SYSTEM ENGINEERING

1. INTRODUCTION

System Engineering is the conduct of those engineering functions that are performed within a telecommunication system to enable it to carry out the task for which it is designed. Within the Royal Navy, System Engineering is carried out by Weapon Engineering Staff at COMMCENS and Transmit/Receive Sites throughout the Shore system whose tasks include:

(1) Understanding the various languages, codes and operating signals of Military and Civil Communications.

(2) Understand the engineering, traffic and procedural aspects of complete communication systems.

(3) Maintain a continuous appreciation of all factors necessary to allow effective real time control of communications facilities.

(4) Liaison with other DCN stations, manned by Army, RAF and civilian to provide the required DCN services.

2. The references for System Engineering are DCNP 4 and JSP 321 (Manual of System Engineering). These publications contain practices and parameters necessary to the fulfilment of the above.

3. <u>SYSTEM ENGINEERING PRINCIPLES</u>

The principle of System Engineering (SE) to be used depends on the control system in use. As outlined earlier (Chapter 4) two systems are in common use, though JSP 321 uses the terminology of Centralised System Control (though the RAF are slowly changing to Split Control).

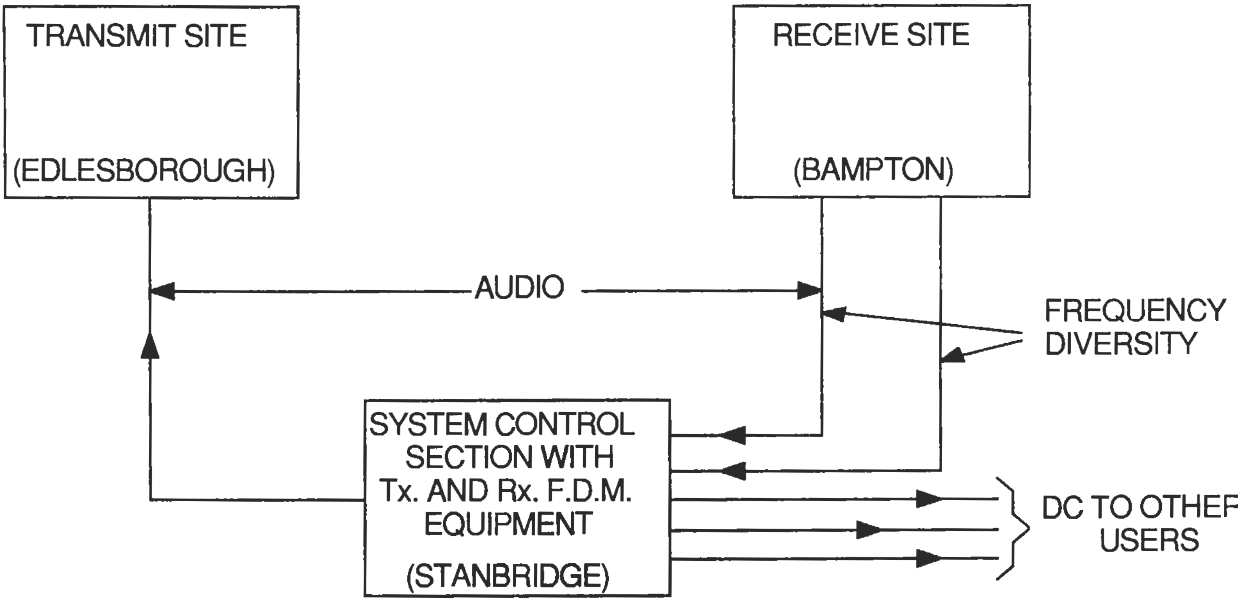

FIG 6.1 CENTRALISED SYSTEM CONTROL

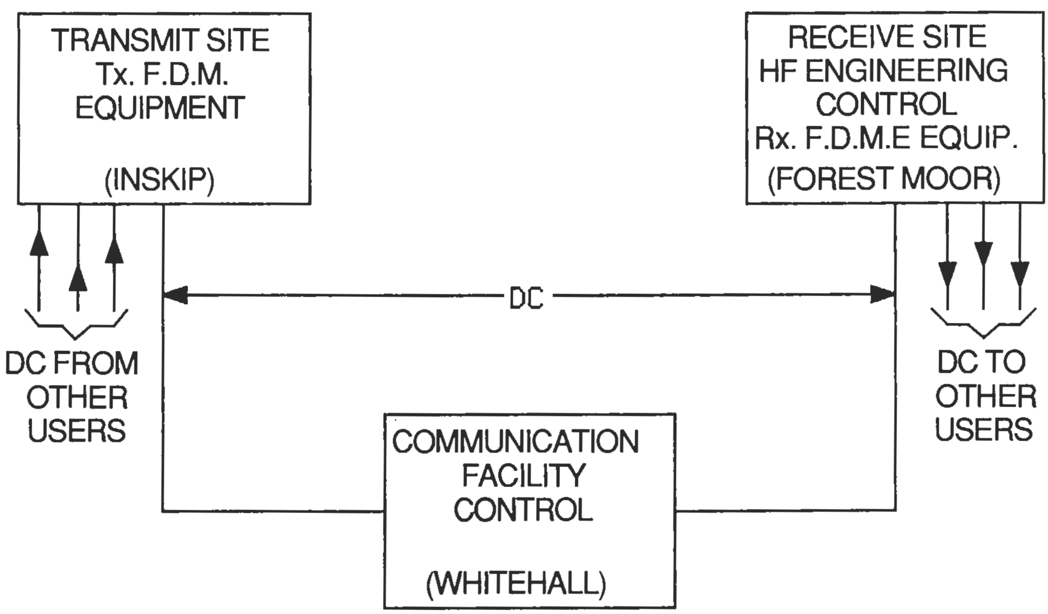

FIG 6.2 SPLIT CONTROL

4. In the Split System, control of the HF circuits is split between Circuit Facility Controls (CFC) and HF Engineering Controls (HFEC). Signals to transmit sites are usually fed via their associated Receive Site (HFEC).

(1) The CFC is responsible for the utilisation of channels, engineering control of links (whether land-line or radio relay) between telegraph users and the message centre, between the message centre and the HFEC and for all the equipment in the CFC.

(2) The control of the purely radio portion of the system is split between the HFECs at the two ends of the circuit. The HFEC is also responsible for the links between it and its group Transmit Site.

5. The stated system control philosophy is that "Every station in a communication system is responsible for the system control of the RECEIVE PATH of each element passing through or terminating at its location. For transmit paths, stations are responsible for assisting the distant receiving station to exercise control". The only exceptions to this rule are those stations operating with a CHIRPSOUNDER.

6. SATELLITE COMMUNICATIONS will be studied later in this chapter.

7. <u>ENGINEERING LANGUAGE</u>

Engineering messages are written in a special code and format in order to keep them short, to the point and to cut-out "chat". ACP 131 lists the International 'Q' and Military 'Z' Codes (also summarised in JSP 321), whilst ACP 127E contains other prosigns often used. Some of the more common codes are listed at ANNEX A, whilst ANNEX B gives examples of engineering messages. Since the introduction of the Engineering Liaison Teleprinter Network (ELTN) a shorthand colloquial language has evolved in the RN which unfortunately is passed from hand-to-hand and contains few formal codes. Other organisations interfacing with the ELTN are properly trained and use the correct codes. Consequently System Engineering Staff should be encouraged at all times to use the correct format.

8. <u>SECURITY</u>

At the present time the ELTN is not protected by crypto, though plans are in hand to do so. It is therefore easily monitored and the following rules should always be observed:

(1) Classified information is never to be passed over engineering circuits. A traffic channel must be used.

(2) OPSIGS augmented by system and crypto condition codes are to be used, the 'Z' Code being used in preference to the International 'Q' Code. Plain language, limited to what is strictly relevant, is only to be used to complete or amplify OPSIGS.

(3) Specific malpractices to be avoided are:

a. Unofficial conversation.

b. Use of unauthorised PROSIGNS.

c. Transmission of Operators Names.

d. Profane or improper language.

e. Identification of locations.

f. Official conversation of any kind not directly concerned with engineering unless authorised by higher authority.

g. Assigned frequencies of ship, mobiles or broadcast frequencies.

h. Security breaches, when monitored are to be reported.

9. ELTN Backrolls are kept for two months when complete for possible vetting, then destroyed.

10. <u>COMMUNICATIONS FOR CONTROL AND ENGINEERING</u>

Several methods of communication exist to allow System Engineering Staff to exercise control over the traffic system. These may be broadly grouped into two divisions:

(1) <u>Local Liaison</u>

All UK sites are connected by the ELTN or the PETN. These are uncovered networks and enable Systems Staff to have effective communications with Transmit or Receive Sites and other COMMCENS. All Engineering Instructions must be passed over this network to avoid ambiguity and to preserve a record. All messages must have the time of transmission using the OPSIG ZUB. Stations are also connected by a direct telephone system, however engineering orders should not be passed over this system.

(2) <u>Distance Liaison</u>

a. <u>HF Radio</u>

Ideally all multi-channel HF Radio Services carry one channel for exclusive engineering use, connecting HFECs and sometimes extended to CFC. If this channel does not exist, engineering messages must be sent on the traffic channel with the appropriate priority.

b. SATCOM

All SCOT trunks carry one engineering channel for SCS to SCS engineering, extended to ESEC.

c. Miscellaneous

Certain circuits require unusual engineering communications such as sending messages via TELEX, or relaying via other stations.

11. CALLSIGNS

International callsigns are allocated to individual nations or organisations in accordance with an agreed plan and may contain 3 to 5 letters:

(1) Fixed Land Stations, 3 letters.

(2) Ships, 4 letters.

(3) Aircraft, 5 letters.

12. All UK controlled stations are allocated callsigns within the following groups:

(1) GAA to GZZ.

(2) MAA to MZZ.

(3) 2AA to 2 ZZ.

ANNEX C lists some of the more common callsigns in Shore Telecom use.

13. ELTN AND PETN

The RAF tend to allocate one teleprinter (T/P) to each engineering connection, leaving it permanently connected. Should radio conditions deteriorate the T/P will print a lot of rubbish. RN liaison T/Ps are grouped such that each T/P handles up to 4 circuits, connected by a concentrator. A call initiates a long space on the incoming line, causing an alarm on the concentrator, allowing the circuit to be switched to an unoccupied T/P. In this system it is essential that callsigns are used and all messages are timed.

14. PASSING ENGINEERING MESSAGES OVER TRAFFIC CIRCUITS

Where it is not possible to pass messages over an engineering circuit because the circuit is faulty or the message is classified, the message may be passed over a traffic channel. It must be written on a standard message form and treated in all ways as a service message (the SIC 'SVC' should be used). The messages must have the appropriate classification and precedence.

MESSAGE SUBECT		PRECEDENCE
Frequency, mode or propagation path change. Report of faults degrading traffic.	))	IMMEDIATE
INT QSWs and ZRGs, and warnings of requirements for action 2 or 3 hours ahead. Reports of faults not degrading traffic.	)))	PRIORITY
Fault reports after rectification. Exercise information, trials etc a week ahead.	))	ROUTINE

15. QUALITY CONTROL

System Engineering peculiar to individual services will be discussed later in this chapter. There are however a number of principles which are common and are discussed here in no particular order.

16. Monitoring

DCN records demand that each radio trunk and each channel within that trunk, be monitored for performance every 15 minutes. This is done by monitoring on a TREND TDSA and is the responsibility of the Watch Quality Controller (WQC). Should a circuit begin to deteriorate it should be possible to improve, or QRT it before traffic garbles. There are four major courses of action which may be taken to improve a circuit which has deteriorated.

(1) Patch in replacement equipment.

(2) QRT until equipment is repaired if no replacement available.

(3) Change frequency.

(4) Change mode of operation.

17. Frequency Changing (QSY)

Communication quality, reliability and susceptibility to jamming on HF is dependent on the frequency in use. Methods used to determine when to change frequency are:

(1) Distortion Monitoring. Regular monitoring of fortuitous distortion is a reliable aid in determining when a QSY is necessary. This must be carried out at a point in the system before regeneration takes place.

(2) It is possible to forecast the probable time of a QSY from consultation of the frequency prediction chart. This gives a reasonable guide to which frequency to QSY to, but is unreliable for timing the QSY.

(3) Over a period of several days an HF path may be expected to fail at roughly the same time of day. Thus recent path performance gives a rough guide for QSY, or certainly when to intensify monitoring.

(4) Warning from Traffic. A last resort is a warning from traffic that is beginning to garble. By this time TARE may be full of garble and possible security violations may have occurred. This is to be avoided.

(5) Chirpsounder. Stations fitted with Chirpsounder have a very reliable method of assessing HF path performance, which overrules all other methods. (See Chapter 2)

18. When the circuit employs dual path emission, to QSY is simple, once all channels are switched to the good frequency, the other may be changed and no break in traffic is involved.

19. Single path circuits obviously take longer whilst equipment is retuned and crypto synchronised. Once contact is broken, it may take some time to re-establish for traffic, should propagation conditions be poor on the new frequency. Should contact not be established then both ends of the circuit must go to Out of Touch Procedure.

20. Out of Touch Procedure (OOT)

When contact on a circuit has been lost for 30 minutes, both ends revert to OOT. This varies slightly between DCN fixed trunks and RN MRLs and is discussed later under individual services. Once on OOT, every effort must be made to send engineering SITREPS by other means, ie broadcast. Once on OOT the service is keyed by a call tape (ZAI1) or test tape (ZAI2) in plain language (ZNI2) from the 6S6 auto transmitter at the Unclassified PJF. The receive leg being monitored there by T/P. The call tape will list frequencies in use plus any further instructions required (see below). It is very rare for a DNC fixed HF Multi-channel trunk to revert to OOT, though very common on HF MRLs.

21. OPENING CIRCUITS

When a circuit is to be commenced at a certain time (eg commencement of MRL/CRL), that time is known as E-hour. This time will be stated in the MARLACT ALPHA signal (MRL) or the CRLI (CRL) or by signal for circuits required at short notice. Obviously prior to E-hour patching arrangements will have been made to establish the cct. Then:

(1) At E-15 min a standard call tape is run (ZAI1, ZNI2) from the UCPJF and the receive leg monitored.

(2) When contact established in either direction the call tape is interrupted to give reception SITREP. (ANNEX B) (eg ZBZ of incoming leg).

(3) E-hour. If nothing heard transmit ZGN and continue with call tape. If contact established go ZNI1 and once crypto in sync, ZAI4.

22. CLOSING CIRCUITS

Once a circuit is finished with and the operations have exchanged last numbers, ie QRT, it may be closed down (ZKJ1) by engineering teleprinter. On receipt of this from Systems Control all patches may be removed and equipment reverted to stand-by.

23. RESOURCE ALLOCATION

It is imperative that Systems Control know the resources available to them. Consequently at a large Systems such as COMMCEN WHITEHALL (GYA) a large stateboard is kept up to date with current equipment state at remote stations. Generally it is transmitters which are at a premium, specially LF and VLF, so the board is only concerned with transmitters. There is usually one All Purpose Spare (APS) LF transmitter which may be used on any service should the dedicated transmitter fail.

24. Before the end of the working day the day staff at CRIMOND (GZL) will provide a SITREP over the ELTN of all equipment fitted.

25. At midnight the C-O-W at INSKIP (GQF) raises a similar signal to GYA giving full details of all equipment stating use, serviceability etc. On the basis of these signals the WSC can keep his records up to date and will know just which resources he has available.

26. Service priorities have been agreed between CDCN and CINCFLEET and a priority list is held by the DEO, who in the event of a major failure will use his resources to meet the priorities.

27. LF MAINTENANCE

Because of the shortage of VLF and LF transmitters, a strict maintenance policy has been agreed to and published in RNCP 1. When a transmitter is taken for maintenance it is replaced by the APS, as listed in RNCP 1, prior warning having been given on the service. Should a transmitter on a higher priority service fail the APS may be withdrawn at no notice. LP maintenance times are strictly adhered to unless cancelled by prior agreement (SSE) such as for an exercise. Closing down transmitters for maintenance and raising the APS is always conducted over the ELTN.

28. CRIMOND OPERATION

As seen in Chapter 4, GZL may be operated from GYA or GXQ. Control is changed each Sunday night, so that each station remains conversant with the remote control board, which is not easy to operate. Every operation which takes place is also logged on the GZL engineering T/P as GZL are unable to check the connection of their equipment locally. This log will also appear at the other control station, allowing them to keep their MIMIC board up to date.

29. Any faults at GZL which require rectification before the next day require the duty Senior Rate to be contacted and for him to drive to the station to correct the fault. This may be difficult in bad weather conditions and sometimes makes it necessary to place CRIMOND services elsewhere.

30. ROUTINE CHECKS

Within the watchkeeping organisation of a Station Group and a COMMCEN in particular several routine checks are carried out at regular intervals:

(1) Line Checks. All lines connected to the UCPJF which are not in constant use are checked once a week. The lines are divided into groups and are checked during the night watch. The distant terminal connects transmit and receive lines ("putting a loop on") and the looped line is checked with a TDMG and TDSA. Lines outside tolerance are reported to BT (ie local 'Q' centre). The checks are conducted in both directions.

(2) Equipment Checks. All spare equipment is checked weekly. This includes crypto, terminal equipment, transmitters and receivers. A special weekly check is conducted on the MTRC so that it is ready in the event of a TARE outage.

(3) Power Supplies. All stations fitted with emergency power supplies are required to run them on full station load for a number of hours each month. (JSP 321 2C2-4).

31. Requests for outages for preventive maintenance are made in a signal format (JSP 321) and will be discussed later. Long periods of down time are negotiated well in advance and replacement services promulgated in plenty of time, eg OAKHANGER (GFK) down time or INSKIP (GQF) LF aerial maintenance.

32. FREQUENCY AIRING

To ensure the suitability and protection of frequency assignments and to comply with Radio Regulation 1959 paras 619 to 622 it should be arranged that all assigned frequencies at all stations should be radiated at least once yearly.

33. This may be done by use of spare equipment or by temporary use of alternate path equipment on fixed services fitted for DPE. Transmissions from a ship alongside near an inactive radio station may be used in lieu. Preferably all frequencies should be aired quarterly. They are usually controlled by GYA and transmitted from GQF.

34. All frequencies in regular use obviously do not need airing, but there are many other frequencies allocated to now obsolete DCN Services, Exercise and Operational Broadcasts, extra MRL frequencies, which require regular airing if they are to be protected for future use.

35. MAJOR BREAKDOWNS

Despite being fitted with emergency power supplies, it is still possible for stations to have total power failures, or for the failure of some major component in the station to affect many services. When such a breakdown occurs, contingency plans, laid down in DCNP 6 (Network Operational Orders) attempt to re-route traffic in the network around the outage. Outages are known as "........... OUT" ie SKIPOUT, WHITOUT, BODDOUTetc and are exercised regularly by CDCN. A TARE fitted COMMCEN can suffer two forms of outage:

(1) 'ALPHA' - TARE FAILURE - the COMMCEN can continue to operate using manual facilities.

(2) 'BRAVO' - TOTAL POWER FAILURE - no facilities available at all, COMMCEN unable to declare outage except by BT telephone.

36. All COMMCENS are fitted with a small MTRC which will be patched into use by Systems Staff in the event of an ALPHA outage. DCNP 6 only plans for single outages, in the event of a multiple outage CDCN central staff will take control of the System from their Operations Room at HQDCN.

37. Dual role stations are also supplied with Single Service contingency orders to re-configure the Single Service system. RN Broadcasts all have a Primary, Secondary and Tertiary injection points. The priority of restorations of DCN and Ship Services has been agreed between CINCFLEET and CDCN and is controlled by the DEO in consultation with his list, though of course RN communications are mostly affected by a 'BRAVO' outage, when for a WHITOUT BRAVO.

(1) Broadcasts move to Secondary Injection Point.

(2) UKRSS moves to alternate 5 channel system at Pitreavie.

(3) Satellite Ship/Shore moves to other sites with possible reduction in channels.

(4) GZL control goes to GXQ.

(5) NSR 7345 comms control goes to GXQ.

38. The reporting of MAJOR OUTAGES is considered below.

39. SYSTEM ENGINEERING APPLICABLE TO CERTAIN SERVICES

There are certain peculiar problems, individual to certain services which are discussed below. They must however be considered in conjunction with those above.

40. DCN HF FIXED TRUNK SERVICE

The channels within a DCN trunk service have priorities, listed in DCNP 3. The channel with the highest priority is normally that which is likely to suffer the least degradation (ISB - HU1, LU1). On multi-channel circuits (ISB or SSB) the power radiated per telegraph channel is inversely proportional to the square of the number of channels radiated ie:

$$\text{Channel Power} = \frac{\text{Peak Power}}{n^2} \qquad (n = \text{No of channels})$$

41. Consequently, in periods of propagation difficulty (ie fading) it is a considerable advantage to reduce the number of channels radiated. The published DCN policy is:

(1) The LINCOMPLEX Voice channel is discarded.

(2) Shed 4 channels of those remaining.

(3) Reduce to Engineering channel only.

(4) As a last resort change mode to CW.

42. These decisions are normally made by HFEC in consultation with DEO. It is fairly common for the LINCOMPLEX channel to be shed, but rare for any others to be lost. HFEC must liaise with the exclusive users of shed channels, specially on their restoration.

43. In the event of complete communications failure it is necessary for both ends of the circuit to go to Out of Touch Procedure. HFECs at each end of the circuit exchange Frequency Calling Schedules (FCS) each month. These are calculated from all available data and are dispatched not before the 20th of the month so they are as current as possible. As soon as contact has been lost for 30 mins, both ends commence to radiate in accordance with their FCS, unless the leg is covered by Chirpsounder and some other form of communication can be established to exchange optimum frequencies. Fig 6.3 shows a typical FCS.

GIAD for JUNE 1-30

0001Z	10.2	QLH	11.5
0400Z	11.5	QLH	12.3
0800Z	12.3	QLH	13.6
1200Z	13.6	QLH	14.2
2000Z	14.2	QLH	12.3
2200Z	12.3	QLH	11.5
0001Z	10.2	QLH	11.5

FIG 6.3 EXAMPLE OF FCS

44. Once sending blind, engineering channel only, the call tape must contain a SITREP and should a blind QSY be sent, local receivers must monitor all three frequencies.

45. Should a fixed trunk fail for any equipment reason which cannot be swiftly remedied, then an alternative system of communication should be set. Major routes have published alternatives, whilst when considering new circuits, an alternative route is always planned (viz UK - FI with alternate route via ASC).

46. <u>CONTINGENCY REAR LINK (CRL)</u> (DCNP 7)

DCNP 7 (Contingency Rear Link Instruction) contains all the instructions necessary for the rapid activation of a CRL Service and are held by all DCN CRL anchor stations. When an operation for which the CRLI is not included in DCNP 7 is mounted a CRLI is issued either by letter (JSP 321 3C2 ANNEX A) or by signal (JSP 321 3C2 ANNEX B) giving all relevant information.

47. As the mobile is only operating SPE a slightly modified opening procedure is used. Two calling frequencies are prepared by HFEC in a similar manner to the Fixed Trunk FCS. At E-hour each end of the CRL will radiate a calling frequency. During EVEN hours the primary FCS frequency will be used and during ODD hours the secondary. Detailed instructions are in JSP 321 3C2-1. The requirement for CRLs as with DCN Strategic Services is to provide QRK 5/ZBZ 5, however the requirement for the deployed force to communicate has overriding priority, hence as soon as QRK 3 (morse) or ZBZ 4 (telegraph) has been achieved the service may be used for traffic.

48. Out of Touch Procedure is similar to other services, ie 30 mins after losing contact. Consideration of the equipment involved will show that propagation problems are usually on the MOBILE to anchor leg, due to low power equipment and often extremely difficult operating conditions. CRLs are often multi-channel and carry an engineering channel which normally terminates at HFEC (GXQ).

49. <u>RN BROADCAST</u>

Responsibility for engineering lies with the Broadcast Control Station (BCS). Among other things the BCS must monitor the broadcast transmission off the air and ensure timely correction of errors. In addition, ships experiencing difficulty in receiving a broadcast will report by COMMSPOT report to the BCS.

50. <u>HF BROADCASTS</u>. Radiated on a number of frequencies to give gapless cover. These frequencies may be continuous or the higher and lower frequencies will be QSY'd at dawn and dusk.

51. <u>LF BROADCASTS</u>. Normally continuous on a frequency declared by UKNAVCAMS. Should this frequency (transmitter) fail, or the transmitter be required for routine preventive maintenance, the frequency may be replaced by the All Purpose Spare (APS), this decision being taken by UKNAVCAMS.

52. <u>SATCOMM BROADCASTS</u> are monitored by RAF OAKHANGER, engineering between ship and shore being carried out on a secure engineering channel.

53. <u>DIRECTIONAL BROADCASTS</u>. Occasionally directional components of a broadcast are required for ships in particular areas or for other special purposes. These are normally provided using spare equipment and frequencies and on directional aerials. In these instances, frequency schedules are arranged and passed to the ship, being updated depending on readability reports from the ship.

Note: If the ship is CHIRPSOUNDER fitted, then normal rules apply. (Para 78 refers)

<u>RATT SHIP-SHORE</u>

54. Effective use of RATT Ship Shore depends on mutual co-operation between ship and shore station. Using the COMAL system, shore stations monitor ship transmissions, noting radiated frequencies, distortion, frequency shift and procedural errors; ships must take note of the discrepancies reported and correct the cause.

55. Ship/shore channels may be operated on Satcomms or HF. Within UK, operation is automatic with MEP controlling the system and initiating receipts and condition codes for transmission on the Channel Availability and Receipt Broadcast (CARB). Continuous monitoring is then automatic, the ship being responsible for checking the progress of the call by reference to CARB. Ships experiencing difficulty in accessing ship shore should send a COMMSPOT report iaw RNCP1.

56. Any ship with procedural or engineering errors on their ship/shore transmissions is to be warned by means of a Control Report One message iaw RNCP 1, a record of such reports being held by UKNAVCAMS.

UKMACCS

57. As this is operated by either the Primary or Secondary Coastal System Control (CSC) and since the operating CSC is manned at all times, control and to an extent engineering, is vested in the operators who have full remote control facilities for all radio equipment at both North and South sites. (Direct line facilities to the Operational Control Authorities (OCA) at MHQs allow them to operate but not control the system).

58. UKMACCS operates in 7 MF/HF bands (1, 2, 3, 4, 6, 8 and 12 MHz) with two Calling/Answering bands available at one time. Within each band there is one Calling frequency, one Answering frequency and a number of CSC and mobile Working frequencies. However Working frequencies from other bands may be ordered by the CSC. When a Calling frequency is available, "Channel Free" tones (two different audio tones repeated at 5 second intervals) are radiated on the associated Answering frequency.

59. UKMACCS employs a system of frequency management which, by constantly reviewing the current ionospheric conditions, predicts the optimum Calling/Working frequencies to be used at any time.

60. The CSC usually guards two Calling and Answering channels from the seven listed in the Frequency Plan, the actual ones being indicated by "Channel Free" tones.

61. To determine which Calling/Answering channels are available, ships tune through the 7 CSC Answering frequencies until "Channel Free" tones are heard.

COMMUNICATION SPOT REPORT (COMMSPOT REPORT)

62. To assist Area/Sub Area Commanders and Shore Communication Agencies, ships and submarines must keep Shore Stations aware of communication conditions in their area. COMMSPOT reports, in the format described in RNCP 1, are to be submitted by surface and sub-surface units at any time when Ship/Shore or Broadcast communication difficulties are encountered or whenever significant equipment defects occur.

63. CHANNEL PATCHING

Channel patching is the means of effecting relays and is the tandem connection of channels in two or more services. Each point of connection is termed a relay station. The need to resort to a relay may arise from:

(1) A requirement for interconnection between two points not connected by a direct service.

(2) A requirement to interconnect a number of points for conference purposes.

(3) Inadequacy of an existing service either because of deterioration of that service or because of unusual traffic demand.

64. Channel patches may be either established patches which are bi-directional and have been subjected to trial and proved, or ad hoc patches effected to meet a new requirement or contingency.

65. <u>Opening up a Patch</u>

To open a patch involving 2 DCN fixed services, eg for teleconference purposes:

(1) Station requiring the conference informs local HFEC of requirement.

(2) Local HFEC informs relay station of requirement and requests that the teleconference channel be opened for testing.

(3) Relay station opens channel both ways and transmits ZAI2, ZNI2, monitors incoming channel and informs distant station of requirement, requesting that teleconference channel of the second DCN Service be opened.

(4) Checks are carried out on both DCN Services.

(5) When both DCN Services are ZBZ5 both ways, ZAF users, to meet at crypto for synchronisation before correcting to bays.

66. When patch is no longer required, both ends notify relay station ZKJ1. Both channels are then closed and the patch removed. ANNEX B shows an example of signals used to open a patch.

67. <u>MARITIME REAR LINKS (RNCP 1)(HF)</u>

There are several anchor stations for MRLs worldwide, but that in UK is the GYA, GXQ and GQF group. Ships requiring an MRL apply by signal (MARLACT REQUEST) to CINCFLEET, info UKNAVCAMS, CDCN. This signal gives:

(1) MRL required.

(2) Mobile terminal/authority.

(3) Shore terminal/authority.

(4) Nature of requirement.

(5) Start time and estimated position of mobile.

(6) Estimated duration.

68. On approval by the operating authority, the anchor station will raise two engineering signals to set up the MRL to the mobile, info the Radio Stations involved. These signals are known as the MARLACT ALFA and MARLACT BRAVO, and involve calculations of optimum frequencies through the time of the MRL from the sources of information listed in Chapter 2.

(1) MARLACT ALFA

a. Start time.

b. Mode of emission, frequency shift, arrangement, baud speed.

c. Shore Transmit Frequencies.

d. Ship Transmit Frequencies.

e. Suggested shore start frequency.

f. Ship start frequency.

g. Crypto keying material.

h. Alternative engineering circuit.

j. Alternative traffic circuit.

k. Special Instructions (RIs, circuit termination etc).

(2) MARLACT BRAVO

a. Ship/Shore out of touch frequencies.

b. Suggested Shore/Ship frequencies (allowing for 10% separation - CAW).

69. Should the MRL run for sometime and the mobiles position change, several MARLACT BRAVO signals may have to be raised. The mobile must reply to the MARLACT signals either agreeing or suggesting alternative frequencies as those proposed may interfere with exercise or operational COMPLANS. ANNEX D illustrates a typical MRL with signals and frequency prediction charts.

70. The circuit is initially opened as described in paragraph 21. Once the circuit is ZBZ5, ZNI2, ZAI1 at the UCPJF a move to ZNI1 working may be made:

(1) Shore Station connects the receive leg for secure working, keeping transmit in PL and passes condition message 'IP' to mobile.

(2) Mobile connects its transmit leg for secure working and initiates PMI followed by a test tape.

(3) Shore monitors receive leg for phasing and correct tape copy. If correct transmits 'AB', if incorrect requests another PMI with "BO".

(4) Mobile connects receive leg for secure working and passes "IP" to Shore.

(5) Shore sends PMI and test tape.

(6) Mobile monitors and if correct transmits 'AB', exchanges ZBZ reports and passes circuit for traffic, ie to MEP (anchor).

71. Once in traffic the MRL requires regular monitoring by System Staff to try to forecast propagation difficulties, which usually occur on the RLAD leg. Often DPE is employed on ADRL, but is difficult on RLAD because of shortage of resources in the mobile.

72. Engineering messages must be passed over the traffic circuit and so must be given suitable precedence. QSYs may take place whilst ZNI1, but may require to revert to ZNI2 and involve opening the circuit again. SITREPS should be exchanged regularly and mobile should report change of position.

73. In the event of loss of either leg for 30 minutes the out of touch frequency schedule (MARLACT BRAVO) and the procedure for opening the circuit is to be followed. Engineering messages are to be dual routes via the OOT frequency and the stand-by circuit (MARLACT ALFA Para H). ANNEX D gives examples of typical engineering messages.

CHIRPSOUNDER OPERATIONS

74. CINCFLEET has available twelve CHIRPSOUNDER receivers which are deployed as required, controlled by CINCFLEETWE (Radio) utilising the CHIRPMOVE signal.

75. MRL Operation. When engineering an MRL using CHIRPSOUNDER, the responsibility for frequency management lies with the ship having the CHIRPSOUNDER receiver.

76. The Shore Station will order frequency changes based on advised Ship Frequency Optimum Transmissions (FOT) and information derived from its own Chirpcomm to contact the ship if communications are lost.

77. Broadcast Operation. Current and future broadcast policy is directed towards providing the correct HF frequency components for broadcast recipients rather than attempting to provide saturation coverage of a wide area. Components are planned using propagation predictions and advance positional information, both of which may be found to be erroneous.

78. CHIRPSOUNDER fitted ships are responsible for monitoring their relevant broadcast paths and passing information to their BCS as and when required using CHIRPREPORT format.

79. BSCs may call for CHIRPSOUNDER reports using the CHIRPREQUEST format.

80. Ship/Shore Operations. CHIRPSOUNDER fitted ships should carry out a path analysis before attempting a ship-shore access when it is known that a CHIRPSOUNDER transmitter is operating in the vicinity of the receiver station.

81. Where more than one access frequency is indicated the frequency giving the lowest Limited Range of Intercept (LRI) should be used and in all cases, transmitter power output should be restricted to the minimum necessary to achieve satisfactory information exchange.

82. Tactical Operations. Procedures given for broadcast and ship-shore operations are equally valid for tactical HF communications at sea. Non-CHIRPSOUNDER fitted ships may call for CHIRPSOUNDER reports using the CHIRPREQUEST format.

83. COMMCEN MONITORING FACILITIES

A COMMCEN connected circuit may be monitored in several different ways as illustrated in Fig 6.4. As may be seen it is sometimes necessary to monitor an outgoing line should the DISTA have monitored their receive leg and found no defects, to prove a defect in the line between. All PL monitoring at the CSF must be controlled with care to prevent a breach of security.

84. Parallel monitors are usually applied for long periods to identify intermittent faults. Catastrophic faults can easily be found in the normal way. As shown it is possible to monitor lines with a pen recorder to give a long term record of line performance. In some cases a pen recorder is permanently connected to a line by backpatching, for very important circuits.

85. SATELLITE CIRCUIT ENGINEERING

Satellite engineering is slightly different to HF System Engineering in a number of ways, though the principles remain the same. SATCOMS are virtually free from propagation difficulties and are expected to provide a very high degree of circuit availability, limited only by equipment failure. Satellites may be jammed, usually resulting in a reduction in the number of available channels. Channel shedding is carried out by the Satellite Ground Terminal in accordance with the Priorities in DCNP 3, or as ordered by CINCFLEET.