INTEGRATION OF ARTILLERY AND MISSILES SYSTEMS IN THE AIR DEFENSE FRAMEWORK

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The topic on integrated systems of weapons represents an actual area of concern for many countries, which are interested in such systems and allocate funding for research programs. From this point of view, Romania is in a development stage, but the prospects are encouraging, more and more scientists being interested in the research connected with the development of such platforms. In this paper we present an analysis of the most advanced air defense systems that ensure proper airspace security, emphasizing on the need for their integration on a common weapons systems platform.

Key words: *Integrated Air Defense, Network Centric Warfare (NCW), allocation targets, flexibility, redundancy.*

1. INTRODUCTION

The new vision of the battlefield requires a complete change in the way the military forces operate. The changes refer the ability to adapt to a wider range of missions (from the entire spectrum of war), their organizational design principles, the development of leadership through the adoption of adequate training methods and strategies, and the introduction of new technologies.

The integrated systems of weapons have evolved in the recent years in two directions with converging effects: the technical (tactical) upgrade of the equipment used in operations and building new platforms that present an improved striking precision at larger distances, in all weather conditions, based on the emergence of new digital equipment and striking technologies, which have the ability to adapt to the needs of current battlefield while providing a real-time picture of it.

In this paper we intend to present an analysis of the most advanced air defense systems that ensure proper airspace security, emphasizing on the need for their integration in a common weapons systems platform. This system must be able to provide a reliable picture of the air situation by providing key elements related to the identification and location of friendly and adversary forces combined with the dissemination of this information to all hierarchical structures, thus achieving information dominance.

We choose this topic on integrated systems of weapons because it represents an actual area of concern for many countries, which are interested in such systems and allocate funding for research programs. From this point of view, Romania is in a development stage, but the prospects are encouraging, more and more scientists being interested in the research connected with the development of such platforms.

2. THE CONCEPT OF INTEGRATED AIR DEFENCE

The premise on which the foundation of the concept of Integrated Air defense is set is that the society has changed profoundly because of the wealth of information and the military should not lag behind. The changes were driven by integrated

development processes of economic organizations through the usage of information technology to achieve new standards of business efficiency.

Military operations must be conducted under the rules of economic profitability and practicality and are subject to the same actionable patterns characterized by:

- shifting focus from the platform (with its limited specific sensors and striking elements) to networked systems, which offer improved opportunities;
- treatment of actors (fighting entities) not as independent elements, but as part of an ongoing environmentally integrated entity;
- flexible policies and procedures which ensure rapid adaptation (or even survival) in such changing environments.

An integrated Air Defense system involves engaging the enemy in several progressing stages and requires: prioritization of objectives, rapid communications, radars that work synchronous with the launch systems, and uniform response of the whole entity over the whole protected territory of responsibility.

Those systems are basically computerized networks that include sensors, communication nodes and command centers, each of it performing special / essential tasks for good functioning of the entire system [4].

In theory, an integrated system should work by itself (almost without human intervention) once the target / targets have been distributed and the launch command was given.

2.1. Definitions

When we speak about integration, we understand the synergetic actions required to defend Romanian airspace against air attacks. The responsibility (authority) to assign necessary forces and to defend (prevent) in peacetime, crisis or wartime situations belongs to Military Strategic Command within General Staff and to Air Operational Command (COAP), which allocates all of the existing air defense elements in the Romanian Army. This enables the existence of a unified system with synergistic effects and capabilities nationwide.

The COAP provides the commandants with forces and facilities which could be used immediately. This creates the premises of the development of air defense efforts and coordinates requirements and integrates air control elements within its structure and with structures designed to execute the Air Policing service. Integration refers to the synergistic effect of convergence efforts and capabilities, and do not require the addition of supplementary weapons systems or platforms for air defense.

Integration is the best way to create an effective air defense and allows for event prevention and reduced essential risks/hazards. Specificity and dynamics of air operations clearly show two dominant factors governing air defense systems model: the opportunity for action response and speed of reaction. These factors require flexibility, redundancy and comprehensive response speed.

When it comes to integrate specialized forces for air defense missions, we should consider the following principles:

- the placement under unified operational command and control of all air defense units, in peacetime and war requires the application of restrictions related to the use and deployment of forces;
- the use of air defense forces designated for the execution of missions other than air defense, is done with the information / approval of hierarchical chain of command;
- the administrative and logistic support for air defense units designated category should remain in the responsibility of forces headquarters to which they belong;
- all units designated to participate in Romania's air defense must be connected to the National Air Command Control System (SCCAN);

- Reporting and Control Centre (RCC), with its elements of supervision and Air Policing functions as a component of the Air Operations Centre should be staffed only with trained personnel from Air Force.

2.2. Trends in achieving VSHORAD-SHORAD-MRAD class systems

The main trends in the development and improvement of integrated air defense systems are:

- development of combined multichannel systems - radar-cannon-rocket;
- the management of different categories of fire means (namely guns and surface-to-air-missiles) to be made by the same command and control system;
- the usage of new wavelengths; practical usage of the electromagnetic spectrum is under constant investigation;
- dimensional systems usage for determining coordinates of aerial targets;
- achieving an air defense systems' reaction time less than 5 s through integration;
- the achievement of increased mobility and launch capabilities in all weather conditions;
- increasing the security of information transmission through the usage of automatic encryption systems.

3. THE ROLE OF DIGITAL COMPONENTS WITHIN THE INTEGRATED AIR DEFENCE SYSTEMS

The change from analog to digital represents the process of implementing advanced information technologies, allowing all troops an improved and constant monitoring of friendly forces and the enemy. Existing and envisaged digital technologies will increase the efficiency through better usage of resources, transmission and exchange of information in real time to maintain a clear and accurate battlefield picture, adapted to the needs of each decision maker. This program is one of the highest research priorities of the moment in Romanian Air Forces.

This process requires the introduction of current technologies through acquisition or rehabilitation (modernization) of existing equipments. The aim is to achieve awareness of the situation, capability to answer key questions of the fighting forces (Where am I? Where are my own forces? Where is the enemy?) and improved control and command systems.

Without such digital transition, the Network Centric Warfare (NCW) concept would not have been possible to be achieved.

Figure 1: Stability operational environment

The old 1970s generation technique is generally no longer a key element on the battlefield. The new aiming devices belonging to the so called Army Battle Command System (ABCS) consist of:

- Tactical command system and positioning system - the Maneuver Control System (MCS);
- Information fusion devices - All Source Analysis System (ASAS);
- Indirect fire control systems - Advanced Field Artillery Tactical Data System (AFATDS);
- Logistics Control System (CSSCS);
- Air Defense Systems Air and Air Missile Defense Workstation (AMDW).

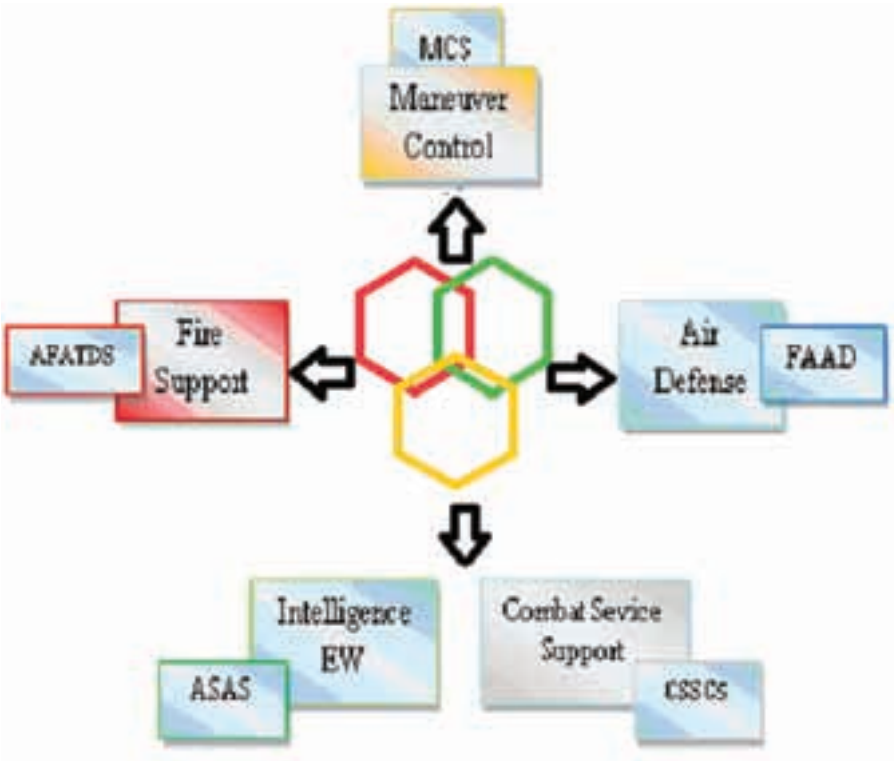

Figure 2: Army Battle Command system (ABCS) architecture

The introduction of a system-level tactical management allows each user to always have a situation image that provides three essential information covering locations: own forces, allies and adverse forces. At the same time, allows the transmission to the members of the network, real-time information about the opponent, giving commanders the possibility of providing further notice through electronic mail, accompanied by a graphic that indicates new targets. By integrating the system it ensures:

- information superiority (Information dominance) and its knowledge due to horizontal movement of information and network redundancy (which ensures stability), which can speed up the decision-making cycle (agility);
- extension of the operation by switching to a battleground segmented (deep / close / rear), and symmetrically to a larger space, nonlinear and asymmetric in depth which have taken decisive and precise operations (complexity);
- shift from the predominance of direct heat to it and the addition of the indirect to reduce the number of platforms to increase the effectiveness of common terminal mobility (ability to carry);
- constant flow of information logistics, allowing direct support as needed based on the precise distribution of the sectors of employment (endurance).

Network Centric Warfare advantages are numerous but, as pointed out earlier, in many of the new concept analysis, it is at the beginning.

4. AERIAL TARGETS DISTRIBUTION USING A COMPUTER SIMULATION

In this simulation example we will use the coordinate transformation in C++ programming. We presume

that targets will fly into systems responsibility airspace from various directions and with different speeds. From this perspective we have to allocate the targets to each system.

The targets distribution depends on the system's performances. To achieve the proposed task of simulation we established first the systems configuration (location; limits - left/right; number of systems).

We take into account six systems, thus two of them belong to antiaircraft artillery (AAA) and others four to Surface-To-Air Missile (SAM). The systems characteristics are presented in **Table 1**.

Table no. 1. System characteristics

Systems/ parameters	System units	$S_1^1 S_{AAA}^{12}$	$S_{21} S_{SAM}^{22}$	$S_{31} S_{SAM}^{32}$
Maximum range	[m]	3500	10000	40000
Minimum range	[m]	300	1500	2400
High altitude	[m]	3000	12000	10000
Low altitude	[m]	50	50	3000

There are 15 targets. The targets speed various between 200 and 1000 m/s. The targets characteristics are:
- flight direction (azimuth);
- flight altitude;
- speed;
- number;
- rectangular coordinates.

For example:
Target number 14:
- flight direction - 300;
- flight altitude - 6000 m;
- speed - 40 m/s;
- rectangular coordinates:

x = 4
y = -13

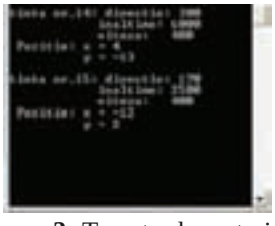

Figure 3: Targets characteristics

The possibility of targets distribution to integrated system was assessed by simulation. At the end of the simulation process it was indicated that only 7 targets were allocated to the systems depending on their performances.

The simulation briefly presented refers to a platform of integrated air defense systems.

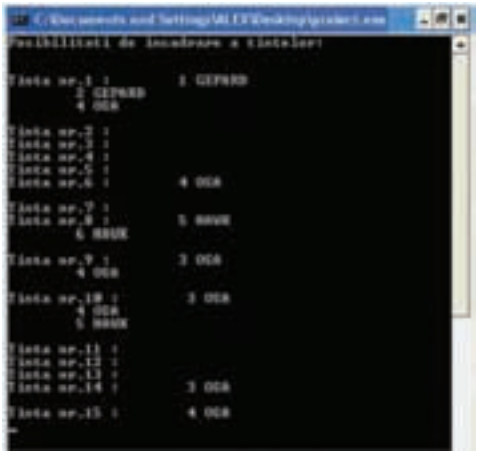

Figure 4: Targets allocation

5. CONCLUSIONS

The majority of people admit that we are members of a new era of information and engineering which influences the battlefield changing. Thus it is necessary to carry out the transformation that represents a vital component of Armed Forces being required new strategies in the process of acquisition and personnel training.

High technology, information technology, and new weapon systems create conditions for the expansion of the space of confrontation and for the setting up of new types of conflicts, based on the principles of information, instant fightback, actions network, reduction of the amount of waste and collateral effects.

It is also necessary to be applied a fundamental change of the way we think and act, being conscious that the precision, speed and flexibility of network-based military operations can produce a decisive effect on the battlefield.

Starting from these premises, we presented a study reported to the creation need of an integrated air defence model. The own forces and systems should follow the necessary steps to achieve a new qualitative level in order to deal with new types of threats.

This paper represents an analysis of air defense systems concerning its interconnection, stage of modernization, latest technologies purchased, future trends in weapons industry and management resources with a highlight on the compatibility of their synergetic functioning.

It is needed also to underline the necessity of using our own forces' weapons as a whole and to state the necessary steps which have to be followed for the materialisation of a platform that provides a real-time picture of the new threats, increasing precision of the impactor and targets neutralization.

The final goal of any initiative regarding the establishment of an integrated air defense system should take in consideration the theory, functioning and practice of generically named "systems of systems".

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