

# **Exploiting The Electro-magnetic Spectrum In Jointmanship**

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## INTRODUCTION

Military Operations are executed in an increasingly complex Electro-Magnetic (EM) environment. Electronic Warfare (EW) is a military capability that must be integrated into a given military operation as it supports all phases and aspects of the campaign. This is equally applicable in the planning and conduct of joint operations. It has become the principal means waging and winning a war. The vast array of capabilities, skills, techniques and organizations of war is a recipe for chaos without thoughtful planning to assure interoperability, synchronizing and synergy. To retain the freedom of action required to apply maximum combat power at a chosen point in the battle it is vital that a Commander must be able influence the Electro Magnetic Spectrum (EMS). This influence either by dominance or control can only be achieved through holistic EMS planning in conjunction with commander's operational plans.

The EMS is an inexhaustible national asset and it can be used without depletion, but it is limited in capacity. These principles equally apply in the conduct of Joint operations. A Joint force commander in the operational theatre plans and fights the campaign while component commanders exercise tactical control of land, sea and air forces. The integrated battle concept recognizes the symbiotic relationships of land, maritime and air forces and underscores the fact that no single service can win war by itself. Effective command and control of EW assets in Joint operations would comprise of direction at the highest level to achieve unity of purpose, combined with delegation of authority for achieving objectives to the lowest level appropriate for the most effective use of various assets available for the accomplishment of the mission. To fully comprehend the conduct of Joint EW operations in the Indian context, it is necessary to have a comprehensive overview of systems, procedures, and organizations in place as on date and identify future courses of action.

## SCOPE AND PURPOSE OF THE STUDY

This study aims to analyse the current status of exploiting the EMS in jointmanship in the Indian context. After a brief overview of the concept of EW per-se and as a sub-set of Information Operations/Warfare (IO/IW), the analysis examines the individual services EW perspectives. As the services provide most of India's EW assets, a basic understanding of each service's perspective would greatly facilitate the planning and coordination of EW at the joint level. Thereafter, all the connected issues relevant to the planning, coordination and integration of EW for joint operations are looked at.

Doctrinal support for joint EW operations would be examined to highlight the training aspects as also the institutional support to be in place for an effective EW at all levels of operations to include strategic, operational and tactical keeping in mind the scope of joint operations in the Indian context. Management Challenges as also certain EW aspects very specific to the existing tri-service commands, i.e., Andaman and Nicobar Command (ANC), and Strategic Forces Command (SFC) as also the proposed Aerospace Command will be examined. These represent arenas for major joint operations in the future. The study will culminate with a few suggestions for necessary action and deliberation. Experiences/Lessons learnt from some of the joint operations conducted by Indian Armed Forces in the past have also been incorporated. As always, in a study of such a nature, it is never the intent to restrict the judgment of a commander in executing the mission in a manner he deems most appropriate, but to ensure unity of effort in the accomplishment of the overall mission of the joint operations.

## CONCEPT OF ELECTRONIC WARFARE (EW)

EW aims at controlling the EMS by attacking an adversary's ability to effectively use the spectrum, while protecting the friendly use of it. A thorough knowledge of the adversary's use of the spectrum is required to effectively employ EW. It pervades all aspects of the modern battlefield and has the potential to have an impact on all elements of the Command and Control (C2) cycle. EW resources are used to monitor the adversary's activities in the EMS, indicate adversary's strength and dispositions, give warning of adversary's intentions, deceive and disrupt sensors and C2 processes, and safeguard the friendly use of the EMS. The integrated use of EW throughout the battlefield supports the synergy needed to locate, identify, damage and destroy enemy forces and C2 structures.

The activities of EW are applicable across the whole spectrum of military operations and are not confined to warfare, conventional or

otherwise. In peacetime, armies attempt to intercept, locate and identify the source of a potential adversary's electronic emissions. Analysis may reveal details of capabilities as well as vulnerabilities that can be used to gain an advantage in times of conflict. Although EW is targeted against the technology, the ultimate effect is on the commander's ability to move through the C2 cycle. The human element of the command system is both the strongest and weakest link, and can be fairly enshrouded in the fog of war if supporting communications and information systems are disrupted, degraded or deceived. EW often provides commanders with substantial capabilities to electronically influence and control the battlefield. EW is also an area of considerable innovation. Inevitably, and often very rapidly, advantages gained by technological or procedural changes are met with equally effective countermeasures.

EW is an overarching term that includes three distinct components namely:

- Electronic Support Measures (ESM);
- Electronic Counter Measures (ECM);
- Electronic Counter Counter Measures (ECCM).

Electro-Optical (EO) systems are finding their way into nearly all military applications in the battlefield, such as day and night surveillance and observation, weapon targeting, fire control, tracking, ranging, missile guidance and communication. The side with capability to degrade the opponent's EO systems will have the winning edge and this adds yet another dimension to EW — Electro Optical Counter Measures (EOCM). Directed Energy Weapons (DEW) are the weapons of the future. The EOCM mentioned earlier would fall in the in the ambit of 'Low Power Lasers (LSL)'. 'High Power Microwave (HPM)' and 'Charged Particle Beam (CPB)' are presently in the advanced stages of application research.

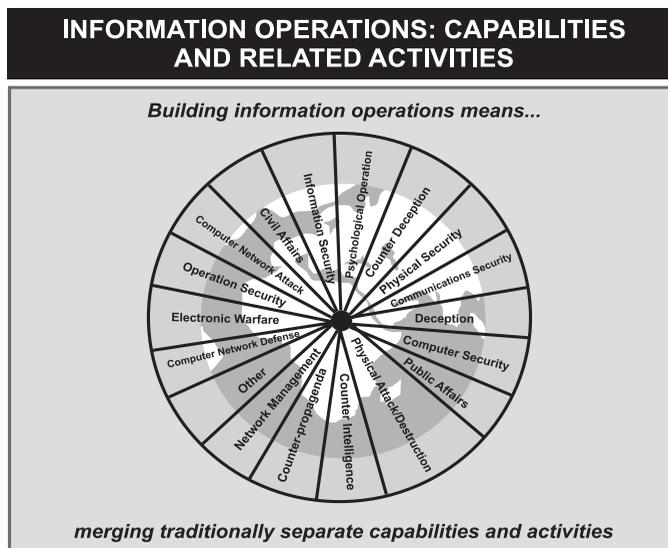
#### EW AS A PART OF IO/IW

EW is an important part of Information Operations(IO). Information Warfare (IW) is IO conducted during the time of crisis or conflict. EM energy is the means by which modern information systems process and store information. EM energy is also used for sensing, measuring, analyzing, and communicating information. This dependence on EM energy and use of the EMS by the systems that sense, process, store, measure, analyze, and communicate information create IO/IW opportunities and vulnerabilities that EW can address. ECM tactics, techniques and procedures from a variety of EW platforms can offer a range of lethal and non-lethal options to affect adversary information and information

systems. ECCM tactics, techniques, and procedures are essential to protecting friendly information and information systems. ESM is a primary means for gathering information during joint operations.

All EW activities conducted as part of or in support of joint operations should be coordinated through the IO/IW cell of the joint staff in order to realize the potential synergistic benefit of synchronizing the efforts of all the capabilities and related activities of IO/IW in a coordinated manner (see Figure 1). Specific activities and concerns that must be coordinated across IO elements and activities include Psychological Operations(PSYOP), Operations Security (OPSEC), military deception, physical destruction and computer network warfare. The deconfliction and coordination of EW activities in an operation is a continuous process for the IO/IW cell and EW staff personnel.

Figure 1. Information Operations and Related Activities



Source: Joint pub 3-13--Joint Doctrine for Information Operations

### SERVICE PERSPECTIVES OF EW

Planning and execution of Joint EW is affected by the different viewpoints on EW held by the three Services. Although formal definitions are standardized, different operational environments and tactical objectives lead to variations in perspective among the three services.

**Indian Army:** The focus of Indian Army(IA) EW operations is based on the need to synchronize lethal and non-lethal attacks against adversary Command,Control and Communications(C3) targets. Army EW systems disrupts,delays, diverts, and denies the adversary while protecting friendly use of communications and non-communications systems. The perspective of Army is directly associated with the combined arms structure of adversarial forces and the manner in which both friendly and adversary combatants conduct combat operations. The high mobility of opposing combat forces and the speed, range, precision accuracy, and lethality of their weapons systems place stringent demands on the C2 systems of both friendly and adversary ground force commanders. Organic EW resources available to support IA operations are limited. Mission requirements usually exceed operational capability.

Cross-service EW support, synchronized with Army combat operations, is essential to the success of joint military operations. Joint planning and continuous, effective coordination are critical to synchronizing joint EW capabilities and generating joint combat power at the critical time and place in battle. The Army has its dedicated EW systems to support Low Intensity Conflicts Operations (LICO) or when engaged in Counter-Insurgency (CI) operations. An integrated EW system for exclusive employment in mountains is also under active consideration.

**Indian Navy:** Naval task forces use all aspects of maritime environment and EW in performing their naval warfare tasks. Emphasis is given to surveillance, the neutralization or destruction of adversary targets, and the enhancement of friendly force battle management through the integrated employment and exploitation of the EMS. Naval battle groups employ a variety of organic ship borne EW systems, primarily for self protection. Naval aviation forces with dedicated EW systems on board (if and when made available) are the primary means by which naval forces take the EW fights to the adversary at extended ranges. Naval task force use of the EMS encompasses measures that are employed to:

- Coordinate, correlate, fuse, and employ aggregate communication, surveillance, reconnaissance, data correlation, classification, targeting, and EM attack capabilities;
- Deny, deceive, disrupt, destroy, or exploit the adversary's capability to communicate, monitor, reconnoiter, classify, target, and attack;
- Facilitate anti-ship missile defense; and
- Direct and control employment of friendly forces.

**Indian Air Force:** The Indian Air Force (IAF) conducts a variety of EW operations, including ECM, ECCM, and ESM. In addition, EW supports

Suppression of Air Defences (SEAD) and IO. The object of these operations is to increase aircraft survivability, enhance the effectiveness of military operations, and increase the probability of mission success. The IAF's EW system development and deployment focus on this task. The Air Force uses an integrated mix of disruptive and destructive EW systems to defeat hostile integrated air defenses. Disruptive EW systems, (e.g., self-protection jamming) provide an immediate but temporary solution. Destructive systems provide a more permanent solution, but may take longer to fully achieve the desired results. The integrated use of destructive and disruptive systems offsets their individual disadvantages and results in a synergistic effect. Successful EW operations emphasize risk reduction while still maintaining mission effectiveness. The military significance of EW is directly related to the increase in mission effectiveness and to the reduction of risk associated with attaining air superiority. The Air Force employs a variety of ground, air based assets to accomplish these tasks. Space based assets when made available can further these efforts.

#### PLANNING, COORDINATING AND INTEGRATING EW FOR JOINT OPERATIONS

EW is a complex aspect of modern military operations that must be fully integrated with other aspects of joint operations. This is necessary if one is to achieve EW's full potential for contributing to an operation's objectives. Such integration requires careful planning. EW planners must be concerned with coordinating their planned activities with other aspects of military operations which use the EMS as well as third party users of the spectrum that EW does not wish to disrupt. Coordination of military use of the spectrum is largely a matter of coordinating with other staff functions as well as the other elements of IO, such as 'Psychological Operations' (PSYOPS) planners and components which rely on the EMS to accomplish their mission. Coordination of EW activities in the context of third party use of the EMS is largely a matter of spectrum management and adherence to established frequency usage regimens and protocols.

Like other aspects of joint operations, joint EW is centrally planned and decentrally executed. Since the Armed Forces provide most of the country's EW assets available in joint operations, Service component EW planners must be integrated into the joint planning process. The role of EW in Joint operations must be viewed in the larger context of 'Command and Control Warfare (C2W).

C2W is the approach to military operations which employs all measures (including but not limited to Operations Security, Military Deception, Psychological Warfare, EW and Physical Destruction), in a deliberate manner, mutually supported by intelligence and information systems, to

disrupt, or inhibit an adversary's ability to command and control his forces while protecting and enhancing our own. These five elements must be used in varying degrees and the critical aspect of C2W is the synergism gained by planning and conducting all the five elements in a coordinated manner. Traditionally the planning responsibilities for these elements have resided in separate elements of any headquarter.

There is now a need to make them function under a single entity namely the Joint EW Control Centre (JEWCC) to be set up in each Joint Headquarters as part of the 'Operations and Planning' branch of the controlling headquarters. In this way, each of the five elements is employed to accomplish its intended mission without adversely affecting any other contributing component. Once the Joint EW plan has been formulated, EW planners must monitor its execution and be prepared to carry out any modification to the original plan as the dynamics of the operation plan dictates. A suggested charter of responsibilities of the proposed JEWCC is attached at Appendix 'A'.

**EMS Management:** Since EW activity takes place in the EMS, joint EW planners must closely coordinate their efforts with those members of the joint staff who are concerned with managing military use of the EMS. Joint EW planners should establish and maintain a close working relationship with the frequency management personnel. An integrated set up called the Joint Frequency Management Centre (JFMC) is a necessity for identifying the requirements for friendly communication nets, EM navigation systems, and radar. These requirements should be considered with respect to anticipated operations, tactical threat expected, and EM interference considerations. Once identified, these should be compiled as 'Joint Restricted Frequency List (JRFL) under appropriate categories like 'Prohibited/Taboo/Guarded' functions, nets and frequencies. JFRL is a critical management tool in the effective use of EMS during military operations.

A JFMC must be established at each of the Corps and Joint Headquarters (when established) whose responsibility is to prepare the JFRL and assist the EW staff in the planning process of EW operations being conducted jointly or by earmarked service EW assets. Automated frequency management tools can be a great help. Assessment of EM environment (EME) conducted during the planning phase constitutes a best guess based on information available at that time. Following deployment and buildup, and during the actual employment of the joint force, the operational area EMS will create a new, and somewhat different, set of parameters. Further, this environment will constantly change as forces redeploy and as C2, surveillance, weapons systems, and other spectrum-use applications realign. Since EW is concerned with disruption

(ECM), protection (ECCM), and monitoring (ESM) of the EMS, EW staff personnel have a major role to perform in the dynamic management of the spectrum during operations. A comprehensive and well thought out JRFL and 'Emission Control (EMCON) plan are normally the two tools that permit flexibility of EW actions during an operation without compromising friendly use of the EMS. EMCON is the selective and controlled use of EM, Acoustic or other emitters to optimize C2 capabilities while minimizing operational security viz. detection by enemy sensors minimize mutual interference among friendly systems and/or execute military deception plan. A suggested charter of responsibilities to be assigned to the proposed JFMC is at Appendix 'B' attached.

#### DOCTRINAL GUIDANCE FOR JOINT EW

Principles that guide the conduct of EW operations in individual services would continue to remain valid and continue to guide the conduct of EW in joint operations. However, the importance of planning and coordination of EW, dictates that the planning for such operations at the joint level must flow from the highest coordinating headquarters to avoid any duplication of effort.

The release of India's first Joint Doctrine on May 2006 marks a major step towards military integration and interoperability among the three services. Intended to complement existing individual service doctrines, the Joint Doctrine outlines the guiding principles for future joint operations by synergizing their operational capabilities. The new doctrine purportedly exhorts the services on the need for joint planning and resource sharing.

A beginning has also been made in the jointness in IW by the issue of a Joint doctrine on IW. However both these doctrines are classified documents and hence a critical appraisal cannot be made though it is believed that these are only of generic nature and do not address many existing inter-service doctrinal disconnects. A joint EW doctrine is essential for success because organizational synergies to be gained from joint efforts are as important as new military technologies which we may use for future operations. A well conceived and articulated doctrine reflects the collective will and intent and being a shared view ensures the much needed unity of effort. Acting as a guide it would need judgment in its application. Its value will lie in it being relevant, achievable, acceptable and adaptable. While evolving such a doctrine it has to be seen that it dovetails in the overall concepts of joint operations. A joint EW doctrine does not imply that it is advocating a separate phase of war but it is a strategy that would merge into the overall concept of joint operations. A joint EW doctrine would ensure a more focused effort towards a unified purpose

by a set of inherently inter-operable and synergistic joint capabilities. Such a doctrine would further the much needed 'joint mind-set' from the highest level of planning to the lowest tactical level.

#### ISSUES OF INTEROPERABILITY

Interoperability is essential in order to use EW effectively as an element of joint military power. Increased interoperability is a key prerequisite for enhancing jointness. The major requirements of interoperability are:

- To establish standards and practice procedures that allow for integrated planning and execution of EW operations (including joint EW); and
- To exchange EW information in a timely and routine fashion.

This exchange may be conducted in either non-real time or in near real time via common, secure, jam-resistant radios and data links. The ability to exchange near real time data (such as targeting information) enhances situational awareness and combat coordination between various force elements, including EW assets, is a critical combat requirement. This exchange of data relates to ESM, ECM, and ECCM, including friendly and adversary forces data. Routine exchange of data among joint force components, the joint force and supporting commands and organizations greatly facilitates all types of EW planning.

It is suggested that at the Headquarters Integrated Defence Staff (HQ IDS), a separate functional entity be set-up to initiate and oversee joint interoperability and integration initiatives and to suggest material and non-materiel solutions to interoperability challenges. This can be best done by working closely with the three services, DRDO and other government/public/private production agencies. This special entity could enlarge its scope of jurisdiction to include Command, Control, Communications and Intelligence (C3I) and other combat support systems thereby increasing combat effectiveness through interoperability.

#### MAINTENANCE OF EW DATA BASES

Automated EW databases can assist EW planners by providing easy access to a wide variety of platform-specific technical data used in assessing the EW threat and planning appropriate friendly responses to that threat. However, planners should keep several considerations in mind when relying on automated data. There are a large number of databases available to military planners. Some of these databases are maintained by the Services, others by various intelligence community

agencies or other Ministry of Defence (MOD) organizations, and allied organizations. Still other databases may be maintained by academic or private (profit or non-profit) organizations. "Threat" data is compiled by intelligence organizations. Compilation of accurate technical data in one place is a lucrative target for hostile intelligence collection. For this reason, access to friendly forces data must be highly restricted and harder for planners to obtain than threat data which can be accessed through normal intelligence channels. The level of detail, specific fields, and frequency of update may vary widely across different databases dealing with the same data. The way that data is organized into fields in a database and the level of detail are functions of what the data is used for and the cost associated with compiling and maintaining each database.

The sources of data being used for planning should be a topic of coordination among EW planners. If necessary, joint planners should provide guidance about what sources of automated data should be used for specific EW planning purposes. Planners should request that organizations that maintain important sources of EW data update their databases (or specific parts of them) more frequently than normal when planning specific operations. Planners should be cautioned about using unofficial sources of data, especially those available through the Internet which may be subject to manipulation by organizations hostile to national policies and objectives. However, open source intelligence remains a viable and important source of valuable information. Continuous maintenance of data bases during peacetime permits rapid identification of voids, which then becomes the priority areas during a crisis. Two technologies have been central in improving the qualitative and quantitative value of the knowledge available to decision makers: Data mining techniques and Knowledge management technologies. Adoption of these techniques and technologies will help in taking advantage of all available information both internal and external to the EW systems.

#### EW IN JOINT EXERCISES

The practical meaning of jointness is derived essentially from promoting joint exercises, and will emerge as operational forces work out the myriad aspects of what joint operations entail. Joint exercises are a unique opportunity to exercise component EW capabilities in mutually supportive operations. Identification EW exercise objectives must be consistent with the overall exercise objectives in scope, purpose, and the level of effort. Such exercises must ensure that the development of EW concept of operations is integrated into the larger concept of IO/IW. Missions, organizational procedures, structures and coordination channels must be designed and tried out to meet war time requirements. While

conducting joint exercise(s), it is expected that each service would share their experience and problems faced so that weaknesses can be addressed jointly if need be. Also the strengths of each can be optimized to its maximum effect especially if there are voids in a particular field or application. Peacetime training and operations stress the development of procedures for employment during war.

For training purposes the EW environment in an exercise should be as realistic as possible. However, the need for realism to support training must be weighed against the concern for safety and avoiding disruption of the EM spectrum used by third parties, both civilian and military, outside the scope of the exercise. When planning joint exercises with foreign armed forces, we need to address difficulties that may crop up because of ill-defined security issues, different crypto equipment, differences in the level of training of involved forces and language barriers. We also need to develop a clear and easily understood policy on the disclosure of EW information.

Many important technologies in the area of networking, simulation, virtual reality, and artificial intelligence have moved from behind the walls of military secrecy into the commercial sector. There is an urgent need to develop a "Joint Electronic Combat EW Simulator" to depict force-on-force simulations. Such an initiative would provide enhanced capability to train battle staffs in the planning, execution and evaluation of EW for a wide range of battlefield scenarios. This will also ensure avoiding excessive wear and tear of operationally deployed EW assets. There are also several automated aids and software tools available for war gaming and other allied planning processes. Use of automated tools to integrate different elements of IO/IW would also very useful to EW planning staff. The variables that affect the propagation of EM energy are known and subject to mathematical predictability. The use of automated analysis tools that graphically display transmission paths of such energy can be a useful aid in EW planning.

#### DEVELOPMENT/PROCUREMENT OF EW EQUIPMENT

Reliable, effective and affordable equipment that exploits high technology is essential to provide the battle winning edge. Long term development period of much modern EW equipment require the decision of procurement based on an informed assessment of how the EW threat scenarios likely to emerge over the next ten to twenty years. However this is notoriously difficult to predict. This necessitates procurement priority to be given to systems, which have the inherent flexibility, or can be easily modified or adapted to the changing circumstances. It is hence important to identify those critical disruptive technologies which are likely to have a major

influence on EW capability. It is an acknowledged fact that the present pace of development and productionisation of indigenous EW systems hardly inspires the users. The inordinate delay and huge cost and time overruns are a cause of concern.

There is a need for the apex decision making body of the nation to ensure that EW equipment procurement program integrate the needs of the timely introduction of replacement items, funded and managed on whole life basis with due allowance for planned updates during their life time. Ensuring commonalty of equipment where feasible will not only reduce costs but also ensure greater degree of inter-operability leading to better coordination. Robustness and innate capabilities of domestic defence industries making strategic electronic equipment or under license arrangements is vital. Critical voids need to be made up by procuring minimum operationally inescapable EW assets ex import if need be on priority. Budgetary support for such acquisitions must be ensured. HQ, Integrated Defence Staff (IDS) could prioritize such acquisitions. As EW is technology intensive and thus expensive, there is a case for coordinating the procurement of EW equipment as well as standardization. Certain features like interception of High Frequency signals and Radar surveillance could also be coordinated between the three services. There is also scope for identifying spares of indigenous variety meeting all the essential technical specifications to replace items bought ex import. The present practice of buying 'two years and five years' spares along with the imported main systems needs a relook, especially when indigenous near equivalents are available.

#### MANAGEMENT CHALLENGES

**National Information Board (NIB) :** The Kargil conflict led to a very comprehensive review of our security apparatus and higher defence management. On recommendations of the Kargil Review Committee, the Prime Minister appointed a Group of Ministers (GoM) to examine the national security system and to make appropriate recommendations. Among the many recommendations made by the GoM, setting up of a 'National Information Board (NIB)' was recommended. The NIB was approved by the Prime Minister in May 2002. The National Security Adviser (NSA) was to be the Chairman of NIB with the Cabinet Secretary, the three Service chiefs, Secretaries of all important ministries and heads of intelligence and research organizations co-opted as members. The main charter of such an apex organization would obviously be to develop policies and ensure its implementation by creation of appropriate institutions dealing with IW and Information Security. In doing so, NIB would ensure that the country develops a holistic approach in developing specific IW capabilities.

While the deliberations of NIB would be classified, it is hoped that this body meets regularly and monitors the progress on acquisition of the requisite IW capability keeping in mind the threat posed by our adversaries in the near and long terms. It is a sad commentary that while we are good at setting up such bodies, the follow-up and periodic meetings of such organizations are very unsatisfactory. In addition to the setting up of NIB, it is felt that there is a need for a full time working group on this issue. This group should be well represented by Services, DRDO, academicians, and experts, from legal, finance, industry and other sectors. This group would give inputs, which can supplement requirements and inputs given by Service headquarters. This group must be able to contribute to synergize the efforts at the national level. This group could be named as 'Information Warfare Advisory Group (IWAG).

Based on the national perspective plans, defence services should formulate a five year action plan including setting-up of appropriate institutional structures. Joint perspectives must be borne in mind while formulating service specific plans. To coordinate such efforts at the joint services level, it is recommended that a "Defence Information Operations Agency (DIOA)" be established at the HQ, IDS. As scope of IO extends across a time continuum from 'Peace, Crisis, Conflict and Return to Peace', DIOA could oversee all the related capabilities which includes, Computer Network attack, Deception, Destruction, EW, OPSEC, PSYOPS and related activities of Public affairs and Civil affairs. Such a set-up would help in understanding the environment, assess its interests and the adversary's pressure points and then use whichever capability or related activity that will best affect the adversary. A suggested organization of DIOA is at Appendix 'C'.

**Joint Electronic Warfare Board (JEWB):** Good precedence exists in that we already have a single point joint forum within the Ministry of Defence (MOD) with a charter to synergize the efforts of the three services in enhancing the Jointmanship in Electronic Warfare field, besides monitoring the EW projects implementation of the three services. It is presently chaired by Chief of Integrated Staff to Chairman Chief of Staff Committee (CISC) with members drawn from all the three services as also representatives from all concerned Production agencies and Defence research establishments. Over the years this forum has been actively utilized by the Services, industry's representatives and DRDO to project their views on matters pertaining to production and fielding of EW systems. With no executive authority and financial powers, JEWB is often relegated to an advisory and status monitoring roles only. While the issue of the appointment of a Chief of Defence Staff (CDS) continues to be wide open, the Services need to re-engineer themselves to fit into a mould of

jointness to make the JEWB to play a more pro-active role. Some areas of concern that needs immediate attention include:

- Fielding of Integrated Non-Communications EW systems for the Indian Army.
- Dedicated EW systems for LICO in both Northern and North-Eastern sectors.
- Elevated EW platforms for enhanced range and area coverage.
- Track based EW platforms to support to fast moving and highly mobile mechanized forces.
- Development of Directed Energy (DE) weapons system to damage or destroy adversary equipment, facilities and personnel by a beam of concentrated EM energy or atomic or subatomic particles. Possible applications include lasers, radio frequency weapons and particle beam weapons.
- Satellite Communications and Cellular Communications monitoring systems at the field level.
- Acquisitions of systems to take on enhanced frequency coverage, use of 'frequency hopping' 'communication equipments, induction of 'Software Defined Radio' sets and growing sophistication of anti-jam propagation techniques.
- Qualitative technological improvement of Direction Finding (DF) sub-systems to achieve greater accuracy and flexibility in its deployment.
- With increasing use of secrecy devices as also use of 'frequency hopping sets', detection and interception of signals/messages have become more challenging. Technology forecasting must be an ongoing exercise in the design and configuration of EW systems, integrated or discrete.

### Joint Services EW Group for ANC

Flowing from the Task Force recommendations, ANC was established in 2001 as part of a larger plan to enhance inter-service integration and promote 'jointmanship'. ANC has no dedicated EW set-up in its ORBAT, as on date. It is for consideration that a dedicated 'Joint Services EW Group' be raised to provide the EW support to ANC for its strategic and operational missions. This would form the basis for other such integrated commands that may be set up later. In carrying out their assigned tasks, their responsibilities would include some of the following;

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- Coordinate EW operations with other strategic/operational/tactical operations.
- Joint EW planning efforts and preparation EW appendices to Operation plans.
- Supervise the implementation of EW policies and instructions within the ANC Commander's operational area and supervising the adaptation of those plans to meet operational contingencies.
- Preparation of the JFRL for specific operations and exercises within the operational area.
- Monitor the number, type and status of EW assets within the operational area or involved in specific operations or exercises.
- Supervising the analysis of EW plans and activities during operations and exercises within the operational in order to derive lessons learned.

The exact composition and structure of the proposed Joint Services EW Group could be worked out by a team of EW experts from each Service and the Coast Guard and based on the availability of EW assets and participating force levels. In fact this exercise could be a good test bed for future guidance as and when more Unified Theatre Commands are raised from within the existing resources.

### LANGUAGE SPECIALISTS/TRANSLATORS AND INTERPRETERS

This is a weak area which needs to be tackled on a priority. Both operations, namely Pawan (in Sri Lanka) and Vijay (Kargil) highlighted the reality that the MOD/Service HQ needs a significantly improved organic capability in languages and dialects of our neighbourhood region and a greater competence and regional area skills, especially in view of the 'out-of-area' contingencies. MOD needs to evolve a comprehensive road map to achieve this competency and keeping in mind a surge capacity to rapidly expand this capability at short notice.

### EW SUPPORT TO SPACE BASED OPERATIONS

Space is inexorably becoming the new high ground and Star Wars are no longer in the realm of science fiction. Physical destruction, laser blinding and electronic warfare are all likely to be employed to deny the enemy the use of his satellites and to safeguard the use of one's own satellites for their force multiplier value. India is on the threshold of entering a new era in space exploitation. There is a need to deliberate on how best the space assets could be integrated into our military operations. To this end

it is learnt that the IAF has established a Space sub-branch at Air Headquarters. It has also recommended the setting up of an "Independent Aerospace Group" to liaise with the Department of Space as the next 'logical step'. On the sidelines of an international seminar on Aerospace the former Air Chief, Air Chief Marshal SP Tyagi went on to say that the Government is seriously considering the creation of a tri-service Aerospace Command. The Defence Space Vision --2020 which outlines the road map for the Armed forces in the realm of space includes intelligence, reconnaissance, surveillance and navigation as the thrust areas in its first phase (2007-2012).

The ability to restrict or deny freedom of access to and operations in space is no longer limited to global military powers. Knowledge of space systems and the means to counter them is increasingly available on the international market. Nations if they wish can possess or acquire the means to disrupt or destroy an adversary's space systems by attacking the satellites in space, their communication nodes on the ground and in space, or ground nodes that command the satellites. The reality is that there are many extant capabilities, such as Anti-Satellite Weapons, Denial and Deception measures, Jamming, use of micro satellites, hacking and nuclear detonation that can deny, disrupt or physically destroy space systems and the ground facilities that use and control them.

More and sophisticated technologies for jamming satellite signals are becoming available. For example, it is learnt that Russia is marketing a handheld GPS jamming system. A one watt version of such a system, the size of a cigarette pack is able to deny access to GPS out to 80km; a slightly larger version can deny access upto 192 km. Both are compact and powerful enough to jam an aircraft's GPS receiver signal, which could disrupt military missions or create havoc at an airport. Such indicators of the potency of EW needs to be taken cognizance of and appropriate defensive steps initiated.

#### EW SUPPORT TO NATIONAL STRATEGIC ASSETS

India maintains a "no-first-use" "minimum nuclear deterrent," nuclear policy in the event of war as enunciated in its Nuclear Doctrine, released in 1999. India's Strategic Forces Command (SFC) was formally established in 2003. The joint services SFC is the custodian of all of India's nuclear weapons, missiles and assets. It is also responsible for executing all aspects of India's nuclear policy. However, the civil leadership, in the form of the Cabinet Committee on Security (CCS) is the only body authorized to order a nuclear strike against another offending strike. In effect, it is the Prime Minister who has his finger "on the button".

A Nuclear Weapon State (NWS) would normally need to have the following nuclear weapons infrastructure in place to ensure that it has a functionally effective nuclear force to meet its national security objectives:

- Research and development laboratories and testing facilities, including for computer simulation-based testing.
- Weapons manufacturing complex to produce fissionable material for warheads and to manufacture nuclear warheads.
- The nuclear arsenal, which would include ready warheads and the delivery systems necessary for delivering them on the selected targets—SSMs, ICBMs, IRBMs, fighter-bomber aircraft and SLBMs—and the base required for the storage and maintenance of nuclear weapons, along with the training and supply of nuclear forces.
- An integrated satellite, aerial and ground-based surveillance system to provide information and intelligence about the activities of inimical countries and to gather data for 'targeting'.
- An early warning and attack assessment system of radars, other sensors and processing stations to detect and provide inputs of warning and categorize attacks.
- A C2 structure to analyze data, make decisions, plan, direct and control the targeting and employment of nuclear weapons, should it ever become necessary.
- A fail-safe communication system with built-in redundancy to link the surveillance, early warning and command and control systems with the nuclear forces so as to distribute warning data and ensure the timely passage of execution commands.
- And, a well-conceived and rehearsed civil-defence system to minimize damage, treat casualties and to assist the civil population to recover from the ravages of nuclear explosions.

It is obvious that effective C2 of nuclear forces cannot be organized without appropriate communications, credible intelligence capabilities, survivable surveillance and reconnaissance means and computer networks to process the voluminous inputs and present suitable options for targeting and attack. In short, what is now called a C4SR system. Such systems would require a sound ECCM in place to ensure that the response that is visualized is executed with certainty and speed. The EW support must ensure that a viable C2 system fulfilling the following conditions exist:-

- It should be able to absorb a first strike and continue to function effectively.
- It should have real-time reconnaissance capability for the National

Command Authority (NCA) to assess the damage sustained, take stock of nuclear forces still available and their deployment areas to assist in the formulation of a plan of retaliation.

- It should have adequate computer processing facilities to permit rapid re-targeting of missiles and other nuclear forces prior to launch.
- There should be continuous, fail-safe two-way communications between the NCA and the nuclear forces for an appropriate response.
- And, a channel of communication with the adversary must remain available to permit negotiations for escalation control and conflict termination. (Strategic Analysis- IDSA, January 2000, Vol. XXIII, no. 10).

#### CONCLUSION

The current 'Revolution in Military Affairs (RMA) is based around the proliferation of information aids, electronic target acquisitions, and rapid decision-making to seize fleeting opportunities in the battlefield. Without doubt, the current RMA is one of information: what is it, who has it and how it is transmitted?

IW will dominate 21st century conflict. Those, whose detection instruments sequentially gather, interpret and disseminate faster than their opponents will make the most appropriate decisions and therefore execute the most effective operation. It is likely that the operational environment will be characterized by greater lethality, dispersion, increased volume and precision of fire. Better integrative technology leading to increased efficiency and effectiveness will be another feature of modern warfare. One will also witness a paradox of greater invisibility and increased delectability. Such a battlefield scenario will call for joint application of force and fighting as an integrated whole.

It also follows that future battlefields will be shaped by the deliberate targeting of an adversary's C2 systems, thereby limiting his capability for re-organization, redeployment and logistic reinforcement. The ability for the commander to 'see' the adversary's organization and interpret its moves provides him with the opportunity to attack in such a manner that he can destroy the adversary's ability to reorganize his combat power. The US experience in the recent Gulf wars highlighted the worth of this type of targeting; within hours of the 'air war' commencing, the Iraqi C2 system was significantly degraded.

However, friendly C3 systems, data networks and communication nodes will be increasingly threatened by an array of 'technology based,

EW 'soft-kill' systems focusing on the selective destruction of these assets. It is imperative that the commander implements a structured, deliberate procedure to ensure that his decision process and tools are protected. To achieve this level of security to our own assets and threat to the adversary, the EW capability of the deployed force must be organic to the organization. Such an arrangement will offer the commander a heightened degree of accurate and timely target detection, identification and response. A holistic approach to EMS management is vital to ensure unity of effort and efficiency of provision of the spectrum so as to maximize available combat power and retain the freedom of action on the battlefield.

The integration required for successful application of EW in joint operations means that planning must be conducted at the highest level. A dedicated organization for this purpose is a must at the Joint Force Headquarters wherein EW operations are dovetailed into the operations plan. Planning and conduct of Joint EW operations must be conducted based on a sound EW joint doctrine in accordance with advances in technology and place the personnel with the most responsibility for the conduct of EW at the forefront of the planning process. Dedicated staff of EW set-up must ensure that EW planning starts in the early stages of Joint operations planning and are coordinated with other aspects of operations plan every step of the way. Planning guidance for EW should be included in an operations plan. The review of lessons learned from previous, similar joint operations, exercises is an important and cost effective way to avoid documented mistakes committed earlier. Effective EW starts with well trained and qualified people and sound guiding doctrine backed by well established and practiced procedures.

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Appendix 'A'

(REFERS TO PARAGRAPH 12)

CHARTER OF RESPONSIBILITIES JEWCC

1. Coordination with tactical operations and other members of the Operations and Planning Staff.
2. Drafting and Supervision of the implementation of EW policies and instructions within the commander's operational area.
3. Serve as the command's principal delegate to EW planning and coordination meetings within the operational area.
4. Supervision of EW planning efforts and the preparation of EW appendices to operation plans.
5. Coordination of the planning for and preparation of EW in joint exercises within the commander's operational area.
6. Monitor the number, type, and status of EW assets within the operational area or involved in specific operations or exercises.
7. Represent EW interests in the preparation of the JRFL for specific operations and exercises within the operational area.
8. Monitor the execution of the EW plans in current operations and exercises within the operational area and supervising the adaptation of those plans to meet operational contingencies.
9. Coordinate and supervising the analysis of EW plans and activities during operations and exercises within the operational area in order to derive lessons learned.
10. Supervise the preparation and submission of EW lessons learned in accordance with After-action reports.

Appendix 'B'

(REFERS TO PARAGRAPH 13)

CHARTER OF RESPONSIBILITIES-JFMC

1. Develop and distribute spectrum use plans that include frequency re-use and sharing schemes for specific frequency bands as appropriate.
2. Periodically update and distribute JFRL as necessitated by changes in operation plans/tasking and phases of operations.

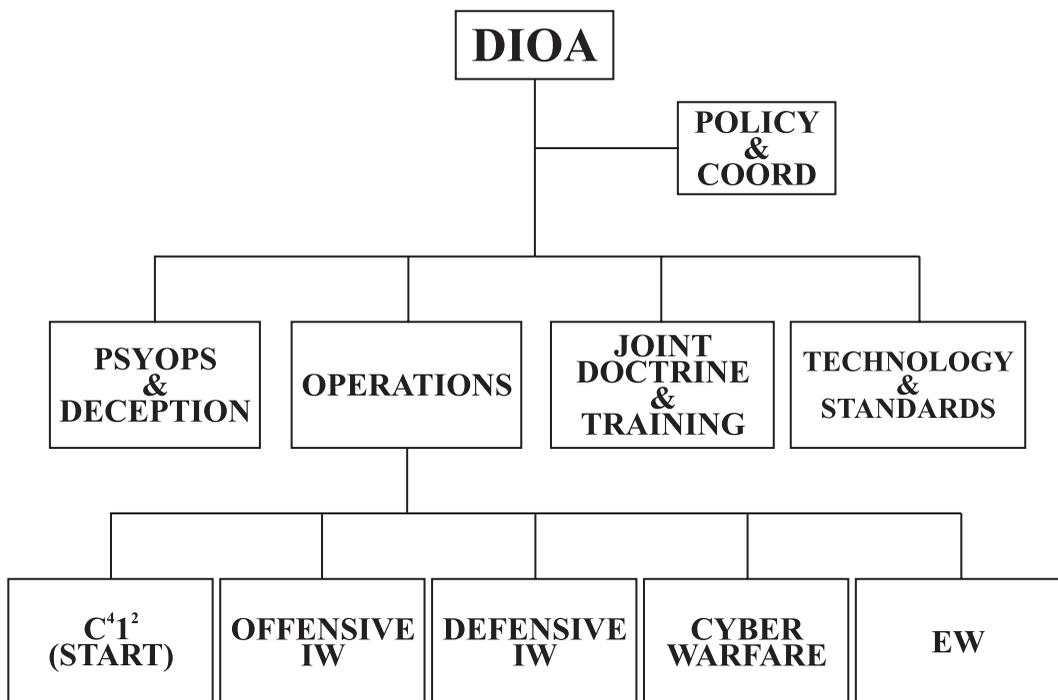
*Exploiting the Electro-Magnetic Spectrum in Jointmanship*

3. Provide administrative and technical support for military spectrum use.
4. Exercise frequency allotment and assignment authority allowing maximum latitude and flexibility in support of combat operations.
5. Establish and maintain common data base necessary for planning, coordinating and controlling spectrum use. This data base should contain spectrum use information on all emitters and receivers, military, civil available as appropriate for the area of responsibility involved.
6. Analyze and evaluate potential spectrum –use conflicts.
7. Receive, report on, analyze and attempt to resolve incidents of unacceptable electro-magnetic interference and refer incidents that cannot be resolved to the next higher spectrum management authority.

Appendix 'C'

(REFERS TO PARAGRAPH 22)

DEFENCE INFORMATION OPERATIONS AGENCY (DIOA) – HQ IDS



Appendix 'D'

(REFERS TO PARAGRAPH 28)

SUMMARY OF RECOMMENDATIONS

**Establishment of a Joint EW Control Centre (JEWCC):** (para 12). Like other aspects of joint operations, joint EW planning necessitates the setting up of a JEWCC. Such an entity will ensure that EW planning starts in the early stages of operational planning and coordinated with all aspects of operational planning in every step of the way. Suggested charter of responsibilities of JEWCC is at Appendix A.

**Setting up of Joint Frequency Management Centre (JFMC):** (Para 13). Most of the elements and activities of IO depend on, use or exploit the EMS for at least some of their functions. The deconfliction and coordination of EW activities is a continuous process and is best performed by the proposed JFMC. Suggested charter of responsibilities is at Appendix B.

**Compilation of Joint Restricted Frequency List (JRFL):** (Para 13). The preparation of JRFL—a time and geographically oriented list of frequencies to include Protected/Guarded/Taboo functions, nets and frequencies is an important prerequisite for the conduct of joint EW operations. JRFL is a critical management tool in the effective use of EMS during military operations. Care must be taken to ensure that it is limited to minimum number of frequencies.

**Formulation of EMCON plan:** (Para 13). EMCON very briefly is the selective and controlled use of EM, Acoustic or other emitters to optimize C2 capabilities while minimizing operational security, viz., detection by enemy sensors minimize mutual interference among friendly systems and/or execute military deception plan.

**Formulation of a 'Joint EW Doctrine':** (Para 14). Doctrine is a codification of professional norms and practice. While some beginning has been made in the form of the issue of a 'Joint IW doctrine', it should logically lead to the next step of the formulation of a 'Joint EW Doctrine'. Such a publication will ensure that all functional element of EW are guided in the support of joint operational objectives. A suggested scope of such a publication has also been indicated in the paper.

**Interoperability issues:** (Para 15). It is suggested that at the HQ, IDS, a separate functional entity be set-up to initiate and oversee joint interoperability and integration initiatives and to suggest materiel and non-materiel solutions to interoperability challenges. This can be best done by working closely with the three services, DRDO and other

government/public/private production agencies. This special entity could enlarge its scope of jurisdiction to include C3I and other combat support systems thereby increasing combat effectiveness through interoperability.

**Maintenance of EW Data Bases:** (Para 17). Automated Databases assist EW planners in providing an easy access to a wide variety of platform –centric technical data useful in assessing the EW threat and planning appropriate response to that threat.

**EW in Joint Exercises.** (Para 19). Joint exercises provide a unique opportunity to exercise component EW capabilities in mutually supportive operations. EW exercise activities must be well planned in order to balance EW training objectives with other training objectives. Because of the complexity of good EW planning and the impact that EW has on many other areas of joint operations, EW should be included in joint exercises. Post exercise and Evaluation prior to the conclusion of the exercise will help in compiling and documenting lessons learned.

**The Use of Simulators, Planning Process Aids and Graphic Analysis Tools:** (Para 20 refers). Many important technologies in the area of networking, simulation, virtual reality, and artificial intelligence have moved from behind the walls of military secrecy into the commercial sector. There is an urgent need to develop a “Joint Electronic Combat EW Simulator” to depict force–on–force simulations. Distributed interactive simulation, and networked virtual reality features offer tremendous opportunities for EW planning in a network centric environment. Incorporation of models of EM propagation will serve as a useful guide in the graphic display of transmission paths of EM energy. Such aids combined with operational experience would result in greater refinement of the art and science of application of EW in the new emerging ways of warfare.

**Development/Procurement of EW Equipment:** (Para 21). Though some new initiatives have been set in motion in the recent past to streamline procurement procedures, the in-ordinate delays in the development of indigenous EW systems are a cause of concern. Indigenous project “SAMYUKTA” is a case in point and could provide some useful lessons for the future. Critical voids that exist in our inventory need to be made-up, even if need be by importing systems. Budgetary support for such acquisitions must be assured. HQ IDS could prioritize such requirements. Technology forecasting must be an ongoing and concurrent activity in the design and configuration of future EW systems. Standardization and spares management would be a welcome step in enhancing Jointmanship.

**Functioning of National Information Board (NIB):** (Para 22). An apex organization NIB at the national level has been tasked to formulate National level IW policy in consonance with the overall national security perspective, direction, control and funding. It needs to be appreciated that the issues involved are of unprecedented complexities and interwoven dependence at the levels of individual functionaries, organizations at the political, economic and social domains, more often with tremendous clash of interests. Periodic monitoring of various institutions and dedicated establishments towards acquisition of requisite IW capabilities must be done. At the national level a 'think tank' in the form of an 'Information Warfare Advisory Group (IWAG)' has been suggested in the paper. Defence Services in turn should formulate long term plans to begin with a 'five year' plan along with appropriate institutional structures. Joint perspective must not be lost sight off. To coordinate such efforts in conjunction with DRDO, a dedicated agency to be called as '**Defence Information Operations Agency (DIOA)**' has also been suggested. Its main task would be monitor and allocate resources to various institutions/specific IO capabilities being developed across the entire time continuum extending from peace to crisis to conflict and back to the restoration of peace. A suggested organization of DIOA is given at Appendix 'C'.

12. **Functioning of Joint Electronic Warfare Board(JEWB).** (Paragraph 23 refers). This forum has been functioning for some years. Efforts must be made to make this forum to play a more pro-active role in giving an increased sense of urgency for timely execution of EW projects. Areas of concern requiring more focused attention have been identified in the study.

13. **Fielding/Raising of a Dedicated Joint Services EW Group for the Andaman and Nicobar Command (ANC).** (Paragraph 24 refers). There is an operational requirement to have dedicated '**Joint Services EW Group**' for the ANC in view of the strategic role(s) assigned to it. The exact composition and structure of the proposed EW Group can be worked out by a study group comprising of members from all the three Services and Coast Guard and based on the availability of EW assets and the levels of participating forces. Such an initiative would also serve as a test bed for refining our doctrine/concepts of Joint EW operations. Suggested tasks that could be assigned to this EW group have also been stated.

14. **Availability of Language Specialists/Translators and Interpreters.** (Paragraph 26 refers). MOD needs to evolve a comprehensive road map to achieve adequacy and competency of personnel in languages and dialects of our neighborhood region especially

in view of the 'out-of-area' contingencies. We also need to keep in mind a surge capacity to rapidly expand this capability at short notice.

**15. Institutional Support for Development of IW Expertise.**

(Paragraph 27 refers) An '**Institute of Information Warfare (IIW)**' has been recommended to be set up either as an independent entity or to begin with an enlarged faculty at one of the existing premier training establishments under the proposed Indian National Defence University (INDU), with experts drawn from the Services, DRDO scientists, IT professionals and experts from political, legal and financial fields. Combat specific institutional support should be extended from service specific/joint training institutions.

**16. EW support to SFC and Proposed Aerospace Command.**

(Paragraph 28-30 refers) These are emerging arenas for joint working in the future and would need some deliberation to identify dedicated EW support. Aspects which merit attention have been identified in the study.□