

**CHAPTER 3**  
**MILITARY SPECTRUM STRATEGY**



### 3. FOREWORD

The Ministry of Defence UK military spectrum strategy is aimed at providing and maintaining access to the radio spectrum for vital military tasks. It recognises the commercial value of spectrum and forms the basis from which military use of the radio spectrum is effectively and efficiently managed.

The Defence Radiocommunications Branch (DRB) of the MoD is responsible for implementing this strategy and for ensuring that other branches of the MoD, the Defence Procurement Agency and military headquarters staffs are aware of the extent and range of access to radio spectrum necessary for military tasks.

The highly mobile nature of military operations and their logistic support requires extensive use of high speed, high capacity communications for voice, data, video conferencing and imagery. Many of these requirements can only be met by the use of radio or satellite links. Similarly, target acquisition and surveillance systems using radar technology and radio navigation play a vital role in many military systems. Military communications, sensor and navigation equipment enhance the capability of fighting systems and multiply the effectiveness of forces. The use of the radio spectrum is therefore a pre-requisite for successful military operations.

Until recently, the military have enjoyed unencumbered access to a large part of the radio spectrum. However, as made clear in Chapter 2 of this document, there is now increasing civil demand for access to many parts of their spectrum. Despite recent reductions in force levels, following the end of the cold war, the requirement for military access to radio spectrum has not

reduced to the extent that might have been expected. The move towards more flexible, highly mobile joint task forces, together with the rapidly expanding demands for more accurate and timely information in both the front line and within headquarters is causing an exponential growth in the need for bandwidth and thus spectrum. Another factor is that training previously carried out abroad now needs to be done at home. This growth trend for the military need for spectrum, which is expected to continue for the foreseeable future, will need careful management if military access to spectrum for both current and future UK defence needs is to be assured.

A major challenge facing the MoD and the RA is to reconcile the increasing demands for both civil and military spectrum. As a means of meeting the wide variety of spectrum needs in the UK, the RA is promoting the principle of sharing frequency bands between different users. This approach recognises that military frequency band should remain under MoD management but that greater spectrum efficiency can be achieved where suitable sharing arrangements can be agreed. There are limitations on sharing, for example it is not normally feasible in NATO harmonised bands because of the needs of visiting forces, and there are a number of technical and operational requirements which need to be met. In particular, sharing arrangements need to make clear the circumstances in which pre-emptive MoD access to shared spectrum would be required. Nevertheless, MoD has been able increasingly to make spectrum available on a shared basis for civil services; see Chapter 2.

### 3.1 Spectrum Management in NATO

The European Radio Frequency Agency was set up by the Allied Forces after the Second World War to co-ordinate military development and use of the radio spectrum. The Agency was subsequently renamed the Allied Radio Frequency Agency (ARFA) and recently became the NATO Frequency Management Sub-Committee (FMSC) or Sub-Committee 3 of the NATO C3 Board. The Sub-Committee has a staff at NATO Headquarters in Brussels. All NATO nations may send representatives to Brussels and they are joined by representatives from the major NATO Commands and from a NATO agency that manages NATO infrastructure communications projects. The number of nations attending meetings of the FMSC has been expanded by the addition of Eastern European partners in new NATO political groupings. With the admission of new NATO partners and NATO operations in support of the United Nations outside the NATO area, the attention of the FMSC is much less directed towards matters affecting the UK and DRB takes this into account.

The FMSC has delegated authority from the NATO nations to manage the frequencies in some bands on a day-to-day basis and maintains data bases of military frequencies and equipment requiring co-ordination across NATO. The FMSC includes a group of communications specialists that meet to consider areas of technical difficulty that arise. The NATO Joint Frequency Agreement (NJFA) produced originally in 1995, lists frequency bands that have been co-ordinated across NATO Europe for military use. These bands have been accepted for military use by civil administrations in NATO and in CEPT. At present the FMSC is preparing a NATO strategy for spectrum management.

Frequency co-ordination of new equipment in NATO involves a two-stage process. The first stage comprises a request for supportability of new radio or radar equipment. Each nation gives full details to the FMSC of the equipment planned for development or production with an indication of likely deployment. NATO nations comment on use in their country indicating whether geographic or technical restrictions may be necessary. The second stage occurs when the equipment is to be fielded; this stage requires specific authorisation of use by frequency assignment and these assignments are then registered in the FMSC Master Radio Frequency List (MRFL). This registration gives protection of the assignment throughout the territory of the European NATO nations.

The FMSC arranges regular civil/military meetings that are attended by representatives from the civil administrations of NATO nations. In this way a close dialogue has grown up with the civil administrations. The administrations develop an improved understanding of military requirements and are better able to ensure that their planning takes into account military needs.

### 3.2 Spectrum Management in CCEB

Each year the heads of the military communications staffs of Australia, Canada, New Zealand, the United Kingdom and the United States, comprising the Combined Communications-Electronic Board (CCEB), meet to discuss communications matters. Similarly their frequency planners meet six weeks beforehand to prepare a spectrum management report covering the most significant developments in the past year. This liaison on points of concern continues throughout the year. The main agenda item of FPMs is normally preparation for a

forthcoming World Radiocommunications Conference (WRC).

The Frequency Planners Meeting (FPM) includes representatives from nations in all three ITU regions so the FPM is able to take a global view of WRC preparation. At FPMs the UK representative comments on NATO and European plans; similarly, regional plans are reviewed by the North American and Pacific members.

### **3.3 Strategy for Current MoD Spectrum Access.**

#### **3.3.1 VLF bands (3 to 30 kHz)**

MoD uses spectrum in the VLF band for maritime sub-surface long-range broadcasts, including communications to strategic naval forces. The appropriate details have been registered nationally and with the ITU to protect these assignments. If necessary DRB will seek the advice of operational sponsors of UK VLF systems to check that proposed assignments will cause no harmful interference to naval VLF communications.

The band is also used by some civil low power devices but they operate on a non-protected basis.

#### **3.3.2 LF Bands (30 to 300 kHz)**

Military navigational beacons operate in the LF bands. UK assignments are co-ordinated with the agencies concerned and are registered in the National Frequency Register (NFR) and the International Frequency List (IFL). Military ships and aircraft use Decca and Loran C navigation systems as required. The band is also used for long range maritime broadcast communications. These arrangements will continue and it will be necessary to ensure that these assignments are protected.

#### **3.3.3 MF Bands (300 to 3000 kHz)**

Naval and air forces use non-directional MF beacons for navigational purposes. The beacon channels are co-ordinated with other users on a national basis and the co-ordination takes into account usage by other nations.

#### **3.3.4 HF Bands (3 to 30 MHz)**

Military units use the HF frequency bands between 2.5-30 MHz extensively for short-range tactical communications and for long range navy, army and aircraft communications. Some Aeronautical Mobile (Off Route) service bands are dedicated for military use but other HF bands are shared with civil users on a "first come, first served" basis. Operating arrangements exist to pool HF assignments between NATO nations and commands for exercises; these arrangements are negotiated between NATO nations.

HF communications have been significantly improved by the use of advanced signalling techniques with microprocessor channel control; these new methods have been tabled in the ITU so that regulatory provision can be developed for them. DRB will be discussing the subject in NATO.

#### **3.3.5 VHF Bands (30 to 300 MHz)**

A number of small VHF bands are managed by MoD and are heavily used for tactical training, a vehicle communications network, the MOULD fixed network, a small number of aircraft assignments for NATO aircraft, and many local mobile radio nets. Both Combat Net Radio (CNR) and the Single Channel Radio Access (SCRA) element of the tactical area communications system, Ptarmigan, have insufficient assignments for effective operational and communications training under the control of Army Districts. It is

planned to move local land mobile nets to UHF as sets are replaced to free VHF channels for allotment to Army Districts for day-to-day assignment.

### 3.3.6 UHF Bands (300 to 3000 MHz)

The MoD UHF bands accommodate a wide variety of important communications systems. The 225-400 MHz band has been harmonised for military use throughout NATO for tactical and mobile communications. The band is the most important part of the spectrum for command and control of NATO operations. MoD's frequency management strategy in this band will continue to be the satisfaction of military tactical communication requirements for ships, land forces, air defence and air traffic control, search and rescue, and mobile satellite links.

Following a NATO agreement that the sub-band 225-230 MHz could be used for civil purposes subject to national approval, the MoD agreed to the use of this sub-band for the new Digital Terrestrial Broadcasting system T-DAB. A European allotment plan was agreed at Wiesbaden, Germany 1995 which distributed the T-DAB channels across Western Europe. NATO studied the effect of these channels upon air-ground-air assignments used by NATO air forces and concluded that some of the aircraft assignments close to 230 MHz could be at risk. It is particularly important that the integrity of the aeronautical emergency channel at 243 MHz is not prejudiced. DRB will closely monitor interference reports from military units, that might result from T-DAB channels as the T-DAB system is extended across Europe.

UHF "Air-Ground-Air" assignments in the 225-400 MHz band throughout NATO Europe have been allotted to the FMSC staff at NATO Headquarters in Brussels to ensure compatibility across the NATO European nations. A reorganisation of the air assignments is undertaken periodically

to recover channels no longer used and to take advantage of the availability of narrower bandwidth equipment. DRB co-ordinates UK military requirements and single service actions in response to FMSC decisions.

A major part of the 225-400 MHz band is kept for tactical radio relay use. In the UK the radio relay equipment used by the Army is currently the Triffid series. This comprises radio relay heads that operate in a number of different frequency bands giving a variety of ranges and band width capacities to meet the tactical requirements. The Triffid links create an area trunk communications system, Ptarmigan. Training by Ptarmigan units with frequency channels allotted to the Army is an important peacetime activity. It is mainly carried out in training areas away from population centres but some Territorial Army units also train locally with Ptarmigan at weekends.

In response to urgent civil administration requirements for spectrum for a harmonised Pan-European civil emergency services frequency band, NATO finally agreed to the use of two sub-bands at 380-385 and 390-395 MHz for this purpose. The TETRA system was specified and the Home Office set up a project termed the Public Safety Radio Communications Project (PSRCP) to meet the needs of police and other safety services in the UK. MoD interest in joining the PSRCP which will be limited to military support of the emergency services such as Military Police and Search and Rescue (SAR). Military access to these sub-bands is still possible outside the PSRCP allotted frequencies.

The frequency band 400-450 MHz is managed by MoD and covers the meteorological services, land mobile services and accommodates the land and helicopter radars. Part of the band is shared with Amateur services on a secondary basis; this means that the Amateur services

cannot claim protection and must not cause interference to military usage. In practice this works well because little frequency co-ordination is required. Any interference problems are quickly resolved by direct contact with the Headquarters staff of the Radio Society of Great Britain (RSGB). DRB will continue this valuable relationship although any formal changes in spectrum co-ordination procedures must be arranged through the Radiocommunications Agency.

The frequency band 400.15-406 MHz is used for meteorological sondes and satellites, telemetry and data links. There is pressure to introduce Mobile Satellite Services (MSS) in the band 405-406 MHz and DRB will need to ensure that military usage is protected, in addition to the meteorological sondes operating at 1.6 GHz.

A long range early warning surveillance radar operates in the band 420-450 MHz. The radar is established under an inter-governmental agreement and is expected to remain for the foreseeable future.

Land mobile nets use channels in the band 406-450 MHz at most units and barracks for a variety of important purposes including security, crash and fire nets, maintenance teams, logistic support etc. Some sub-bands have been shared in urban areas with civil private mobile radio systems for a considerable time. Sharing arrangements have also been agreed with the RA in the range 410-430 MHz to allow the introduction of the Terrestrial Enhanced Trunked Radio system (TETRA) for civil users. Some interference issues associated with the roll out of the Dolphin network have yet to be resolved. DRB will seek to restrict new requests for military UHF assignments within the bands 406-410 and 430-450 MHz subject to local technical compatibility.

DRB shares the UHF frequency band 590-

598 MHz with the CAA for aeronautical radio navigation radars. These radars are at civil aviation, RAF and MoD DPA airfields and will not be replaced in this frequency band when taken out of use. Measures have been taken to reduce interference to Channel 5 TV and vice versa.

The frequency band 856-860 MHz accommodates a number of 500 kHz tactical training radio relay channels; these channels are allotted to and assigned on a daily basis by the appropriate Army District Headquarters.

The bands 870-888 MHz and 915-933 MHz are managed by MoD and DRB retains them for Army communications training with wide-band Triffid radio relay sets; in this case the sets tune at 500 kHz channels over the range 690-960 MHz. The bands also contain two civil TV Outside Broadcast (OB) links.

In the past, DRB agreed to share Army tactical training in the frequency bands 870-888 and 915-933 MHz with civil analogue cellular systems, subject to some exclusion zones and to an overall pre-emptive return of the spectrum to MoD when necessary. As analogue cellular systems are now being removed, the cleared spectrum they occupied is under discussion between MoD and RA for occupation by new civil systems including digital cellular systems, TETRA and railway communication systems. DRB will seek suitable sharing arrangements to allow the continuation of communications training in the frequency bands concerned.

The ITU designates the frequency band 960-1215 MHz globally for aeronautical radio navigation systems. In the UK this band is managed by CAA which oversees the introduction and use of civil distance measuring systems (DME) and Traffic Collision Avoidance Systems (TCAS). Military forces use part of the frequency

band for a tactical navigation system (TACAN), the assignments of which are co-ordinated through CAA and NATO. The band includes the two channels, 1030 and 1090 MHz, for the current Interrogation Friend or Foe (IFF). In addition, the important Joint Tactical Information Distribution System (JTIDS) uses hopped frequencies in the band 969 - 1206 MHz (Note: JTIDS has no frequencies within 20 MHz of the IFF frequencies).

Military forces may operate JTIDS in this band in UK airspace only on a strict non-interference basis to civil aeronautical navigation installations. The CAA-MoD JTIDS agreement contains precise restrictions on JTIDS operation to avoid the possibility of interference to civil DMEs.

DRB manages the frequency band 1215-1350 MHz to accommodate surveillance radars primarily for maritime and air defence. Civil aviation has a similar need for long range surveillance radars. MoD provides access for data links, electronic warfare training, security video links and some civil fixed links. The band also includes the assignment of 1227.6 MHz registered with the ITU for use by the satellites of the Global Positioning System (GPS). DRB will ensure continued access to this band for long range radars and to maintain protection of the GPS channel.

MoD manages the frequency band 1375-1400 MHz primarily for tactical training with the third head of Triffid radio relay equipment. In addition, like many other MoD frequency bands, DRB has made frequency assignments in the band to a variety of wide-band radio equipment. These assignments include security surveillance, video links and data links; except for a small number of civil channels, the assignments are not registered nationally. DRB will take account of the need for protection of radio astronomy in the adjacent frequency band 1400-1427 MHz.

The band 1427-1452 MHz provides the paired Triffid radio relay channels for the band 1375-1400 MHz. There are a large number of military telemetry and data link assignments in the band. DRB will ensure that access to the band for tactical training and for airborne and fixed telemetry links is retained.

The frequency band 1559-1610 MHz is allocated to the aeronautical radio navigation and radionavigation satellite services and provides an assignment at 1575.42 MHz for the primary down link of GPS. The GPS assignments require MoD protection in the UK and will be taken into account in WRC preparation.

Meteorological sondes for the Meteorological Office and Army artillery units work in the band 1670-1690 MHz; these balloon-mounted devices incorporate low power transmitters which rise into the troposphere, relaying barometric parameters. Their use is widespread in Europe and will be taken into account in national and international spectrum management. The frequency band is shared with the UK Terrestrial Flight Telecommunications System (TFTS) transmitting on 1670 MHz and meteorological satellites transmitting on 1670.5 and 1671.5 MHz.

There are meteorological satellite systems in the frequency band 1690-1710 MHz; Lasham was formerly the satellite receiving earth station in the band but its function has been relocated at West Freugh. These systems will continue in use and will be protected.

Satellite Telecommand, Telemetry and Control (TT&C) is provided for the SKYNET satellites at 1760 - 1840 MHz for the command uplinks and 2200 - 2290 MHz for the telemetry downlink. Special arrangements are in place to enable co-ordination with civil services in the uplink

band in the vicinity of the TT&C stations in the UK.

The frequency bands at 2025-2110 MHz and 2220-2290 MHz have been identified by the RA for future NATO exercises; this is to harmonise with European planning. These are civil bands in the UK but may be used on prior request for NATO training in specified training areas. Future radio relay equipment should tune over the band 1350 - 2690 MHz to take advantage of these bands that may be adopted as a NATO harmonised bands in the future.

The MoD has an allocation in the frequency band 2300-2450 MHz for radar on a secondary basis that is used for naval radar calibration and local devices. The frequency band 2310-2450 MHz is used by military fixed, telemetry and mobile services. The long-range airborne telemetry links are particularly carefully protected. The band includes sharing with the Home Office. In Europe low power devices are being agreed in the bands 2400-2450 MHz that DRB will take into account.

The frequency band 2700-2900 MHz houses the airfield surveillance and air traffic control radars of civil aviation, military and MoD PE airfields. The band also accommodates naval radars. Maritime, air traffic control and range safety radars operate in the frequency band 2900 - 3100 MHz.

### 3.3.7 SHF Bands (3 to 30 GHz)

DRB manages the frequency band 3100-3400 MHz for military radars. These include short-range air and ship defence systems and long range air defence and airborne radars.

In the band 3400-3600 MHz DRB assigns some frequencies for airborne and naval radars and for radar development; DRB has also agreed to civil mobile links for TV Outside Broadcasts and to civil Radio

Fixed Access installations.

MoD shares the band 4200-4400 MHz with civil aviation for use by aircraft precision radar altimeters and ground proximity warning systems. This band will need protection for the future.

MoD manages the frequency band 4400-5000 MHz for military fixed and mobile services. The band has been harmonised throughout NATO for military services. It is mainly used in the UK for fixed links between military. The band contains many channels for the wide band head of Triffid radio relay, used for high capacity down-the-hill links for Ptarmigan.

Aeronautical radio navigation systems occupy the frequency band 5000-5150 MHz. The band is planned for the Microwave Landing System (MLS) and ICAO has made paired assignments for all UK military airfields. Military airfields in the UK will be fitted with MLS. A carrier landing system MADGE occupies parts of the band 5004.5-5200.5 MHz and is used by aircraft carriers for Harrier deck landings.

Military tactical radars use the frequency band 5250-5850 MHz for short to medium range functions while sharing with civil outside broadcast links, Meteorological Office weather radars, range tracking, vehicle location and research and development radars.

The band 7250-7750 MHz covers the UK SKYNET fixed satellite down link; mobile satellite services use 7250-7300 MHz. The up-link is engineered at 7900-8400 MHz with 7900-7950 MHz for the mobile up-link; this system remains the primary military link to UK forces overseas. The satellite allocation is a harmonised NATO band and many NATO partners have similar satellite systems. DRB will maintain this allocation. The SKYNET up-link band is also used for some military

fixed links that have been co-ordinated in order to protect the satellite earth stations from interference. DRB participates in international satellite co-ordination meetings for UK military systems in support of the Radiocommunications Agency.

The frequency band 8500-10000 MHz is allocated to the radiolocation service although the frequency band 9300-9500 MHz is primarily for radio navigation so other radars in that band must not cause interference to navigation systems. The band is widely used for military radars including battlefield radar, surveillance radars at ranges and MoD DPA sites, precision approach radars at many airfields, on naval vessels for missile control and tracking. Assignments exist also for wide band data links; there are several assignments for civil security devices for UK-wide use. WRC-97 upgraded the status of Science Services in the band; compatibility will generally depend upon geographic separation. The need for high discrimination radars is widespread and will continue. Wide band systems are also increasing in number.

MoD manages the band 10.0-10.5 GHz for high discrimination radars, some of which are in development or on trial. An airborne radar is currently in training and exercise use but with low power and only occasional flights. In this band MoD has agreed to civil sharing to assist the introduction of civil Radio Fixed Access, subject to some exclusion zones adjacent to military ranges.

The frequency band 13.25-14 GHz is allocated to aeronautical radio navigation and radiolocation. The band is widely used for airborne Decca Doppler radars, and naval radars. Assignments have been made to MoD establishments and ranges for the development and use of low level air defence, surveillance and navigation radars. A naval target illuminating radar operates in the band. DRB are monitoring

developments.

A harmonised NATO band has been established in the frequency band 14.62-15.23 GHz for fixed and mobile communications and airborne data links. The band is also for fixed links including some civil links by special arrangement.

The frequency band 15.7-17.3 GHz is extensively used for a variety of wide band data, command links, trial radars, survey, distance measuring and civil airfield movement control radar devices. The band 15.7-17.1 GHz has been harmonised for military use in NATO.

The harmonised NATO band at 20.2-21.2 GHz is planned for down-link military mobile satellite systems. The mobile satellite allocation is paired with the up-link band of 43.5-45.5 GHz in the NATO Joint Frequency Agreement. There is great pressure for this frequency band to be used for civil satellite systems of non-NATO countries.

A NATO harmonised band exists at 26.5-27.5 GHz for fixed and mobile systems. Wide band fixed links have been installed at Larkhill for trials; the band is planned for wide band systems possibly requiring up to 1 GHz band width. Part of this band and the adjoining band above may be used to implement wide band interactive services. The technology developed for these services could have many military uses and DRB will be monitoring developments.

### **3.3.8 EHF Bands (30 to 300 GHz)**

The frequency band 30-31 GHz is a planned NATO harmonised band for mobile military satellite systems; it is also paired with the frequency band 20.2-21.2 GHz for military use.

Naval, land and airborne tracking radars operate in the frequency band 33.4-36.0 GHz. The band is harmonised in NATO for

radiolocation.

The frequency band 36-37 GHz is a NATO harmonised band planned for military fixed and mobile services.

The frequency band 39.5-40.5 GHz is a NATO harmonised band planned for satellite systems. It is paired with the frequency band 50.4-51.4 GHz.

UK SKYNET satellites use the NATO harmonised band at 43.5-45.5 GHz; it is also used by satellite systems of other NATO partners.

The frequency band 50.4-51.4 GHz is a NATO harmonised band planned for future satellite systems, paired with the frequency band 39.5-40.5 GHz.

The frequency band 59-61 GHz is a NATO harmonised band being developed for radar, fixed and mobile systems. In the UK the frequency band 59-64 GHz is allocated to fixed, mobile and radiolocation services. MoD manages the mobile and radiolocation usage. Radar systems are also under development. With the high radio propagation losses in these frequency bands it is expected that sharing between different services will not be difficult.

The following bands are identified for future systems:

- a. 71-74 GHz: Fixed, Fixed satellite, Mobile, and Mobile satellite services.
- b. 76-81 GHz: Radiolocation services. Trials are current.
- c. 81-84 GHz: Fixed, Fixed satellite, Mobile, and Mobile satellite services.
- d. 92-95 GHz: Fixed, Fixed satellite, Mobile and Radiolocation services. Trials are current.
- e. 95-100 GHz: Mobile, Mobile satellite, Radio navigation satellite, radiolocation

services.

### **3.4 Military Spectrum Management Developments**

#### **3.4.1 Satellite Systems.**

The UK will continue to rely upon satellite communications for strategic and tactical communications in the future; these must be co-ordinated internationally. However, the agreements reached during co-ordination can place limits on the operational capability of the satellite in peacetime. A further difficulty arises if multiple frequency band transponders are chosen because the limitations on orbital position in one frequency band may impact on the other frequency bands.

All submissions to the ITU for the registration of satellite systems are circulated by the ITU to all ITU members; often NATO staff will prompt a response from the NATO nations. The ITU has recently agreed that satellite notifications should be on a cost recovery basis in future. DRB and RA will continue to review ITU weekly circulars to protect the SKYNET constellation and future UK military satellite planning.

#### **3.4.2 Radio Aeronautical Navigation Systems**

The RAF rely upon the tactical radio navigation system, TACAN, for aircraft area and tactical navigation, in addition to other sources of navigational information such as Doppler radar and hyperbolic position-fixing systems such as LORAN C and Decca. The Global Positioning System (GPS) is well established but is not expected to replace TACAN for military use. TACAN uses spectrum in the range 960-1215 MHz. Assignments for TACAN are co-ordinated with ICAO and are managed by the NATO staff in Brussels for NATO use.

The band 960 – 1215 MHz is globally dedicated to aeronautical radionavigation and in the UK it is used by both civil and military aviation. Distance Measuring Equipment (DME) provides a measurement of the distance from a ground beacon to the aircraft. Enhanced systems are being introduced for secondary radar but there are no military plans to reduce reliance on TACAN/DME for area and tactical navigation. There are proposals for US and European civil GNSS systems in this band. DRB will work closely with CAA to monitor developments in the band.

#### **3.4.3 Aeronautical Radio Communications Systems**

Since 1992 air-ground-air communications are based on a 25 kHz raster. In the civil VHF band (118 – 137 MHz) ICAO has decided to bring the spacing down to 8.33 kHz in order to resolve the shortage of channels. At this stage there are no plans to extend this raster to the military UHF band. New technology based on digital or TDMA techniques could be introduced to conserve spectrum if military specifications can be met.

#### **3.4.4 Battlefield Communications**

Military planning staffs are increasingly looking to make use of modern commercial IT systems in the battlefield and these will require communications. The TETRA and GSM technologies are particularly attractive and the Army is already exploring the possibilities for area mobile communications. Military access to GSM and TETRA spectrum would be required for training in the UK and overseas. There are geographical sharing possibilities in the UK between military training areas and urban locations for the GSM extension bands 880–888 MHz and 925–933 MHz.

Although propagation characteristics favour use of the TETRA bands in the frequency

band 380-400 MHz, a similar arrangement would be possible with TETRA in the 870–876 and 915–921 MHz bands if it is adopted by civil users. NATO military access might be limited to 2 x 1 MHz for each technology with the allocation varying in different countries. This access would need to be harmonised if NATO forces adopt these technologies.

For radio relay above 1 GHz, NATO planning aims at a tuning range of 1350-2690 MHz.

Battlefield communications have extended into higher frequency bands with the need for wide band remote control and data systems to reduce manpower demands and to cater for the many microprocessor-controlled weapon systems. DRB needs to be consulted at every stage of the development.

There has also been an extensive development of computer-based frequency management systems to provide real-time control of spectrum compatibility in the field. New radio communication systems incorporate information management systems; these include frequency management. The DRB continues to monitor developments in this area.

### 3.4.5 Radar

The geographical position of the UK as an offshore island places great emphasis on long range military radar to detect intruders. Also the high density of civil air traffic alongside military air activity extends the radiolocation spectrum requirement. The use of radar for aeronautical radionavigation will continue.

Radar design is always a compromise between the operational requirement and the dictates of the laws of nature. It is generally not an option to develop one type of radar in a different radiolocation band. In any case multiple radar bands offer an

enhanced resistance to jamming attack. In general new radars follow their predecessors into the same frequency bands.

The radiolocation allocations below 1 GHz are suited to specialised radar applications. The frequency band 1215-1350 MHz is used for surveillance with the emphasis on maximum range (only limited by radar line of sight) and specialised radars. The long-range surveillance function is also shared with civil aviation. Some applications require even longer wavelengths and access to frequencies below 1 GHz, may continue to be required.

Access to the frequency band 2700–3100 MHz for radionavigation is essential to meet the civil/military needs for ship and aircraft surveillance. For the military, the advent of enhanced space navigation services will not change their reliance on radar. Access to the 2700 – 3100 MHz radionavigation bands will continue to be required on a secondary basis.

The frequency band 3100-3400 MHz is heavily used for high powered land, airborne and naval radars with a considerable geographical spread. Peacetime training includes electronic warfare exercises with countermeasures requiring wide bandwidths, and frequency and band diversity. Sharing with other services is not a practical proposition due to the high powers and specialised modulation techniques of these radars together with the susceptibility to interference of their very sensitive receivers.

### 3.4.6 Wide Band Data Links

The frequency bands available for the growing demand for airborne and terrestrial wide-band mobile communication links are 4.4 -5 GHz, 10.15-10.3 GHz, 14.62-15.23 GHz, 26.5-27.5 GHz, 36-37 GHz, 59-61 GHz and 81-84 GHz. These bands have all been agreed for military systems in NATO.

### 3.4.7 HF Frequency Management

The use of microprocessor-controlled HF frequency management systems has led to considerable improvements in the efficiency of HF communications. HF channel sensing systems have been available for some time; these allow the selection of assigned channels that demonstrate at any moment the best response to ionospheric radio propagation. The microprocessor has permitted this selection to operate automatically almost as changes in propagation occur. The next stage will be to dispense with HF fixed assignments altogether and to allow automatic selection of suitable channels at the moment of need in the frequency range and over the path desired; the channel sensing mode would avoid the selection of channels already in use.