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ANALYSIS OF ELECTRONIC WARFARE BY PLATFORM AND WARFARE AREAS. (U)
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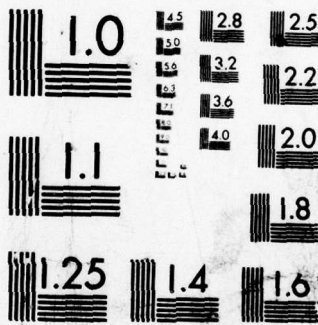
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ANALYSIS OF ELECTRONIC WARFARE BY PLATFORM AND WARFARE AREAS

P. C. Fletcher

15 February 1979

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Electronic Counter-Countermeasures Countermeasures Electronic Warfare Platforms Military Intelligence		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Electronic Warfare (EW) is analyzed with respect to its role in the "information war," namely, as the interface between the electronic systems of friendly and enemy forces. It is then broken down by function and platform. Past attempts to synthesize these elements of EW into fighting the "information war" are discussed and the need for including all the elements of EW into this war are pointed out. Recent attempts along these lines are briefly mentioned.		

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ANALYSIS OF EW BY PLATFORM AND WARFARE AREA

A fundamental concept of warfare is that of the "information war."¹ Electronics and electromagnetics are the major means for conducting this information war (which must be viewed as ongoing during periods of peacetime, cold war or hot war). A major aspect of the information war is the activity that takes place at the interface between our electronic systems and those of our adversaries. This interaction is called electronic warfare (EW).

From a top level, top down point of view, EW should be seen as one characteristic activity (= function) of an integrated warfare system. When the warfare system is partitioned into subsystems, the allocation of EW functions to these subsystems is part of the overall partitioning process. The specification of the *EW function* of the warfare system and subsystems is identical to the functional specification of the *interface* of our warfare system with those of our adversaries.

This interaction can only be properly specified with a knowledge of the electronic/electromagnetic capabilities of both sides. For this reason, electronic intelligence (ELINT) and other intelligence sources ought to be viewed as part of the system analysis/system management process by which we arrive at the specification of the distributed EW function when we do long-range planning and when we must adapt to emergent tactical situations.

We may now compare this concept of EW with the published definition by JCS: "A military action involving the use of EW energy to determine, exploit, reduce, or prevent hostile use of the EM spectrum and includes activities designed to preserve our advantageous use of the electromagnetic spectrum. This includes enemy's use of optical and infrared means. The EMC concern with EW is the assurance that denying the use of the EM spectrum to the enemy will not also prevent the friendly use of the EM spectrum." The reference further subdivides EW into its three subgroups, Electronic Countermeasures (ECM), Electronic Counter-Countermeasures (ECCM), and Electronic Support Measures (ESM). Further breakdown in the JCS publication is included as appendix A in NOSC Technical Note 3242A.²

However, following the concept of EW in paragraph one, we may break the information war down into its characteristic activities (functions) of surveillance (including detection, location and identification), communication, command and control (including navigation), and weapons electronics (including targeting and guidance). See figure 1. ECM can be considered our attempt to prevent the enemy's information warfare functions from operating. It can be seen to have three parts, counter-surveillance, counter-communication and counter-weapons electronics. ECCM may be considered our attempts to operate our information warfare functions in the presence of enemy attempts to stop them. It may also be divided into three functions: surveillance, communications, and weapons electronics. ESM may be considered to be local (tactical) attempts to determine the status of the enemy in order to support either our ECM or ECCM efforts. Thus, the subgroups of EW break down as given in figure 2. (Common usage of ESM is support to surveillance and weapon CM,

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1. See, for instance, Paul Moose, *Operational Intelligence, Command & Control, and Surveillance: A Perspective*, (to be published).
 2. Naval Ocean Systems Center Technical Note 3242A (Revision), by P.C. Fletcher, 27 October 1976 (revised 8 February 1977).

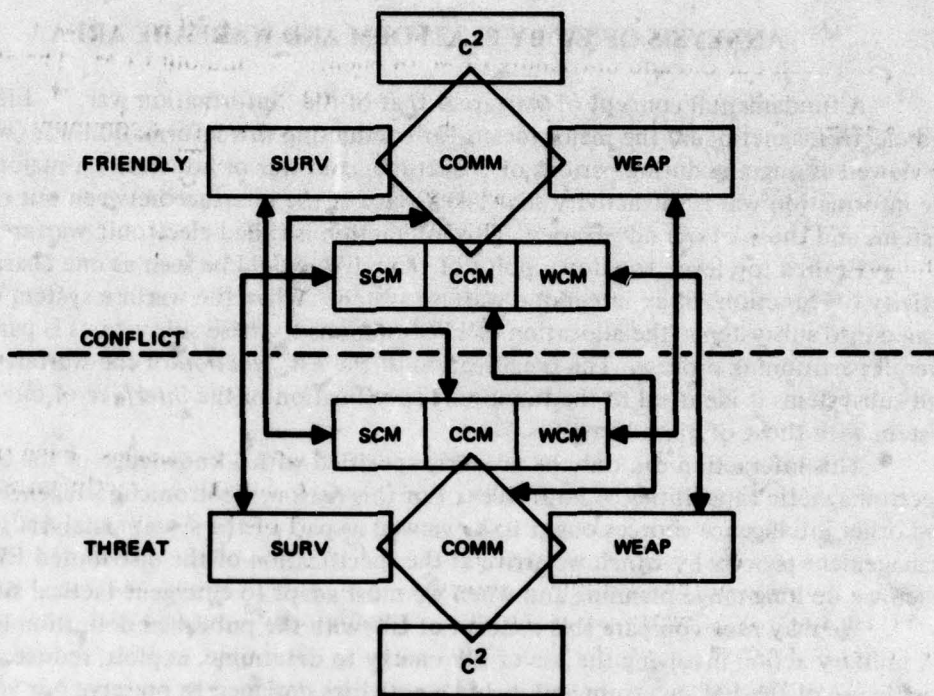


Figure 1. Functions of warfare.

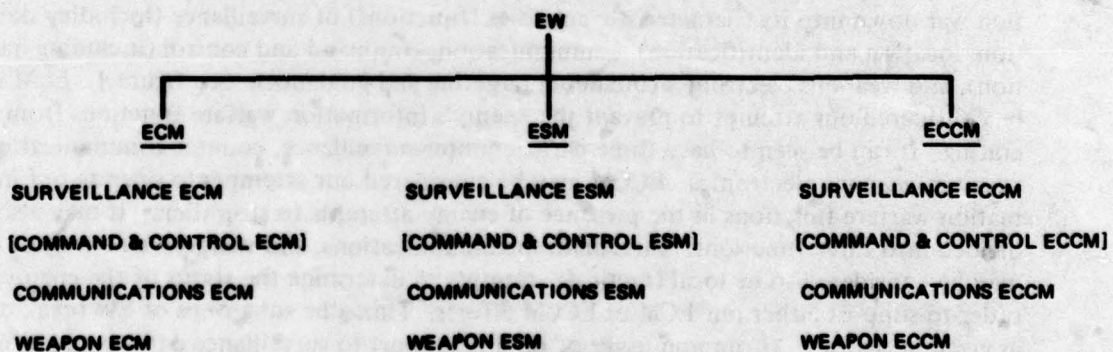


Figure 2. Information warfare functions of electronic warfare.

leaving communication CM and ECCM to support themselves.) We then see the interactions occurring between our CM and unfriendly CCM, or enemy CM and our CCM. The electronic war is then divided into six battles (shown by arrows in figure 1).

Additional unwanted interactions, such as interference between communication and radar systems, also occur between friendly information functions. They are classed under Electro-Magnetic Compatibility (EMC). Because of close proximity, these interactions are often more severe than any that occur from unfriendly information functions. In order for a command system to operate its own information war and disrupt the enemy information war, it must be allowed maximum freedom of operation of each of its functions. Thus, EMC must be considered an important part of the information war.

Although the foregoing begins to give us an outline of EW functions, there is not yet enough detail in the description of EW to allow identification of specific needs of EW, Navy organizations in EW, or specific ongoing programs of EW. For this reason, we have further subdivided EW into groups according to platforms and technologies. Each function (forgetting for the moment C^2 , which controls but does not interface directly with the enemy) involves two platforms, the launching platform and the target platform. (Surveillance and weapons involve one friendly and one unfriendly; communications involves 2 friendlies.) For each of the functions – surveillance, communications, and weapons – we can draw a matrix of platforms as shown in figure 3. Numbers can then be placed within the boxes that refer to the technologies that perform the function. For instance, observing a satellite from another satellite would probably involve electro-optics or infrared imagery, which are designated 1-PO on our chart, 3a. The technologies for the three functions and their use matrices are given in figures 3a, 3b, and 3c. These are the systems that need careful consideration of their ECCM capabilities.

FROM	TO				
	SATELLITE	AIRCRAFT	SURFACE	SUBMARINE	SHORE
SATELLITE					
AIRCRAFT					
SURFACE					
SUBMARINE					
SHORE					

Figure 3. Platform matrix.

The problem of ECM is two dimensions more difficult. First, the countermeasure platform need not be the target platform. Thus, for each number in all three matrices, consideration must be given to all platforms which could effect a countermeasure. Second, for each system, there are a number of alternative courses of action ranging from the passiveness of (1) exploiting, through the more active tactics of (2) hiding, (3) avoiding, (4) deceiving,

SURVEILLANCE PLATFORM	SURVEILLANCE TARGET PLATFORM				
	SATELLITE	AIRCRAFT	SURFACE	SUBMARINE	SHORE
SATELLITE	PO	AS,PU,PS,PO	AS,PU,PS,PO	PU,PS,PO	AS,PO
AIRCRAFT		AS,AO,PS,PU	ALL-8	AO,PO	PO,PS,PU,AO,AS,AU
SURFACE		AS,AO,PS,PU,PO	PA,AA,AU,AS	AA,AO,PA,PO	AS,PU,PS,PO
SUBMARINE		AS,PO,PS,PU,PA	AA,AS,PO,PS,PU,PA	AA,PA	
SHORE	AO,PS,PO	AU,AS,PU,PS	AU,PA,PU	PA	AU,AS,PU,PS

SYSTEMS TECHNIQUES

- | | |
|---------------------------|--------------------------|
| 1. PASSIVE EO/IR - PO | 5. ACTIVE EO/IR - AO |
| 2. PASSIVE ABOVE UHF - PS | 6. ACTIVE ABOVE UHF - AS |
| 3. PASSIVE BELOW UHF - PU | 7. ACTIVE BELOW UHF - AU |
| 4. PASSIVE ACOUSTICS - PA | 8. ACTIVE ACOUSTICS - AA |

TOTAL SYSTEMS - 79

Figure 3a. Surveillance - platform matrix.

LAUNCH PLATFORM	TARGET PLATFORM				
	SATELLITE	AIRCRAFT	SURFACE	SUBMARINE	SHORE
SATELLITE	LOS,SAT	LOS	LOS	BLOS,LOS	LOS
AIRCRAFT	-	LOS,SAT	LOS	LOS	BLOS,OTHER
SURFACE	-	-	BLOS,ELOS,SAT	ACC,OTHER	BLOS,SAT
SUBMARINE	-	-	-	ACC,OTHER	ACC,SAT,OTHER
SHORE	-	-	-	-	BLOS,SAT,OTHER

COMMUNICATION TECHNIQUES

- | | |
|----------------------------------|---|
| A. DIRECT | B. WITH RELAY |
| 1. BEYOND LINE OF SIGHT (BLOS) | 5. RELAY - SATELLITE |
| 2. EXTENDED LINE OF SIGHT (ELOS) | 6. RELAY - AIRCRAFT (A/C) |
| 3. LINE OF SIGHT (LOS) | 7. RELAY - REMOTE PILOTED VEHICLE (RPV) |
| 4. ACOUSTICS | 8. RELAY - OTHER |

Figure 3b. Communications - platform matrix.

LAUNCH PLATFORM	TARGET PLATFORM				
	SATELLITE	AIRCRAFT	SURFACE	SUBMARINE	SHORE
SATELLITE	(M)	(M)	(M)	(M,T)	(M)
AIRCRAFT	(M)	M	M,T,G,Mi	T,Mi	M,G
SURFACE	-	MG	M, (T), (G)	T,Mi	M,(G)
SUBMARINE	-	M	M,T	T	-
SHORE	M	M,G	(M)	-	M

WEAPON TYPE () MEANS IN FUTURE

1. MISSILE - M
2. TORPEDO - T
3. GUN - G
4. MINE - M
5. OTHER - O

GUIDANCE

1. PASSIVE
 - a. UHF
 - b. SHF
 - c. MM
 - d. OPTIC/IR
2. ACTIVE
 - a. SHF
 - b. (MM)
 - c. (OPTIC)

Figure 3c. Weapon - platform matrix.

(5) confusing, (6) disrupting to (7) destroying. In addition, there may be two or three techniques to countermeasure some of the subfunctions/techniques of figures 3a, 3b, and 3c. Thus, in satellite surveillance mentioned above, one could exploit, for example, from other satellites, aircraft or the ground/surface. This exploitation could take the form of determining position of satellite or other platforms, identification, or even alerting to enemy action.

Thus, where the specification for an ECCM technique might include the function, function/launch platform, target platform, and technology, the specification for an ECM technique must include the function, function/launch platform, target platform, ECCM technology, ECM platform, ECM action and perhaps ECM technology. Thus, although there might be only about 30 kinds of systems for each of the major functions of surveillance, communications, and weapons, there are over 100 CM for each of the major functions, ie, 3-4 CM's per subfunction. Since each of the subfunctions must consider all possible countermeasures, there must be over 100 ECCM considerations for each function. Each of these ECM-ECCM considerations may be considered a "battle" in the information war, so one has to account for over 300 battle types. In an actual fighting war, not all of these are going on at once but there is usually more than one battle of a given type going on at any one time since there are many missiles of the same type and several platforms of the same type operating simultaneously. Thus, there may be thousands of information battles going on, each with thousands of signals per second in the electromagnetic environment. EW specialists estimate millions of signals per second as the expected EM environment. It is in this environment that we must make our surveillance sensors, communication links, and our weapons operate and, further, cause the enemy to not function.

The discussion, thus far, has been given for several reasons: first, to provide a common basis for understanding and discussion; second, to give a better appreciation of the complexity that demonstrates the need for an allocation of the C² resources to control the EW

interface; and third, to give to designers of equipment an appreciation of the environment in which their equipment must work.

The process of breaking down EW into its basic elements, as done above, although very multifaceted, is reasonably straightforward compared to the process of synthesis and integration of these elements in a way to optimally carry on the information war and perform a mission. Historically, when functions, such as surveillance, communications, and weapon electronics, were performed on a single platform, the platform was the actual focal point for integration. Thus, we see strong focus in the Navy organization on aircraft (NAVAIR), ships and submarines (NAVSEA). (Satellites came after the platform concentration so we see less concentration on them.) For example, the ship community encompassed all functions from a ship (a row on figures 3a, b, and c). As our ability to coordinate platforms increased, organizations were formed to integrate these into specialized task oriented groups. Thus we have such groups as the Antisubmarine Warfare (OP95), Submarine Warfare (OP02), Surface Warfare (OP03), Air Warfare (OP05) communities. The relationship of some of these communities to our platform matrix is shown in figure 4. As these task groups could work together as independent groups, their operations could coordinate the functions of surveillance, communications, weapons, and countermeasures, without support from other task forces or shore facilities. One could talk about the enemy being "over there" and our task force being "over here," ie, not much intermingling of forces. Electronic countermeasures could be accomplished either by stand-off techniques or by penetration of "enemy seas." Now, with the extension of range of our sensors and weapons, and the intermixing of forces, one begins to organize around the functions that serve the entire Navy worldwide. We see now a fairly sharp trend toward total Navy integration of the electromagnetic functions with the command function. Thus, information war is labeled Command, Control, Communications and Intelligence (C³I) by DOD and SECNAV. (The Army and NATO follow the Soviets and call it Radio Combat. The Air Force is still undecided, but will probably go C³I, following DOD.) The CNO organization is slowly forming a concentration of these electromagnetic functions in OP94 (OP941 is COMM, OP942 is C², OP943 is architecture, OP944 is Electronic Warfare, and soon to be in OP94 is Ocean Surveillance). Similarly, NAVELEX (and particularly PME108) is broadening its C² charter to include the total information war.

Regardless of its title or organization, one must consider the process of integration of the "pieces" of electronic warfare as an important function of EW, and one with a considerable overlap with the C² function. And, as the control of electromagnetic systems becomes more centralized (perhaps from shore, even), the problem of EMC becomes more acute and meaningful as a part of the information war.

At the same time that we see a focussing of our information assets, we see attempts to counter the enemy information assets in a coherent way. Thus, if we call C³I our attempts to fight the information war, then counter C³I is our attempt to counter the enemy's information assets. We call such a program C-C³, although I suspect some attempts are also made to counter the enemy intelligence operations. Obviously we do not hear much about these, but they should certainly revolve around our other counter C³ efforts.

ATTACK PLATFORM	DEFENSE PLATFORM				
	SATELLITE	AIRCRAFT	SURFACE	SUBMARINE	SHORE
SATELLITE	(SPACE WARFARE)				SATELLITE DEFENSE
AIRCRAFT		TACAIR	TACAIR STRIKE WF (MINE WF)	ASW (MINE WF)	TACAIR
SURFACE		AIR DEFENSE SURFACE WF	SURFACE WF	ASW	STRIKE WF AMPHIBIOUS WF
SUBMARINE		SUBMARINE DEFENSE	SURFACE WF	ASW USW	AMPHIBIOUS WF
SHORE	(SPACE WARFARE)	AIR DEFENSE	AMPHIBIOUS WF MINE WF	MINE WF	STRATEGIC WF LAND WF

Figure 4. Warfare – platform matrix.

In conclusion, then, we see (1) that EW, as the interface between the electronic equipments of ourselves and our opponents, plays a major role in the specification, operations and success in fighting the “information wars,” (2) that EW involves all functions of the information war including surveillance, communication, weapons electronics, and their countermeasures and (3) that success in the “information war” depends on a careful trade-off between the many functions and platforms involved.