even rate of speaking, not more than 100 words per minute. If you know that the recipients are taking the message down in writing, speak more slowly.
- Maintain a constant volume when speaking.
- A slight pause before and after numbers will make them easier to understand.
- Avoid making hesitation sounds such as "er".

Remember that the mother tongue of the person receiving the message may not be English, so speak clearly and use the standard radiotelephony (RTF) words and phrases wherever possible.

International phonetic alphabet

Use the words listed below when you need to transmit individual letters of the alphabet:

A	Alpha	N	November
B	Bravo	O	Oscar
C	Charlie	P	Papa
D	Delta	Q	Quebec
E	Echo	R	Romeo
F	Foxtrot	S	Sierra
G	Golf	T	Tango
H	Hotel	U	Uniform
I	India	V	Victor
J	Juliet	W	Whiskey
K	Kilo	X	X-Ray

L	Lima	Y	Yankee
M	Mike	Z	Zulu

Transmitting numbers

The syllables to be emphasised are underlined:

Numeral	Pronounced as
0	ZERO
1	WUN
2	TOO
3	TREE
4	FOWER
5	FIFE
6	SIX
7	SEVEN
8	AIT
9	NINER
Decimal	DAYSEEMAL
Thousand	TOUSAND

Transmit all numbers except whole thousands by pronouncing each digit separately. Whole thousands should be transmitted by pronouncing each digit in the number of thousands followed by the word "thousand".

Number	Transmitted as
10	One Zero
18.3	One Eight Decimal Three
75	Seven Five
100	One Zero Zero
583	Five Eight Three
2 500	Two Five Zero Zero
5 000	Five Thousand
11 000	One One Thousand
25 000	Two Five Thousand
38 143	Three Eight One Four Three

To verify that numbers have been accurately transmitted, the person transmitting the message should ask the person receiving it to read the numbers back.

Transmission of time

Transmit time using the 24-hour clock. All transmissions should be followed by the words "Local Time/ ..... Time/Greenwich Mean Time (GMT)". In most locations you need not use GMT, but check carefully when you are talking to pilots since it is standard procedure for them to use GMT.

Time	Transmitted as
0823 hrs	Zero Eight Two Three
1300 hrs	One Three Zero Zero
2057 hrs	Two Zero Five Seven

Standard words and phrases

ACKNOWLEDGE	Let me know that you have received and understood this message.
AFFIRMATIVE	Yes.
APPROVED	Permission for proposed action granted.
BREAK BREAK	I wish to interrupt an ongoing exchange of transmissions in order to pass on an urgent message.
CANCEL	Annul the previously-transmitted clearance.
CHECK	Examine a system or procedure (no answer is normally expected).
CLEARED	Authorised to proceed under the conditions specified.
CONFIRM	Have I correctly received the following ...? or, Did you correctly receive this message?
CONTACT	Establish radio contact with ...
CORRECT	That is correct.
CORRECTION	An error has been made in this transmission (or message indicated). The correct version is ...
DISREGARD	Consider that transmission as not sent.
HOW DO YOU READ?	How readable is my transmission?
I SAY AGAIN	I repeat for clarity or emphasis.
MONITOR	Listen out on (frequency).
NEGATIVE	No, or Permission not granted, or That is not correct.
OVER	My transmission is ended and I expect a response from you.
OUT	This exchange of transmissions is ended and no response is expected.
PASS YOUR MESSAGE	Proceed with your message
READ BACK	Repeat all, or the specified part, of this message back to me exactly as received.
REPORT	Pass requested information.
REQUEST	I should like to know ... or I wish to obtain ...
ROGER	I have received all your last transmission.

	Note: Under no circumstances use this in reply to a question requiring a direct answer in the affirmative (AFFIRM) or negative (NEGATIVE).
SAY AGAIN	Repeat all, or the following part of your last transmission (ALL AFTER/ALL BEFORE/WORD AFTER/WORD BEFORE etc).
SPEAK SLOWER	Reduce your rate of speech.
STAND-BY	Wait and I will call you.
VERIFY	Check and confirm.
WILCO	I understand your message and will comply with it (abbreviation for "will comply").

Reporting the quality of reception

Use the following phrases when making or responding to queries about signal strength and readability:

RADIO CHECK	What is my signal strength? How do you read me?
YOU ARE	Your signal strength and readability is ..
LOUD & CLEAR	Your signal and readability are excellent.
WEAK	I hear you with difficulty.
NOTHING HEARD	I cannot hear you at all.
READABLE	Good quality. No difficulties reading you.
DISTORTED	I have trouble reading you because of distortion.
UNREADABLE	I can hear that you transmit, but I cannot read you.

Distress/urgency signals

Staff operating radios should familiarise themselves with the distress signals and urgency signals used by pilots of aircraft and vessels in emergency situations.

Any call or message prefixed "MAYDAY" (usually repeated three times on the initial call) means that immediate assistance is required by an aircraft or vessel in distress.

Any call or message transmitted by an aircraft or vessel and prefixed "PAN PAN" (usually repeated three times) concerns the safety of an aircraft or other vehicle, or of some person on board or within sight of the transmitting aircraft or vessel.

Transmissions from aircraft in distress have priority over all other transmissions. On hearing a distress message, all stations must maintain radio silence on that frequency unless they themselves are required to give assistance; in that case, they should listen on the frequency concerned until it is clear that assistance is being given.

Appendix F

INTERNATIONAL LINKS

How to contact Portishead Radio

From your frequency charts, choose a frequency appropriate to your location and the time of day. As a rough guide:

- If the radio path between your station and Portishead is entirely in daylight, try the bands between 20

MHz and 12 MHz.

- If the radio path is half in daylight, try bands 16 MHz to 12 MHz.
- If the path is in total darkness, try bands 12 MHz to 6 MHz.

You can obtain detailed information from Portishead Radio via radio or on telephone number (44) 0278 772209.

Voice contact

Listen on the selected channel and if it is free, call "Portisheadradio" three times followed by your own station identity.

Once you have established communication with Portishead, the operator will advise you on the optimum time and frequency for calling from your location, or give general advice about communicating via Portishead.

Portisheadradio channels effective 1 April 1994

20065
19510
18210
14890
12133
10291
8170
6634

All the frequencies quoted are carrier.

Calling Portishead on radio telex

The Portisheadradio telex system is fully automated, but there are radio officers available to give advice when necessary.

- Select the channel following the procedure already described for voice communication.
- Listen for the "channel free" indicator, a Morse signal followed by a quick burst of data.
- Using the selective call code 3220, the "channel free" indicator will change to a continuous data (telex) emission and you will receive the prompt:

  NO TRAFFIC HELD/QRU
  GA+
  or
  TRAFFIC HELD
  GA+

If traffic is held, key in MSG+ after the GA+ prompt and you will receive your message. Your traffic can be transmitted to you automatically on receipt if you enter a "watchkeeping" file.

Use the OPR+ facility to seek assistance or advice, or to make a manual connection of any of the automatic facilities. For example, if you wish to make a direct telex call to number 46125 in the UK:

GA+ (Portisheadradio computer)

DIRTLX46125+
MOM (Portisheadradio computer)
EXCHANGE ANSWERBACKS
MSG+ (Portisheadradio computer)
YOUR TEXT/KEYBOARD CONVERSATION
KKKK(send this group to terminate the telex connection)

The computer will reply with the date, time, group and duration of the call.

Reply with the new facility command code or BRK+

Store and forward message

If the communication link is poor, you may prefer to submit your message via Portishead's store and forward facility:

GA+
TLX46125+
R00001 TLX (the computer reference number of the message)
MSG+ (Portisheadradio computer)
SEND YOUR MESSAGE
KKKK

If the radio circuit fails before the system receives KKKK, the transmission is disregarded.

Portisheadradio channels effective 1 April 1994

Portishead	Field station
GKE2 4211	4173
GKE4 8417	8377
GKE5 12580	12477.5
GKQ5 12607	12504.5
GKE6 16807.5	16684
GKP6 16824	16701
GKE7 22377	22285

All these are *assigned* frequencies. Depending upon the type of modem or radio you are using, you may need to insert a "frequency offset"; your supplier should be able to advise you on this. If you have problems, call Portishead on voice.

Appendix G

MAKING A SATELLITE CALL

The procedures will vary according to which Inmarsat system you are using and which model of terminal you are operating. Always follow the terminal manufacturer's instructions.

Generic procedures for Inmarsat voice calls are:

- Select appropriate satellite and align antenna.
- Select land earth station ID code:

Earth Station	Code	Region	Service
Goonhilly (UK)	02 002 002	Atlantic East & West	Inmarsat-A Inmarsat-M Inmarsat-B
Eik (Norway)	04 004 004	Indian	Inmarsat-A Inmarsat M Inmarsat-B
Sentosa (Singapore)	10 (octal) 08 (decimal) 210 210	Pacific	Inmarsat-A Inmarsat M Inmarsat-B

Key the two-digit code for automatic service (00) followed by the country code (44 for the UK) and the required number finishing with # (if necessary).

Calling another region

To call a mobile in another ocean region, key the two-digit code for automatic service (00), followed by the satellite region code and mobile earth station identification number.

The satellite region codes are:

Code	Region
871	Atlantic (East)
872	Pacific
873	Indian
874	Atlantic (West)

Useful two-digit codes are common to every Inmarsat service and LES. Those available through BT's Goonhilly LES are:

Code	Description	Access point
00	Automatic calls	International exchange
11	International operator	BT Operator
12	International directory enquiries	BT Operator
13	UK operator	BT Operator
14	UK directory enquiries	BT Operator
33	Technical assistance	BT Goonhilly LES

34	Personal calls	BT Operator
35	Collect calls	BT Operator
36	BT Chargecard calls	BT Operator
37	Call duration advice	BT Goonhilly LES
68	General enquiries	BT Inmarsat office London

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