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Complex of Activities Supporting the Management of the Radio Frequency Spectrum in Military Operations

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Abstract. The dependence of military capabilities on the radio frequency spectrum, as well as the saturation of the spectrum with different users, are part of the realities and challenges of the modern battlefield. This requires the Alliance and the coalition forces to have an effective radio frequency spectrum management concept, and the application of uniform rules will ensure the achievement of electromagnetic compatibility, which is the ability of all units of radio electronic equipment to function when working together in an electronic environment.

Keywords: radio frequency spectrum, frequency management, spectrum management cycle, military radio communications.

I. INTRODUCTION

Radio communication is one of the main types of communication and a means of commanding formations in modern operations. The term "radio frequency spectrum" (RFS) generally refers to the frequency range from 3kHz to 3000GHz that can be used for wireless communication and information transmission. RFS is a natural and limited resource, allowing it to be used simultaneously by multiple users, which can lead to the appearance of mutual interference. In order to prevent the occurrence of this type of interference, it is necessary to ensure conditions for coordinated and harmonized use of the RFS, which is achieved through the management of the RFS. RFS management encompasses any of the spectrum planning, coordination and regulation decisions or actions that directly determine how it will be used.

II. MATERIALS AND METHODS

For the development of the proposed in the report set of activities supporting the management of the radio frequency spectrum in operations, a review of the information in the scientific literature examining the nature and classification of RFS, as well as the problems related to the saturation of the spectrum, was made. A study and analysis of the publications and documents regulating spectrum management in the interest of national security and defence, and in particular in the conduct of operations, have also been carried out.

The dependence of military capabilities on the RFS, as well as the saturation of the spectrum by different users, is one of the realities and challenges of the modern battlefield.

This requires the management of the RFS to ensure the most effective and efficient use of spectrum and meeting the frequency resource needs of military users, while ensuring the necessary coordination with the host countries in the area of responsibility.

As a result of RFS management, mutual interference between friendly transmitters, loss of communication capability due to spectrum oversaturation, and interference with or jamming of enemy transmitters that are sources of intelligence information are avoided.

According to [4], RFS management is understood as "the process of identification and effective use of available RFS for military purposes". This process is related to policies and rules on the allotment of frequency bands, the allotment of radio frequencies or radio frequency channels, and the appropriation (assignment) of frequencies.

RFS management is part of communication and information support, therefore the exchange of information in the interest of the command-and-control system (C2) will depend on the timely and reliable assignment of frequencies and the correct distribution of radio communication assets in the area of operation.

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The process of managing RFS in the Alliance for each operation can be presented as a cycle that contains four phases:

- Preliminary planning phase - related to the collection of data necessary for the management of RFS during the operation.

- Planning phase – the main objective is to prepare a management plan for RFS. During this phase, frequencies and channels are allotted and tables for frequency allotment and assignment are drawn up, in accordance with spectrum management policies and procedures. The result of the activities carried out in this phase is the "RFS Management Plan", which depends on the type of operation and is prepared by the RFS Management Unit as part of the planning process.

- Implementation phase of the operation- Upon reaching the operation area, the implementation of the plan drawn up in the previous phase shall be carried out. During this phase, the RFS Management Unit takes action to: establish and maintain close contact with the authorities responsible for the radio spectrum of the receiving nation and neighbouring nations, resolve conflicts in the use of RFS between users, update the HRS management plan.

- Transition phase - the frequency resource used during the operation is "transmitted" for reassignment in order to be accessible for other purposes and users.

III. RESULTS AND DISCUSSION

Based on the information obtained from the study of the documents regulating the use and management of RFS in the armed forces, this report proposes a set of activities to achieve effective management of RFS in operations, which aims to:

- establish the necessary organization of the radio communication of the formation - determination of the number of networks, the correspondents who will use them, the distance of communication and the type of information exchanged in them;

- analyse the conditions for the use of RFS in the area of operation;

- plan the necessary radio communications;

- plan the allotment of the radio frequency spectrum;

- assign radio frequencies to correspondents.

The proposed complex consists of ten activities listed below:

Activity 1. Definition of the specifics of the operation and planning guidelines.

The activity covers familiarization with the received incoming documents on the planning of the operation - the Plan for the operation and Annex Q [1] from the senior authority, familiarization with the frequency distribution tables in the area of the operation, the requirements of the formation's C2 and the available radio equipment.

From the input documents it should be clearly understood the operational area to which the operation belongs, the type of operation – joint or allied, the presence of support from the host nation, the functions, and responsibilities of the different countries to manage the spectrum within the deployed multinational forces.

According to modern doctrines, military operations should be conducted with the use of joint or allied forces. This requires the planning, coordination, and management of the RFS in coalition military operations to be delegated to a leading nation, with the active and constant participation of all coalition members. In this case, the leading nation is responsible for relations with the civilian administration and provides the framework for the management of the RFS for the deployed military forces.

A leading nation can demand radio frequency resources for exercises or most military operations other than war. Operations that preclude prior coordination with a host nation, such as forced entry, will require the frequency manager to evaluate the electromagnetic environment and spectrum use in subsequent activities.

Activity 2. Collection of information on the RFS.

Information shall be collected regarding the frequencies used for radio exchange in the area of operation, as well as the frequencies for the operation of the own radar, navigation, and weapon systems. This activity continues until the start of the operation and assists in planning.

The product generated by the information gathering activity is a database in the SPECTRUM XXI application, which contains data on RFS and its use by all own military and civilian, available adversary and neutral forces in the operation area.

Activity 3. Summary and analysis of information on RFS.

The activity determines the resource from the RFS required to maintain the C2, the need to prepare frequency sharing plans and reuse them in the area of operation.

This process requires compilation and analysis of the generated data through Activity 2 and helps develop the tables for the allotted frequencies for the subordinate formations and the assigned frequencies for work for the radio resources.

Activity 4. Determination of the factors influencing the organization of radio communication.

The factors influencing the organization of adaptive radio communication in the area of operation can be divided into four areas: Political and Legal Factors, Social and Environmental Factors, Economic Factors and Technical Factors.

Their identification helps to correctly establish the propagation of radio waves, electromagnetic compatibility, operating frequencies, the type of antennas, the range of communication and vulnerability to interception and suppression by enemy electronic warfare forces.

Activity 5. Development of the scheme of radio communications for the operation.

The activity concerns the development of the scheme of radio communications according to the principles for organizing radio communication, the frequency resource that has been allotted and the requirements of the C2.

Activity 6. Assignment of frequencies.

An important point related to the management of RFS during the activity is the development of frequency assignment tables for each of the courses of action (CA).

The table of allotted frequencies and ordered radio networks and directions is the most critical resource available to the CIS planner in the CIS department, because it is the basis for nominating appointments without interference, providing analyses of the impact of electromagnetic warfare operations, as well as identifying and solving interference problems.

During the activity, the table of assigned frequencies of radio stations is prepared. Most often, frequencies are determined by the table of allotted frequencies brought down by the senior authority in Annex Q.

Activity 7. Development of a management plan for the RFS.

A plan is being drawn up for the use of available resources from the RFS, which will be used to organize radio, radio relay and satellite communication in the operation. The basis for the plan is the incoming documents from the senior authority and the results obtained as a consequence of the previous activities.

The RFS management plan shall include the tables of allotment and assigned frequencies of the means of communication, describe all spectrum management actions, and indicate the procedures for reporting interference and the proposed steps for their resolution.

The assignment of frequencies for the operation of radio equipment in radio networks and directions is the actual implementation of the RFS management plan for the operation.

Activity 8. Development of communication instructions for work.

The activity should cover the related to the planned adaptive radio directions and networks: callsigns, network identification rules, the direction output order, the rules for changing the operating frequencies, the coding rules and the entry and change of the cryptographic keys for the operation of the crypto modules.

Activity 9. Preparation of a list of prohibited frequencies.

The list is a product that protects radio communications networks from interference and suppression by one's own electronic warfare forces during exercises or operations.

Activity 10. Interference analysis, interference conflict resolution and their reporting.

Various factors such as impact from the adversary, unauthorized users, incorrectly assigned frequencies, or equipment problems can create interference. The person responsible for RFS shall analyse and define the electromagnetic working environment in order to determine the cause of the interference. Solving them is a daily activity once the forces are deployed and operating in the area of operation. One of the actions that can be taken when interference occurs is the change of the working frequencies of the correspondents, which is reflected in the table of assigned frequencies.

After performing an interference analysis, a report is always created to document the results. These reports are stored in a database that can be used as a history of interference problems. The purpose of the interference reports database is to provide the person responsible for the RFS with information on previous incidents and the steps taken to resolve them.

In conclusion, it can be said that some of the activities in the complex thus proposed, related to the management of RFS in operations, can be carried out simultaneously, while others occur only sequentially, after receiving an outgoing result from the previous ones.

CONCLUSION

Effective RFS management is important for the success of the entire spectrum of operations and exercises conducted by the armed forces.

The proposed set of activities aims to establish the necessary organisation of radio communications in the conduct of operations, to assign radio frequencies to correspondents and to ensure the achievement of electromagnetic compatibility (EMC), representing the ability of different units of radio-electronic equipment to work well when operating together in an electronic environment.

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REFERENCES

[1] N. PAVLOVSKI, *Operations Planning at Tactical Level by Land Forces Units*. Veliko Tarnovo, Vasil Levski National Military University Publishing Complex, 2023, p.282 (ISBN 978-954-753-365-3 – soft cover and ISBN 978-954-753-366-0 – CD) [ПАВЛОВСКИ, Н. *Планиране на операциите на тактическо ниво от формированията на Сухопътни войски*. Велико Търново, издателски комплекс НВУ Васил Левски, 2023, с. 282. (ISBN 978-954-753-365-3 – мека корица и ISBN 978-954-753-366-0 – CD)]

[2] APP-28, Tactical planning for land forces, Edition A Version 1, NOVEMBER 2019.

[3] ATP 6-02.70 Techniques for Spectrum Management Operations. October 2019.

[4] ITU Radio Regulations (4 Vol. Set), 2016 Edition.

[5] Spectrum management in military operations, NSO, 2017.