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UNIFIED ELECTRONIC WARFARE CONCEPTS IN SYSTEMS OPPOSITION

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ABSTRACT Analyzes the systems electronic warfare characteristics of a new generation of antiaircraft systems, systems composition, as well as main functions. Inquires into defense penetration unified electronic warfare modes which can appear during limited wars in the future.

SUBJECT TERMS System opposition Electronic opposition Air defense system

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## 1 FORWARD

As far as the important role of electronic warfare in modern war is concerned, it has forced air defense weapon systems designers to unceasingly renovate design concepts, strengthening the anti-jamming capabilities of anti-aircraft weapons systems in order to increase their effectiveness in "offensive and defensive opposition". The design concept of "system opposition" takes the entire air defense network and makes it act as a single unified, coordinated, mutually compensating, comprehensive air defense system in order to increase the overall anti-jamming capabilities of air defense systems.

With regard to the "system opposition" concept, it will use the hard and soft kill and damage means and resources possessed by the attacking side, such as, radars, photoelectronics, infrared, communications, marine acoustic, active, passive, and so on, to form a unified electronic warfare system which is coordinated, highly effective, and mutually compensating.

## 2 ELECTRONIC WARFARE CHARACTERISTICS OF A NEW GENERATION OF AIR DEFENSE SYSTEMS

Such advanced nations as the U.S. and the Soviets, under the guidance of the "air land battle" operational concept, have stressed great depth in three dimensional air defense and active defense. Besides this, after the Gulf War, a number of nations--in order to increase the military operational capabilities of air defense systems under electronic jamming--will make large investments in the area of countering jamming.

### 2.1 Characteristics of a New Generation of Air Defense Systems in the Area of Electronic Warfare

#### (1) Employment of Multiple Types of System Radars, New Guidance Methods, and Anti-jamming Communications Equipment

In such radio electronic links of air defense as warning, in flight guidance, detection and tracking, guidance, communications control, and so on, opting for the universal use of technologies to strengthen anti-jamming capabilities.

- New system radars: radar systems with such anti-jamming strengths as full coherence, pulse compression, quick frequency change, phase control arrays, dual (multiple) base radars, MTI,

pulse Doppler, and so on.

- Guidance systems: Composite guidance heads, taking such active and passive guidance heads as radar, photoelectric, infrared, television, and so on, and putting them together in pairs to form one system. This takes advantage of their strengths and avoids their weaknesses, increasing antijamming capabilities. Millimeter wave guidance heads. Jamming source homing guidance heads. The combined application in a selective way of various types of systems such as command guidance, active guidance, semiactive guidance, inertial guidance, TVM guidance, and so on, on the same weapon element in order to increase antijamming capabilities.

- Communications control: Radio communications opt for the use of digital encoded communications, skip frequency communications, and so on. Ground communications opt as much as possible for the use of such antijamming communications measures as optical fiber, electrical cable, and so on, as well as antijamming method technologies such as enemy communication operations frequency windows "borrowed for use" in automated reconnaissance.

(2) In radars associated with ground air defense weapon fire power elements, installation of jamming reconnaissance systems is increased, doing real time monitoring of the jamming environment thereby realizing the management by conversion to intelligence of various types of active and passive jamming measures.

(3) Through C3I, the smooth joint use and rational /41 distribution in entire air defense systems of such target information as that associated with multiple types of space, air, ground, and water surface detection, tracking, guidance stations, and so on, taking weapons systems operating in different frequency bands and different airspace and interlocking their defensive organizations so as to expand operating frequency ranges and overlap airspace firepower. When partial weapons elements receive jamming, it is possible to make use of other weapons elements to supply target data and carry out intercept. In this way, it forces the enemy--in the entire airspace and frequency range--to disperse jamming resources, making complete coverage difficult and thereby increasing air defense system antijamming capabilities.

(4) Air defense systems are equipped with numerous ESM operating stations. They carry out analysis of enemy radars as

well as jamming signals. In conjunction with this, they carry out passive detection, tracking, and so on, searching out the operating frequency windows of enemy electronics equipment.

As far as partial radar netting within air defense systems is concerned, this possesses passive operating capabilities, realizing passive target tracking. Moreover, active and passive operating modes are capable of self-adapting change overs.

#### (5) Possession of Soft Kill and Damage Measures

Numerous ECM stations are installed on such platforms as in the air, on the ground, and on ships, using means for soft kill and damage--aerial warnings associated with jamming of "defense penetration areas", aircraft command and airborne navigation radars, terrain avoidance radars, target search radars, radio electronic altimeters, bomb aiming radars, air-ground (ship) missile terminal guidance radars, GPS receivers, IFF receivers, and so on.

(6) Ground radars are equipped with active radar decoys to deflect air-ground ARM. In conjunction with this, use is made of passive camouflage, concealment, smoke screens, decoys, and other such technological cover to defend targets, making hit accuracies of weapons guidance such as infrared television, lasers, radar, and so on, go down.

As far as these electronic warfare characteristics associated with a new generation of air defense systems is concerned, they are realized by such things as going through improvements of currently existing models of weapons systems, developing new models of weapons systems, equipping with corresponding C3I systems, ESM stations, ECM stations, adjustments of defense deployments, and so on.

## 2.2 Paths to Realization

Use of such technologies as phase control array antennas with very good spacial selectivity, side lobe offset as well as side lobe self-adjusting jamming zeroing, and so on, is capable of lowering the effectiveness of current long range support jamming aircraft.

Active radar decoy (deflection systems) and dual (multiple) base radars will make it so that ARM will no longer make people so afraid.

Mixed use of passive detection and active detection will make such questions as who--on the two "offensive and defensive" sides--will detect whom first and whom will be detected and

tracked first all require cautious handling.

Operating within frequency ranges from a few tens of megahertz to a few tens of thousands of megahertz, multiple types of radar stations (including dual and multiple base radars) deployed in ranges of great depth as well as in such places as the ground, the surface of the sea, and the air, will make new air defense systems possess capabilities for the detection and tracking of stealth aircraft.

Air defense system utilization of ECM soft kill and damage technologies will make the performance of some electronic equipment in defense penetration areas go down.

Jamming source homing guidance heads will make carrier craft for such continuous wave noise jamming as that to carry out accompanying support, close range support, and self-protection types be unable to any longer "feel secure in their backing".

In summary, a new generation of air defense systems will no longer simply passively opt for the use of antijamming measures in order to resist soft and hard kill and damage means of the offensive side--such as jamming and ARM. They will make use of these effective electronic warfare methods to realize active defense aimed at the weak points of the offensive side in the electromagnetic frequency spectrum in order to disintegrate enemy air raids.

In the future, it is only with electronic warfare in "offensive and defensive" opposition that it is "true opposition". Both sides will have jamming and counterjamming. Whoever is able to quickly and effectively make use of these opposition means, in real time, taking their own side's weak points and turning them into advantages as well as taking the enemy's advantage and turning them into weak points, will win the victory.

### 3 UNIFIED ELECTRONIC WARFARE SYSTEMS

Directed against new air defense systems which have stronger and stronger antijamming capabilities, future defense penetrations will have large amounts of electronic warfare equipment participating in the battle (The "white snow" activities of multinational units in the Gulf War are an example). Such objectives as how--in real time--to control, manage, and make use of large numbers of electronic warfare aircraft participating in battle, various types of reconnaissance equipment, self-defense jamming equipment and to coordinate the contradictions associated with certain advanced electronic warfare technologies and other equipment (for example, stealth

technology and its airborne active equipment) in order to arrive at the ability to be able to reconnoiter the enemy as well as not being reconnoitered, the ability to jam the enemy and not be jammed, the ability to destroy the enemy's facilities and not be destroyed, and so on, will require an in depth view of the combat situation, unified electronic warfare command centers for whole processes, and using electronic warfare equipment participating in the battle to form a unified electronic warfare system so as to suit a complicated, fast changing enemy situation, rapidly supplying effective electronic warfare support measures, that is, using this most effective method of "systems" in order to oppose "systems" to use the offensive side itself and also form a complicated, fast reacting, integrated system. /42

Unified electronic warfare systems are nothing else than highly integrated, fast responding, self-adjusting unified electronic jamming systems which reside in defense penetration systems and which, to realize certain technological objectives, cause various individual electronic warfare equipment and technologies participating in battle to coordinate with each other, mutually compensating, to realize optimal operational results.

### 3.1 Main Operational Targets

Electronics equipment on such platforms as enemy early warning aircraft, command aircraft, interceptor aircraft, air-to-air guidance weapons, and so on, are primarily radars and communications equipment.

They are such equipment as enemy ground (sea surface) early warning radars, air to surface weapons system C3I and radars, surface to air missile guidance heads, and so on.

### 3.2 Main Support Targets

Friendly ground-to-ground missiles, cruise missiles, attack aircraft, air-to-ground missiles, various types of anti-ship missiles, and so on.

### 3.3 Main Operational Objectives

The purpose is to make the performance of such enemy means

as detection and identification, tracking, guidance, soft and hard kill and damage, and so on to go down as much as possible in order to supply a safe channel for the air attacks of one's own side (and their smooth flight back).

- Electronic jamming aircraft: On the foundation of high power noise jamming craft, improved antenna systems opt for the use of phase control array antennas to the advantage of beam configuration, gain, and direction adjustments and are capable of carrying out jamming of the air and the ground, possess the function of introducing pilotless jamming aircraft, and capabilities to completely analyze jamming effects.

- Long range support type jamming technology: Besides opting for the use at the present time of the implementation of radar and communications jamming, there will be the appearance of jamming aircraft echelon type alternations to cover and permeate kill and damage zones and implement jamming tactics in order to shorten support distances and improve the effects of long range support jamming.

- Accompanying electronic jamming: This will still be an effective jamming tactic. In order to increase one's own survival capabilities, one should possess the capability to transmit active jamming decoys so as to guard against jamming homing ground--air ARM.

- Passive jamming corridors: They will appear as a composite jamming corridor composed of such things as foil strips, infrared and laser absorbing smoke, and so on, in order to realize a screen against such detection devices as infrared, laser, radar, and so on.

- Stealth technology support tactics: Use is made of electronic jamming to implement suppression type interference against non concealed frequency bands and airspace to cover stealth flying platforms (various types of missiles, attack craft, and so on), systematically controlling the radio radiations of stealth platforms themselves in order to lower enemy passive detection system effects.

- Enemy reconnaissance passive operating stations: Use is made of dual (multiple) base radar receiving and sending stations in passive radar nets as well as regularities in the mutual deployment of ESM operating stations, radio signals, antenna exposure, and other similar characteristics. Option is made for the use of communications, radar, photography, and other such means of position fixing reconnaissance and comprehensive measurements of positions in order to facilitate the implementation of jamming or destruction.

- Self-defense jamming: With regard to the introduction

into enemy defensive areas of operational aircraft--toward both the air and the ground--at times when their own loads are limited, RWR as well as foil strips, infrared passive decoy rounds, and trailing type active decoys must be prepared. Airborne active jamming equipment must be selectively installed. When units are organized, airborne alternation formations should be mounted with different jamming equipment in order to realize, between the jamming equipment of various aircraft in formations, coordination in the areas of functions, airspace, frequency ranges, and jamming modes (for example, two point source scintillation jamming) and mutual support.

### 3.4 Composition and Principal Functions

Unified electronic warfare systems are composed of

- C3I systems (used in common with operational systems)
- electronic warfare information processing centers
- electronic warfare equipment (including equipment on such platforms as airborne, suspended compartment, satellite borne, ship borne, missile borne, ground surface, and so on).

Unified electronic warfare systems primarily complete functions described below.

- 1) Selecting electronic warfare equipment to participate in certain tactical operations.
- 2) From the angle of electronic warfare, suggesting offensive flight paths. In conjunction with that, precisely determining and coordinating in real time the relationships of the spacial positions of various operational platforms during activities.
- 3) Coordination and control of the operating periods associated with active electronic equipment of various operational platforms.
- 4) Jamming effects analysis and electronic reconnaissance.

In C3I command centers during defense penetration operations, there is a need for specially set up electronic warfare positions responsible for command of unified electronic warfare systems and communications and coordination of other operational command systems. /43

Unified electronic warfare system electronic information

processing centers record, store, analyze, and process intelligence and data acquired by such reconnaissance means as electronics, photography, and so on--before wars and during combat--on enemy air defense systems as well as friendly electronic equipment. Intelligence and data include:

Enemy ground weapons element location, distribution, number, as well as their various respective operational airspaces, guidance systems, radar performance parameters, antijamming techniques, electronic jamming equipment, and so on, as well as such performance parameters as those associated with enemy airborne weapons performance, number, distribution, radar performance parameters, antijamming techniques, electronic jamming equipment, and so on.

All friendly electronic warfare equipment performance parameters, functions, number, distribution, as well as effectiveness and credibility against enemy operations.

During the execution of tactical operations, on the basis of newly acquired battlefield electromagnetic threat intelligence, unified electronic warfare systems carry out real time analysis. In conjunction with this, they control the execution of needed tactical operations by various operational platforms (for instance, increasing support, shifting the direction of attack, and attack targets, return routes) and so on.

In summary, the characteristics of unified electronic warfare systems are nothing else than that--from a departure point of the situation as a whole, composite netting, coordinated mutual support, rapid response, comprehensive self-adjustment, and so on--they will use these "system opposition" concepts and methods in order to meet the challenge of new air defense systems.

#### 4 CONCLUDING REMARKS

During the Gulf War, multinational units--besides making use of stealth F-117A aircraft and similar specific advanced EW technologies--mostly continued to use jamming equipment, techniques, and tactics of the past. Multinational units grasped in detail intelligence on the Iraqi forces air defense network. Making "smart" use of these systems, they organized long term, in depth, highly coordinated, extremely successful "white snow" electronic warfare operations. We can recognize from these that, from now on, at the same time as the development of advanced jamming technology research, it is also necessary to tap the potentialities of that electronic warfare equipment which has relatively low costs, is relatively simple, and has good reliability and interchangeability. Opting for the use of

computer technology to add considerable improvements to them, quickening reaction speeds, adding mutual communications networks between them, they form a unified electronic warfare system. During operations, commands are unified and coordinated in order to better exert their effects.

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