POLICY FOR THE COORDINATION OF MILITARY ELECTROMAGNETIC SPECTRUM ALLOCATIONS AND ASSIGNMENTS BETWEEN COOPERATING NATIONS

ACP 194

JUNE 2011

FOREWORD

1 The Combined Communications-Electronics Board (CCEB) is comprised of the five member nations, Australia, Canada, New Zealand, United Kingdom and United States and is the Sponsoring Authority for all Allied Communications Publications (ACPs). ACPs are raised and issued under common agreement between the member nations.

2 ACP 194, POLICY FOR THE COORDINATION OF MILITARY ELECTROMAGNETIC SPECTRUM ALLOCATIONS AND ASSIGNMENTS BETWEEN COOPERATING NATIONS, is an UNCLASSIFIED CCEB publication.

3 This publication contains Allied military information for official purposes only.

4 It is permitted to copy or make extracts from this publication.

5 This ACP is to be maintained and amended in accordance with the provisions of ACP 198.

THE COMBINED COMMUNICATIONS-ELECTRONICS BOARD LETTER OF PROMULGATION FOR ACP 194

1. The purpose of this Combined Communications-Electronics Board (CCEB) Letter of Promulgation is to implement ACP 194 within the Armed Forces of the CCEB Nations. ACP 194, POLICY FOR THE COORDINATION OF MILITARY ELECTROMAGNETIC SPECTRUM ALLOCATIONS AND ASSIGNMENTS BETWEEN COOPERATING NATIONS, is an UNCLASSIFIED publication developed for Allied use under the direction of the CCEB Principals. It is promulgated for guidance, information, and use by the Armed Forces of the CCEB nations and NATO.

2. ACP 194 is effective upon receipt for CCEB Nations and when directed by the NATO Military Committee (NAMILCOM) for NATO nations and Strategic Commands.

EFFECTIVE STATUS

Publication	Effective for	Date	Authority
ACP 194	CCEB	On Receipt	LOP

3. All proposed amendments to the publication are to be forwarded to the national coordinating authorities of the CCEB or NAMILCOM.

For the CCEB Principal

Paul Foster

PA FOSTER
Major CAF
CCEB Permanent Secretary

RECORD OF MESSAGE CORRECTIONS

Identification of Message Correction and Date Time Group		Date Entered	Entered by (Signature, Name, rank)
DTG	Correction		

TABLE OF CONTENTS

TITLE PAGE i

FOREWORD iii

THE COMBINED COMMUNICATIONS-ELECTRONICS BOARD LETTER OF PROMULGATION FOR ACP 194 v

RECORD OF MESSAGE CORRECTIONS vii

TABLE OF CONTENTS ix

CHAPTER 1

POLICY FOR THE COORDINATION OF MILITARY ELECTROMAGNETIC SPECTRUM ALLOCATIONS AND ASSIGNMENTS BETWEEN COOPERATING NATIONS 1-1

- INTRODUCTION 1-1
- DEFINITIONS 1-1
- OBJECTIVES OF MILITARY FREQUENCY MANAGEMENT 1-2
- ACHIEVEMENT OF FREQUENCY MANAGEMENT OBJECTIVES 1-2
- STANDARD FREQUENCY ACTION FORMAT 1-3

CHAPTER 2

POLICY AND PROCEDURES FOR COORDINATION OF SPACE ELECTROMAGNETIC SPECTRUM ASSIGNMENTS 2-1

- INTRODUCTION 2-1
- POLICY 2-1
- PROCEDURE 2-1

CHAPTER 3

RESOLUTION OF HARMFUL INTERFERENCE 3-1

- INTRODUCTION 3-1
- POLICY 3-1
- PROCEDURE 3-1

FORMAT FOR CLEARANCE OF INTERFERENCE MESSAGE

- ANNEX A - STATION CAUSING INTERFERENCE 3A-1
- TRANSMITTER STATION EXPERIENCING INTERFERENCE 3A-1
- RECEIVING STATION EXPERIENCING INTERFERENCE 3A-2

CHAPTER 4

SPECTRUM REALLOCATION AND PRICING 4-3

- INTRODUCTION 4-3

INTERNATIONAL SPECTRUM MANAGEMENT DEVELOPMENTS 4-3
IMPLICATIONS OF SPECTRUM REALLOCATION AND PRICING.....4-3
THE CASE AT THE NATIONAL LEVEL CASE FOR MILITARY SPECTRUM ACCESS 4-4
RESOURCES REQUIRED FOR PREPARATION OF MILITARY ARGUMENTS 4-6
CONCLUSIONS.....4-7

CHAPTER 5

***AIDE-MÉMOIRE* 5-1**

MILITARY SPECTRUM REALLOCATION AND PRICING CONCERNS 5-1

INTRODUCTION.....5-1
AIM.....5-1
MILITARY PRINCIPLES.....5-1
ECONOMIC FACTORS.....5-3
POLITICAL FACTORS 5-3
CONCLUSION.....5-4
RECOMMENDATION 5-4

CHAPTER 6

TABLE OF HARMONISED FREQUENCY BANDS.....5-1

INTRODUCTION.....5-1

ANNEX A - CCEB TABLE OF HARMONISED FREQUENCY BANDS 6A-1

CHAPTER 1

POLICY FOR THE COORDINATION OF MILITARY ELECTROMAGNETIC SPECTRUM (EMS) ALLOCATIONS AND ASSIGNMENTS BETWEEN COOPERATING NATIONS

INTRODUCTION

101. Nations, or coalitions of nations, are responsible for reviewing and coordinating the allocation and assignment of frequencies at the military-strategic level to satisfy their joint and combined military requirements. This requires the full coordination of allocations and assignments necessary to ensure that spectrum-dependent (S-D) equipment is supportable in its intended operational electromagnetic environment; specifically to reduce the possibility of harmful interference across national boundaries and to support S-D equipment used by the forces of one nation while deployed in areas controlled by another cooperating nation.

DEFINITIONS

102. For the purpose of military frequency management, the following definitions apply:

a. Administration - Any governmental department or service responsible for discharging the obligations undertaken in the Constitution of the International Telecommunication Union (ITU) or in the Convention of the International Telecommunication Union;

b. Allocation (of a frequency band) - Entry in a Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radio communications services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned;

c. Assignment (of a radio frequency or a radio frequency channel) - Authorisation given by a designated authority for a radio station to use a frequency or frequency channel under specified conditions;dHarmful Interference – interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radio communication service operating in accordance with the ITU radio regulations;

d. Battle space Spectrum Management (BSM) – In the context of this publication, it is the application of the concepts of spectrum management in other than routine military operations.

e. Spectrum Supportability. The process to provide military forces with S-D equipment that is fully operable without EMS related limitations and interoperable with other coalition equipment. SS generally involves three general activities:

- Equipment Certification – Initial coordination with coalition partners and Host Nation (HN) regulatory authorities to receive prior to final development approval or guidance for S-D equipment intended to be deployed into areas over which they have authority.

- Electromagnetic Environment Effects (E3) Control – Engineering applied throughout development to ensure that once the S-D equipment is fielded/deployed, it can operate successfully within its electromagnetic and operational environments
- Frequency Assignment – Obtaining an actual assignment or authorization (license) with specific operating parameters (power, bandwidth, antenna ht & gain, location, etc.) that allows the S-D equipment to operate. (Generally, the "expectation" of receiving a frequency assignment is inherent in favorable host nation comments on Equipment Certification)

f. Spectrum Clearance - Spectrum Clearance is the process of obtaining an actual assignment (or 'license') with specific operating parameters

OBJECTIVES OF MILITARY FREQUENCY MANAGEMENT

103. The objectives of military Frequency Management between cooperating nations are as follows:

a. The coordination of the allocation of frequency bands to equipment where operation of such equipment is likely to affect existing or future equipment used by another nation (i.e., where there is a perceived interoperability or EMC issue);

b. The exchange of information about national frequency allocations;

c. To provide information on the technical and operational characteristics of the S-DD equipment being used or intended for use by each nation;

d. To coordinate and obtain frequency assignments for a particular purpose (e.g., transiting of aircraft, ships, etc);

e. As part of EMS planning, coordinate and obtain frequency assignments when two or more nations are conducting combined or coalition operations or exercises; and

f. To ensure that national administrations understand and represent as appropriate military spectrum requirements at international regulatory forums;

g. To harmonize military frequency bands and military radio services allocation within bands to facilitate frequency interoperability between nations and ensure that these radio services are EMC compatible within these bands;

h. To coordinate, defend, and promote military interests in the radio spectrum at various national and internal meetings and conferences such as World Radio Conferences where international Radio Regulations are amended and have the status of treaty.

ACHIEVEMENT OF FREQUENCY MANAGEMENT OBJECTIVES

104. The objectives of military frequency management between cooperating nations are achieved as follows:

a. Allocations of frequency bands to radio services are coordinated in

accordance with agreed procedures;

b. Exchange of information about national allocations of frequency bands to equipment is achieved by exchanging national allocation tables and circulating amendments as required;

c. Information about the operational and emission characteristics of military S-D equipment are exchanged in accordance with agreed procedures;

d. As part of EMS planning, frequency assignments are coordinated in accordance with agreed procedures;

e. Large scale frequency assignments to support combined or coalition operations or exercises are coordinated in accordance with ACP 190, its supplements, or in accordance with any more detailed and authoritative documents which may be produced for a particular operation or exercise; and

f. Coordination of military spectrum requirements before meetings of international regulatory forums is achieved by discussions at suitable meetings, with circulation of relevant information papers before such meetings.

COMMON EMS DATA EXCHANGE FORMAT

105. While nations may depend upon and use different EMS management systems and databases, it is imperative that nations be able to exchange spectrum use data in a common format that can be accepted by participating nations and when applicable, can be processed by each nation's EMS management system.

a. Standard Frequency Action Format(SFAF): Refer to ACP 190 (B) Annex E for details of the SFAF which is currently being used by the CCEB Nations and other HNs for frequency proposals, assignments, modifications, renewals, reviews, and deletions

b. Spectrum Management Allied Data Exchange Format (SMADEF): eXtensible Markup Language (XML) Current Version. The CCEB has adopted for future implementation and use the SMADEF-XML which is being used within NATO. Transition to SMADEF-XML, which is primarily machine-readable, involves the migration of existing databases and development/of new EMS management tools and major modifications of existing EMS management tools. Prior to full SMADEF-XML adoption, the CCEB will update ACP-190 to reflect appropriate direction and guidance.

CHAPTER 2

POLICY AND PROCEDURES FOR COORDINATION OF SPACE RADIO FREQUENCY ASSIGNMENTS

INTRODUCTION

201. Coordination between nations of frequency assignments for space systems should be effected as required, taking into account the provisions of the ITU Radio Regulations.

POLICY

202. To ensure that the military authorities of cooperating nations may adequately identify, consider, and advise their national civil authorities with regard to the military space systems of the other nations, information should be provided to the nations affected through military channels before the submission of Advance Publication or Coordination Requests to the ITU.

PROCEDURE

203. It is normal for satellite coordination meetings to take place directly between satellite operators (including military authorities) under the delegated authority of their respective national administrations. Meeting records are then passed to the national administrations with a request to inform the ITU of the coordination status achieved.

204. Whenever military space systems for which no international recognition will be sought are to be established, coordination may nevertheless be desirable between the military authorities of co-operating nations. In such cases, the same elements of information that would be required for international coordination should be exchanged between relevant military authorities as early as possible.

CHAPTER 3

RESOLUTION OF HARMFUL INTERFERENCE

INTRODUCTION

301. Harmful interference is defined in paragraph 102.d.

POLICY

302. Within the congested portions of the EMS some interference can be expected and often must be tolerated. Assignments of replacement frequencies should be considered when efforts to alleviate harmful interference are ineffective.

PROCEDURE

303. When the source of harmful interference is considered to emanate from a station of a cooperating nation, the military frequency-management authority for the station suffering interference should attempt to clear this interference directly with the military frequency management authority of the nation to which the suspect interfering station belongs. If this attempt is unsuccessful, the interference should be reported by the military frequency-management authority for the station suffering interference to the civil administration of that nation. The civil administration should be requested to refer the matter to the civil administration of the nation from where the interference is believed to be emanating.

Messages regarding clearance of interference should include certain essential elements of information regarding the victim and source (when known) of the harmful interference. Some nations have established specific procedures and a format for the reporting of interference and when this guidance exists it should be followed. In the absence of any required prescribed format or procedures, the format specified in Annex A to this chapter should be used.

ANNEX A TO
CHAPTER 3 TO
ACP 194

FORMAT FOR REPORTINGREPORTING EMS INTERFERENCE

STATION CAUSING INTERFERENCE

a. Name, call sign or other means of identification

b. (1) Frequency measured
(2) Date
(3) Time (UTC)

c. Class of emission,

d. Bandwidth (indicate whether measured or estimated)

e. (1) measured field strength or power flux-density
(2) Date
(3) Time

f. Observed polarisation

g. Class of station and nature of service

h. Location/position/area/bearing

i. Location of the facility which made the above measurements

TRANSMITTER STATION EXPERIENCING INTERFERENCE

j. Name, call sign or other means of identification

k. Frequency assigned

1. (1) Frequency measured
(2) Date
(3) Time (UTC)

m. Class of emission

n. Bandwidth (indicate whether measured or estimated)

o. Location/position/area

p. Location of the facility which made the above measurements

RECEIVING STATION EXPERIENCING INTERFERENCE

q. Name of station

r. Location/position/area

s. Dates and times (UTC) of occurrence of harmful interference

t. Bearings on other particulars

u. Nature of interference

v. (1) Field strength or power flux-density of the wanted emission at the receiving station experiencing the interference
(2) Date
(3) Time (UTC)

w. Polarisation of the receiving antenna or observed polarisation

x. Action requested

NOTES: 1. The class of emission shall contain the basic characteristics listed and if possible, the additional characteristics. If any characteristic cannot be determined, indicate the unknown symbol with a dash.

2. When measurements are not available, signal strengths according to the QSA scale (see ACP 131 (E)) should be provided.

CHAPTER 4

SPECTRUM REALLOCATION AND PRICING

INTRODUCTION

401. The EMS is a vital, but limited natural resource, owned by each sovereign nation. As such, it is the sovereign right[1] of each nation to use the EMS, within its borders, in any manner that it sees fit. With the rapid evolution and application of new S-D equipment technologies, there is an increasing demand for spectrum for new services.

402. Several major developments - emerging technologies and networks, the growth in the use of spectrum resources and services, and legislative and regulatory developments - have all highlighted the need for a continual assessment of military spectrum requirements.

403. This chapter identifies the actions required to protect vital military access to the EMS in light of increased demands for spectrum and developments in spectrum management. The Chapter comprises 4 parts:

a. International spectrum management developments;

b. Implications of spectrum reallocation and spectrum pricing;

c. Guide to National Arguments; and

d. Resources required for the preparation of military arguments.

INTERNATIONAL SPECTRUM MANAGEMENT DEVELOPMENTS

404. The rapid evolution and application of new S-D equipment technologies that has occurred in recent years has resulted in an increase in S-D systems. Commercial pressures on national administrations for more spectrum to accommodate new technology and the potentially high public (economic) benefit has forced reviews of spectrum management legislation in many countries.

405. Some countries have introduced market based approaches which, in theory, allow a responsive use of the spectrum, to enable it to respond to changes in technology and consumer demand.

406. National frequency allocations are being reviewed, and spectrum is under consideration in some countries for reallocation from "government" to "non government" sectors. National reviews are concentrating on spectrum efficiency and are focusing on the military use of the spectrum. The overall impact is a gradual reallocation of spectrum from military to civil use.

407. As market-oriented spectrum management regimes are introduced, the military, under the auspices of the government, may be required to purchase or relinquish spectrum, which could have an operational impact on military effectiveness.

IMPLICATIONS OF SPECTRUM REALLOCATION AND PRICING

408. Access to relatively interference free spectrum is essential for military preparedness

[1] See the Preamble to the Constitution of the International Telecommunication Union.

and the conduct of operations. Contrary to a view that spectrum affects solely communications systems, virtually every aspect of military readiness and effectiveness depends upon the EMS. Target acquisition, weapons control and guidance, dissemination of intelligence information, navigation and terminal control, administrative telecommunications, and command and control rely on adequate access to the EMS.

409. Increasingly, the network-centric warfare philosophies being adopted by modern military forces rely upon some assurance of spectrum access. There are clear, finite minimum spectrum requirements which are related, directly, to the operational effectiveness of all military S-D systems. Spectrum reallocations in one country may disrupt system interoperability in alliances.

410. Pressure is being brought to bear on government agencies to make military spectrum available for commercial development in the interests of advancing public benefit. In the event that the military cannot compete in the market place with commercial organisations, then complete military S-D systems may be required to relocate to other parts of the spectrum or to be prematurely withdrawn from service. It is imperative that when military systems are required to relocate to other portions of the EMS that a thorough analysis be conducted to ensure the new spectrum is “comparable” in physical characteristics to preserve essential military capabilities.

411. Arranging temporary access to the spectrum for military exercises will become more difficult as portions of the EMS available to the military is sold. In the absence of spectrum available for military operations, the military may have to negotiate shared usage with civil owners of spectrum instead of with national administrations. Temporary access of this nature will no doubt attract a cost.

412. Spectrum access lost to the military as a result of market based reforms in national spectrum management will not be recovered and may jeopardise current and future military capabilities.

THE CASE AT THE NATIONAL LEVEL CASE FOR MILITARY SPECTRUM ACCESS

413. Changes to national spectrum allocation often involve legislative action. The military needs to be involved at all levels and as early as possible during any proposed reallocation process. Involvement will ensure that military requirements are recognised and accounted for in any new spectrum legislation. In making the appropriate bill/act, national regulation must not only take cognisance of international treaties such as the ITU Radio Regulations but also any international military agreements. Senior government officials must be constantly reminded of their obligation to ensure provision is made for public safety and national security.

414. Military spectrum access requirements are diverse and complex. As such the national administration, in the absence of direct timely advice from the military, may make ill-informed decisions concerning military spectrum which could have an adverse impact on operational capabilities. It is incumbent upon the military to ensure that officials are aware of military problems and priorities.

415. The military case for continued access to the spectrum must be related to Defence policy tasks so that the political impact of spectrum loss can be seen. It is also very important for the military frequency manager to participate in national and international

civil/industrial spectrum planning bodies. Military participation and advice can help industry avoid problems and may even help industry to identify commercial possibilities.

416. The military arguments should highlight the following points:

a. The total investment in military S-D systems, including the cost of system development and expected service lifetime of these systems;

b. The identification of vital spectrum interests and common frequency bands, especially when the physical characteristics of certain bands used by military are critical to military operations.

c. The cost to relocate systems in the event they are displaced, along with the cost of any new replacement equipment if existing systems are forced into premature retirement;

d. A definition of vital military requirements during training and conflict, including requirements for today's systems as well as the systems of the future, must be prepared to support the military case;

e. It is essential that the military demonstrate that the EMSEMS is being used in the most effective and efficient manner possible. Continual reviewing of frequency band plans in light of new emerging S-D technology and identification of future requirements, in a timely fashion, will assist in this task;

f. Some multinational military organisations have arranged common frequency bands in order to facilitate interoperability, despite the fact that such bands do not always exist on a worldwide basis. The military case will be strengthened when it is shown that spectrum efficiency is being improved through the use of these common frequency bands and interoperable equipment;

g. The existence of these harmonised bands may make them very attractive to non-military government use and to the commercial sector, especially when commercial organizations are seeking regional or world wide harmonised bands for development of commercial personal communications systems. This possibility must be borne in mind and suitable arguments prepared to safeguard these harmonised bands where they exist;

h. Access to new spectrum will become difficult as spectrum reforms are enacted. Once spectrum has been reallocated to civil use, further military access may be denied unless prior sharing agreements have been set in place;

i. The military may have to compete in the market place for continued spectrum access unless governments make separate provision for Defence and national security.

j. Adequate spectrum must be available to national Defence and to visiting forces for peacetime communications and training. This dictates that some spectrum must be reserved for these intermittent activities, giving rise to a possible perception of spectrum waste;

k. The use of the spectrum by the military in peace time is not reflective of the total spectrum requirements during conflict. These additional combat requirements have often been identified during exercises and operations and

have been met by sharing with civil radio systems or obtaining allotments in civil bands;

l. Difficulties which may occur if classified information cannot be made available to support the military case. To overcome this the appropriate persons in the civil administration must hold adequate security clearances;

m. There is no peace dividend in military use of the spectrum. A peace dividend is illusory because reductions in military forces do not necessarily produce accompanying reductions in spectrum requirements (unless complete systems are cut); often the opposite is the case when reduced military forces must rely upon more S-D equipment to maintain comparable operational capabilities. At best, force reductions may produce a decrease in the frequency reuse factor. Regardless of ongoing force reductions, most military forces are adding radio and radar systems to their inventories. Commanders, faced with cuts in combat manpower, seek force multipliers in the areas of surveillance and warning, target acquisition and, command and control all based on S-D systems

n. Spectrum lost to the military as a result of market based reforms in national spectrum management will not be recovered and may jeopardise current and future military capabilities.

RESOURCES REQUIRED FOR PREPARATION OF MILITARY ARGUMENTS

417. The preparation of the military arguments can only be completed with the assistance of qualified staff. Initially, the identification of vital frequency bands would need to be addressed by national military frequency management staffs in close coordination operational commanders and with colleagues in cooperating nations. Compilation of equipment numbers, cost details and mission impact data is required if investment arguments are to be presented. This collection is both essential and manpower intensive and involves several military functional areas (procurement, supply, finance, operations, etc) to cover both current and future requirements.

418. Legal Support

a. As the spectrum management reforms are legislative and binding on the military, legal support is required from the outset. Agreements may have to be negotiated when spectrum that has been sold/auctioned is required temporarily for exercises, training, humanitarian operations, etc. In the absence of such agreements, the military could be held accountable for any economic harm caused by harmful interference to businesses owning spectrum. This could result in legal action for the recovery of lost revenue by the owner of the spectrum through the judicial system.

b. There is a requirement for Defence legal staff to provide frequency planners with counsel regarding international and national regulations.

419. Meetings between Military Spectrum Managers of Cooperating Nations

a. Recurring bi-lateral and multi-lateral military discussions are necessary if the military is to minimise the impact of the changes in national spectrum management. Although the reforms are national decisions, some advantage

can be gained in international fora such as the ITU by having prior coordination discussions to attempt to influence national positions during preparations for meetings of such fora. Combined military efforts are required with continual information exchange and participation in periodic meetings necessary to review and react to developments.

b. To keep abreast of civil developments, and to ensure that Defence goals are reflected in national policies, it is essential that frequency planners work in various civil symposia and conferences that address spectrum management. In particular, conferences such as the Asia Pacific Telecommunity, African Telecommunications Union, European Conference of Postal and Telecommunications Administrations, Inter-American Telecommunication Commission, League of Arab States, and the Pacific Telecommunications Council` ITU Radiocommunications Sector meetings and World Radiocommunication Conferences (WRCs) should be monitored/ attended and military interests represented. The investment to attend such meetings/conferences is small compared to the losses that will result if spectrum is withdrawn

420. Technical Developments

a. Technical advances in electronic equipment over the last decade have enabled more and different S-D systems to be introduced. The military can take advantage of these developments when replacing systems by utilizing new technologies for S-D equipment particularly employing tighter technical specifications, particularly in radio receivers. Introducing such equipment into the civil sector will also help in achieving these advantages as it reduces the potential for harmful interference. New technologies such as dynamic spectrum access would permit greater opportunities for sharing resulting in more efficient use of the spectrum. Use of data reduction techniques and digital signal processing may relieve some of the congestion in spectrum usage.

CONCLUSIONS

421. Multinational military organisations and the many non-warfighting functions they perform provide an effective case to generate international support for continued adequate military access for use of the EMS. However, it remains that national spectrum management authorities will determine the use of the EMS within their boundaries.

422. The military must be prepared to argue its case at a political level for continued adequate spectrum access. These arguments must be based on military operational requirements reflecting government policies and must include emphasis on informing non-military authorities of military spectrum requirements.

423. To assist in developing national military arguments, adequate financial and legal resources must be provided to ensure that Defence goals are protected in international and national regulatory and spectrum allocation forums.

424. Spectrum lost will not be recovered. This may jeopardise access for future military systems and impose restrictions on current operations and training.

CHAPTER 5

AIDE-MÉMOIRE

MILITARY SPECTRUM REALLOCATION AND PRICING CONCERNS

INTRODUCTION

501. The EMS is a vital, but finite natural resource owned by each sovereign nation. It is the sovereign right[2] of each nation to use the EMS, within its borders, in any manner it sees fit. With the rapid evolution and application of new radio technologies, there is an increasing demand for spectrum for new services. The demand is expressed by both national and international agencies: commercial and private interests, internally, and in the International Telecommunication Union (ITU), representing the world view at its World Radiocommunication Conferences (WRCs).

AIM

502. This *Aide-Mémoire* aims to assist senior Defence staff in the task of protecting vital military interests which need spectrum.

MILITARY PRINCIPLES

503. Spectrum which is lost will not be recovered; sharing is preferable to loss. This might be described as the master principle. Some senior military officers, including some spectrum managers may talk about recovering spectrum from civil users in time of crisis/transition to war. This will only happen in extremes; otherwise, almost all spectrum which is being used by the civil sector will be incorporated into the national broadcasting and telecommunications infrastructure, both of which are vital to mobilisation and any war effort. Inter-service sharing is common practice in the civil sector - it requires effort but it can be made to work.

504. Sharing is a two way street: There is a tendency in some civil administrations to consider sharing only in the context of placing civil systems in spectrum reserved for military requirements. The argument needs to be made that sharing is a two way street, and that it is also necessary to examine spectrum reserved for civil purposes in order to ascertain the extent to which military systems may operate in these bands.

505. Military interests must be recognised and protected by administrations as part of each nation's broad national interests. This is, in essence, the support that spectrum managers desire from senior military leadership. Senior military leaders need to recognise that they are only one player (albeit, a very important one) in the highly competitive spectrum access game. This should not deter them however from championing essential military spectrum access requirements whenever possible. Senior military leaders should, indeed, seek out opportunities to meet with their civil counterparts both in the radio communications industry and, especially, within the national administration to clearly state the military's essential spectrum requirements.

506. Force reductions may generate increased demand for spectrum based systems.

[2] See the Preamble to the Constitution of the International Telecommunication Union.

This may be obvious to senior military leaders, but some civilian leaders have difficulty with the concept. In essence, force reductions, even major force reductions, do not, generally, reduce spectrum access requirements unless a complete class of S-D systems is retired. Force reductions are, often, accompanied by programmes which aim to offset the worst effects on combat capabilities by increasing the capabilities and capacities of surveillance, warning, target acquisition, weapon control and guidance and command and control systems, almost all of which are highly, if not completely, dependent upon access to the EMS. Therefore, far from reducing military spectrum access requirements, force reductions tend to actually increase spectrum use to maintain the same operational capabilities.

507. The increasing operational requirements and the performance requirements of S-D systems required to meet those operational requirements result in increased EMS bandwidth demands.

a. One example is improving surveillance capabilities. The laws of physics are at work here. To track smaller missiles, moving more quickly and closer to the wave tops then it is necessary to increase bandwidth - there is a limit to the gains which signal processing can make. Before the information can be processed enough information must be acquired for analysis to occur.

b. Another example is the increased use of unattended aerial vehicles (UAVs) over piloted aircraft for surveillance and weapons delivery. While the UAVs are less costly than pilot training and fighter/surveillance aircraft, the need to remotely control the UAV and the use of full motion video results in significant increases in spectrum access requirements.

508. Military spectrum use is tied to military tasks and functions which are established and tasked by governments, often distinct from warfighting such as humanitarian or relieve operations. Loss of spectrum may prejudice the tasks or dictate unexpected procurement requirements for replacement systems. This is a political/public policy consideration which **should** be meaningful to senior officials in the national administration.

509. Interference from/to military systems will have an adverse effect on operations.

a. For example, a change in naval operations from “blue water" to “littoral water” has increased the likelihood of interference between maritime and shore based radio systems. A similar situation applies when training areas are decreased. Although the same amount of spectrum is required, the geographical area is smaller and may be closer to populated areas resulting in an increased potential to cause harmful interference to other military users or non-military spectrum.

510. Spectrum use is constrained by treaty obligations. Multi-national military obligations may be used to justify spectrum access. In the case of Europe, the European industry respects the civil/military NATO Joint Frequency Agreement (NJFA) which has set aside certain “harmonized” bands for NATO use throughout NATO Europe as well as in the Partners-for-Peace nations that cooperate military operations with NATO . The ITU Radio Regulations (RRs) in conjunction with national ratification of these RRs constitute a treaty regarding spectrum use and the military, by using "out of band" systems without specific host nation approval violates the provisions of that treaty.

511. Spectrum must be reserved for contingencies and survivability. There is a vital operational requirement which covers, for example, most of the l215 - 1400 MHz bands which are used to provide Electronic Countermeasures (ECM) protection for Naval radars and all the channels which are reserved in COMMPLANS. As far as military spectrum managers are concerned these "reserved" contingency channels are licensed and assigned to military users. To civil users theses channels, while not continuously used may be misperceived as evidence that the military is not using spectrum efficiently.

ECONOMIC FACTORS

512. EMS spectrum access is vital for economic development. Senior military officers must be prepared for and accept this point. It will be raised by private sector executives and by senior officials in the national administrations acting in support of their governments' efforts to increase national prosperity and create jobs.

513. Spectrum has a real capital value which is growing and can generate revenue. A market based approach to spectrum pricing may make sharing very difficult. There are really two factors here. The first concerns the capital value of the spectrum. It is indisputable. In countries where spectrum cannot be traded like any other commodity, the value of the spectrum is appreciated by those who have to pay for it. The second factor is that when the national regime allows for spectrum to be traded, then sharing (the master principle) without cost reimbursement can be very difficult. It is possible however, to design regulatory regimes which can allow **both** spectrum rights and sharing.

514. Spectrum can be seen as a commodity which can be traded. This is a fact. Some organisations see the spectrum as investment opportunities which can increase in value and then traded for profit. This could encourage spectrum hoarding.

515. Military S-D capabilities represent a national capital investment. This is also a fact, however it is often understated or overlooked.

516. Military budgets are not as flexible as commercial funding. This is another important factor which is often unappreciated by executives in the private sector: the service life of military S-D systems. Civil systems have evolved in response to growing and increasingly sophisticated consumer demand and may have a short service lifetime before being replaced by more sophisticated systems. Robust military systems, on the other hand, may have very long service lifetimes, are often employed well past their projected end-of-service dates, and may not employ the most modern, spectrum efficient technology due to the somewhat dated technology being employed.

517. Competition in the market place can result in unused spectrum. This factor relates to the duplication of systems and services which results when, for example, a number of telecommunications service providers in a country may each have national networks. It is possible that none may use their available spectrum to capacity.

POLITICAL FACTORS

518. National spectrum management is subject to international regulations and pressures. This is, in part, a repeat of the “treaty" factor above but with the addition of the aspect of pressures to conform. This is especially relevant to countries with a small economic base which border larger, more dynamic economies.

519. The perceived reduction in the direct military threat encourages a demand for a peace dividend in the spectrum. See discussion under "force reductions" above.

CONCLUSION

520. The need for military spectrum must be understood by both military and national senior civil management. This is a statement of the obvious. There are a few others:

a. The military must recognise that it is in a competition for spectrum.

b. The military must recognise that its mission may not entitle it to an automatic place at the head of the spectrum line.

c. The military must recognise that its practices and procedures cause civilians in the private sector and in the national administration to see waste where the military sees only flexibility or budget restrictions.

RECOMMENDATION

521. Every opportunity should be taken to present to senior military and civilian officials the case for military access to the EMS. This is, indeed, about all that senior military officers can be expected to do. The battle for spectrum access must be waged on several fronts. While the spectrum managers are the main combatants, senior military leaders can and must play a very important supporting role - especially in fora not normally available to the spectrum managers.

CHAPTER 6

LIST OF FREQUENCY BANDS COMMONLY USED BY CCEB NATIONS

INTRODUCTION

601. The table in the Annex to this chapter is a list of spectrum bands that are used by military forces in the CCEB nations, which are located in all three ITU Regions.

602. The Table is intended to only be used as a long range planning tool and **SHOULD NOT** be used as a final reference in lieu of coordinating with, and seeking comments from, either host nations on use of the EMS within their national borders or from established military organizations which may have authority over a particular region, operation, or mission.

603. The Table also shows, for all three ITU Regions, that some spectrum usage by military forces of the CCEB nations may be similar and may enhance the interoperability of coalition forces and their ability to act in concert in Joint and Combined Operations.

CCEB TABLE OF HARMONISED FREQUENCY BANDS

In the following tables, the CCEB Members identified in accordance with the following table, which also shows the ITU Region in which the Member is located.

CCEB Member	ITU Region	Country Abbreviation
Australia	3	AU
Canada	2	CA
New Zealand	3	NZ
United Kingdom	1	UK
United States	2	US

Frequency Band	Military Requirements/Usage	Participating CCEB Nations				
		AU	CA	NZ	UK	US
14-70 kHz	Low Frequency Communications and Sounders for Submarines	X	X		X	X
70-148.5 kHz	Naval Communications.	X	X		X	X
255-283.5 kHz	Air Navigation and Beacons.	X	X	X	X	X
283.5-415 kHz	Tactical Non-Directional Beacons.	X	X	X	X	X
415-526.5 kHz	Tactical Non-Directional Beacons.	X	X	X	X	X
	Naval and Fixed Ground Communications.		X		X	X
1606.5 kHz - 30 MHz	Long Distance Airborne Communications./ (ALSO HAS BEACONS)	X[AUa]	X	X	X	X

[AUa] Also used in Australia for portable Non-Directional Beacons.

Frequency Band	Military Requirements/Usage	Participating CCEB Nations				
		AU	CA	NZ	UK	US
	Telephony Duplex/Simplex Channels; Wideband Telegraphy Channels; & Naval Communications.	X	X	X	X	X
	Fixed and Tactical Communications.	X	X	X	X	X
	Over-the-Horizon Radars	X [AU1]			X	X
30-87.5 MHz	Army Air Force and Navy Tactical/Combat Net Radio Systems. (See End Notes 1 and 2)	X[AUb]	X[CA1]	X [NZ1]	X	X
87.5-108 MHz	Army and Air Force Tactical/Combat Radio Systems.					X[US 1 US2]
108-136 MHz	Aeronautical Radionavigation and Aeronautical Mobile(R)	X	X	X		X
138-144 MHz	Air Traffic Control Communications.				X[UK1]	X
	Land Mobile Communications and Sonobuoy Operations. (SOUNDERS)	X[AU2]	X	X	X	X
148-149.9 MHz	Land Mobile Communications. (NAVAL COMMUNICATIONS/ FIXED)	X[AUc]	X		X[UK2]	X
150-150.8 MHz	Land Mobile Communications.	X[AUc]	X			X

[AU1] For AU, 3025 kHz - 45 MHz
[AUb] Additional Military uses by Australia in this band.
[CA1] In Canada, Combat Net Radio operation outside the band 30-50 MHz is unlikely.
[NZ1] Portions of this band are unavailable due to other national civil usage Broadcasting
[US 1] Navy has a few SINCGARS assignments in 87.5-88 operation on OOB basis with note RR 1.144 applied.
[US2] 88 – 108 MHz is allocated in the U.S. on an exclusive basis to civil FM broadcasting.
[UK1] In UK 142.5 – 143 MHz.
[AU2] In Australia the band 137-144 MHz is used for TV in some areas. Some geographic restrictions exist to military access to this band.
[AUc] Australia also has Sonobouy Operations within this band.
[UK2] In UK 149-149.9 MHz.

Frequency Band	Military Requirements/Usage	Participating CCEB Nations				
		AU	CA	NZ	UK	US
150.8-156 MHz	Land Mobile Communications [US2]	X[AUd]	X		X[UK3]	X
156-174 MHz	Sonobuoy Operations at Sea and in Port (For UK and NZ, 136-174 MHz)	X	X	X	X	X
	Naval Communications.	X[AUb]	X	X	X	X
174-225 MHz	Land Mobile Communications and Broadcast.					X
225-400 MHz	Navy, Army and Air Force Tactical Command and Control. Tactical Satellite. (See End Note 3)	X[AU3]	X	X[NZ2]	X	X[US3]
400.15-406 MHz	Meteorological Aids and Meteorological Satellite Service.	X	X	X	X	X
406.1-420 MHz	Land Mobile Communications.	[AUe]	X		X[UK4]	

[AUc] Australia also has Sonobouy Operations within this band.
[US2] In U.S. 152.0075 & 163.250 MHz, authorized for medical radiocommunication systems on a primary basis; otherwise no US allocation for Federal (military) use. All military use is OOB.
[AUd] Australia also has Sonobuoy Operations and other Military uses within this band.
[UK3] In UK 153.5-154MHz
[AUb] Additional Military uses by Australia in this band.
[AU3] In Australia the band is 230-400 MHz.
[NZ2] In New Zealand the band is 230-400 MHz
[NZ3] In New Zealand the band 494-502MHz is for PPDR communications
[US3] In U.S., military ILS and Air Traffic Control functions are also in this band.
[AUe] 403-430 MHz is planned as a future Australian Government band. Temporary licences may be available for Military use on Ad-Hoc basis.
[UK4] In UK, Land Mobile use only

Frequency Band	Military Requirements/Usage	Participating CCEB Nations				
		AU	CA	NZ	UK	US
	Launch Booster Safety Systems. [US4] Land, Naval and Airborne Radars.					
420-450 MHz	Land Mobile, Radar (Not sure if DoD has LMR operations in this band)	X[AUf]	X		X	X
450-581.9 MHz	Land and Aeronautical Mobile.	X[AUb]		X[NZ3]		X
582-606 MHz	Land Mobile Communications					X
606-790 MHz	Broadcasting and Radar Site Communications.	[AUb]				X
790-960 MHz	Army and Air Force Tactical Command and Control (point to point links) Interconnecting Communications Centres.		X			X
	Naval Air Search Radars	X[AU4]	X	X[NZ4]		
960-1215 MHz (See End Note 10)	TACAN/DME (Air Navigation)	X	X	X	X	X
	JTIDS/MIDS (TDMA Naval Air and Land Control Links)	X	X	X	X	X

[US4] NTIA manual calls for discontinuation of these operations in the 406.1-420 MHz band as of 31 Dec 87. The NTIA manual also states that these operations should be carried out in the 420-450 MHz band.
[AUf] Military use restricted to between 430-450 MHz in Australia.
[AUb] Additional Military uses by Australia in this band.
[AUb] Additional Military uses by Australia in this band.

[AU4] in Australia the band is 850-942 MHz
[NZ4] in New Zealand the band is 850-942 MHz

Frequency Band	Military Requirements/Usage	Participating CCEB Nations				
		AU	CA	NZ	UK	US
1215-1350 MHz	NAVSTAR Global Positioning System. Long Range Air Defence Warning Radars. [US5]	X	X	X	X	X
1350-1400 MHz	Long Range Air Defence Warning Radars. [US6]	X	X			X
1350-1610 MHz	Army and Air Force Tactical, Mobile, Global Positioning System, Airborne Telemetry, and Naval Radar.	X	X	X	X[UK5]	X[US7]
1670-1700 MHz	Meteorological Aids		X		X	X
1755-1850 MHz	Army, Air Force and Navy Fixed and Mobile, Space Operations in Region 2				X	X
2200-2290 MHz	Fixed links, Space Operations (Downlinks), Mobile)				X[UK6]	X
2300-2450 MHz	Airborne Telemetry		X[CA2]	X[NZ5]	X[UK7]	X[US8]
2700-3100 MHz	Navy, Army and Air Force Surveillance Radars.	X	X	X	X	X
3100-3410 MHz	Navy, Army and Air Force Radars.	X	X	X	X	X
3410-3650 MHz	Naval and Land Based Radars		X	X		X

[US5] GPS L2 emissions extend from 1215-1240 MHz centred on 1227 MHz.
[US6] Radar use limited to 1350-1390 MHz.
[UK5] In UK only 1375-1400, 1429-1452 and 1559-1610 MHz is available for military use.
[US7] Global Navigation Satellite Systems authorised in 1559-1610 MHz band.
[UK6] In UK, Mobile Service from 2200 – 2245 MHz and Space Operations from 2200 – 2290 MHz.
[NZ5] In NZ airborne telemetry is limited to 2400-2483MHz
[CA2] In Canada airborne telemetry is limited to 2360 – 2400 MHz
[UK7] In UK telemetry operates between 2310 – 2400 MHz only.
[US8] The U.S. authorises airborne telemetry only in the 2360-2390 MHz band.

Frequency Band	Military Requirements/Usage	Participating CCEB Nations				
		AU	CA	NZ	UK	US
4200-4400 MHz	Radio Altimeters.	X	X	X	X	X
4400-5000 MHz	Fixed and Mobile Command and Control and Tactical Radio Relay (See End Note 2)	X	X		X	X
5000-5150 MHz	Airborne radar and Microwave Landing Systems (5030-5150 MHz per RR 5.444).		X		X	X
5250-5925 MHz	Navy, Army and Air Force Radars.	X	X	X	X	X
5920-7250 MHz	Fixed and Fixed-Satellite Communications. (US Fixed starts at 7125 MHz)		X	X		X
7250-7750 MHz	Satellite Downlinks, Mobile Satellite for Naval and Land Mobile Earth Stations, Fixed Systems. (See End Note 4)	X	X		X	X
7750-7900 MHz	Fixed Systems	X				X
7900-8400 MHz	Satellite Uplinks, Naval and Land Mobile Satellite Earth Stations, Earth Exploration Satellite Downlinks, and Fixed Systems. (See End Note 4 & 5)	X	X		X	X
8400-8500 MHz	Fixed and Mobile systems.	X				X
8500 MHz -10.7 GHz	Navy, Army and Air Force Radars.	X	X	X	X[UK8]	X
10.7-13.4 GHz	Target Tracking and Lock-On Systems.			X		
13.4-14.0 GHz	Navy, Army and Air Force Radars.	X	X	X	X	X

[UK8] In UK, military radiolocation allocation ends at 10.50 GHz.

Frequency Band	Military Requirements/Usage	Participating CCEB Nations				
		AU	CA	NZ	UK	US
14.62-15.23 GHz	Operational Command and Control. (See End Note 2)	X	X	X	X	X
15.4-15.7 GHz	Airborne Radars.					X
15.7-17.3 GHz	Navy, Army and Air Force Radars. (See End Note 5)	X	X	X	X	X
17.3-17.7 GHz	Navy, Army and Air Force Radars. (See End Note 11)	X				X
17.7-20.2 GHz	Space and Fixed Systems.		X			X
20.2-21.2 GHz	Satellite Downlinks. (See End Note 3)	X	X	X	X	X
21.2-24.05 GHz	Fixed Microwave Communications.		X			X
24.05-24.25 GHz	Radars	X				X
25.25-27.5 GHz	Operational Command and Control (Existing or Planned Satellite Systems).	X	X		X	X
30-31 GHz	Planned Satellite Uplinks. (See End Note 3&7)	X	X	X	X	X
33.4-36.0 GHz	Radar Systems. (See End Note 3)	X	X		X	X
36-37 GHz	Fixed, Mobile and Planned Satellite Systems. (See End Note 3)	X	X		X	X
37-39.5 GHz	Existing and Future Fixed and Satellite Systems.	X	X			X
39.5-40.5 GHz	Future Satellite Downlinks. (See End Note 3&8)	X	X			X
43.5-45.5 GHz	Satellite Uplinks and Mobile Systems. (See End Note 3)	X	X		X	X
50.4-51.4 GHz	Future Satellite Uplinks and Planned Terrestrial Systems. (See End Note 3)	X	X			X
54.25-58.2 GHz	Planned Aeronautical Mobile and Satellite Systems.					X

Frequency Band	Military Requirements/Usage	Participating CCEB Nations				
		AU	CA	NZ	UK	US
59-64 GHz	Planned and Existing fixed, Mobile, Radiolocation, Intersatellite Communications and Wireless Computer Systems. (See End Note 9)	X	X		X	X
66-71 GHz	Future Satellite and Land Mobile Systems.	X				X
71-74 GHz	Future Satellite Uplinks. (See End Note 8)		X			X
74-75.5 GHz	Future Fixed, Mobile and Satellite Systems.	X				
76-81 GHz	Future Radar Systems.	X	X		X	X
81-84 GHz	Future Satellite Downlinks. (See End Note 8)		X			X
92-95 GHz	Future, Planned and Existing Radar, Fixed, Mobile and Satellite Systems.	X	X		X	X
95-100 GHz	Future, Planned and Existing Radar Systems.	X	X		X	X
126-134 GHz	Future, Command and Control, Radar and Intersatellite Systems.	X				
134-142 GHz	Future and Planned Mobile and Radar Systems.	X				
144-149 GHz	Future Radar Systems.	X				
190-265 GHz	Future Radionavigation and Mobile Systems.					
231-235 GHz	Future Fixed and Satellite Systems.					
235-241 GHz	Future Fixed and Mobile Systems and Satellite Downlinks.					
241-248 GHz	Future Radar Systems.					

Frequency Band	Military Requirements/Usage	Participating CCEB Nations				
		AU	CA	NZ	UK	US
252-265 GHz	Future Mobile Systems.					
300-1000 GHz	Infrared Technology Development.					X[US9]

NOTES

45-47 MHz is harmonised NATO band type 1 (46.60-47 MHz also accessible by the military in ITU region 2).
This is a harmonised NATO band type 1.
This is a harmonised NATO band type 1, including ITU region 2.
This is a harmonised NATO band type 1 for satellite downlinks.
This is a harmonised NATO band type 1 for satellite uplinks.
15.7-17.1 GHz is a harmonised NATO band type 1.
This is a harmonised NATO band type 2.
This is a harmonised NATO band type 3 including ITU Region 2.
59-61 GHz is a harmonised NATO band type 2 including ITU Region 2.
Global Navigation Satellite Systems are authorized in the 1164-1215 MHz band.
Radiolocation is allowed in this band on a secondary basis to fixed systems and satellite uplink or downlink systems, depending on the ITU region involved.
NATO band type 1: a frequency band that is in general military use in NATO Europe.
NATO band type 2: a frequency band that is planned for military use in NATO Europe.
NATO band type 3: a frequency band that is has been identified for possible military use in NATO Europe.

[US9] In the U.S., reference is made to NTIA Allocation Table, 5.565 and US 375