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**THE DEVELOPMENT OF THE
ELECTRONIC WARFARE CAPABILITY
OF THE HUNGARIAN DEFENCE
FORCES USING SOFTWARE DEFINED
RADIOS**

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NOMINATION OF SCIENTIFIC PROBLEM

The continuous change of the security situation in the different parts of the world, and in many cases its deterioration, places an increasing burden on domestic security organizations, including various secret services, police and border security forces and military forces. Over the recent period, the pressure on these organizations, both from the political side and from the public, has increased in the European countries in connection with planned and committed terrorist attacks. Not only do the forces of the various European countries try to reach the nest of terrorist elements in each country – in many cases in other countries or on other continents –, but in accordance with the country's decision, assist them in restoring or building democracy. In these areas, however, in many instances, they face the asymmetric warfare of today.

The changes of the warfare methods are a major challenge for operational planning professionals, because they often must fight against opponents who do not use advanced technical assets, hide, do not wear uniforms, and many times attack civilian, so-called soft targets. In addition to these problems, of course, we must not forget the hybrid warfare, which, besides the military activities, includes many other hard-to-grasp or intelligible activities, such as cyberwarfare, political and economic pressure exertion.

In order to make these tasks of the armed forces executable at an appropriate level, a competent national defence force - and based on these national forces - a sufficiently scalable and interoperable international force is needed. As I have already explained in the introduction, nations use resources to their own defence forces at varying degrees, but this might result, for instance, in a compatibility problem, which could have negative impact on cooperation.

One of the components of the different military tasks is the electronic warfare, which is constantly present in the conflicts of today, is taken into account in the process of operational planning and in the execution of tasks as a multiplicative, enhancing ability. Previously, it was considered as an integral part of Information Operations¹, Suppression of Enemy Air Defense² or Targeting, and is nowadays treated as an integral part of the frequently-mentioned Anti-Access – Area-Denial³ method.

To make the use of electronic warfare capability really effective, advanced technical assets that utilize the latest technological innovations are required. From the different studies,

¹ INFOOPS

² SEAD

³ A2/AD

articles about military technical presentations, and the descriptions and analyzes of the different conflicts, it is clear that the various states – notably the United States of America, Russia and China – spend significant amount of money on the development of this field and in connection with these developments, to gain practical, combat experience. It should also be emphasized that the incorporation and use of this experience is not only possible when new developments or necessary modifications are made, but also when reviewing electronic warfare Tactics, Techniques and Procedures⁴.

In connection with the Hungarian Armed Forces, we have witnessed significant changes in the last decades. This includes the processes called military modernization, which has led to the significant reduction of the personnel of the Defence Forces and the obsolescence of previous technical equipment, unfortunately not followed by procurement procedures.

In my professional opinion, it can be stated that the Hungarian Defence Forces must have defensive and offensive electronic warfare capability proportional to Hungary's economic and military performance, to which the currently available developments and procedures must be used.

Based on the results of my research, my professional opinion is that the use of software radio technology is a good basis for the development of the capability, so that the future development will be ensured in the existing tools. It is important to note that ad-hoc procurement of devices of different types and capabilities at the various military organizations or reception of assets from other organizations cannot be considered an appropriate level of development.

NOMINATION OF RESEARCH HYPOTHESES

Based on the above, I intend to justify the following hypotheses:

- The electronic warfare capability and its use in conflicts will be important for all nations in the future as well. The electronic warfare will continue to be an integral part of the warfare methods and procedures, nations continue to spend significant amount of money on its development, and with the combined use of different technologies further enhance its effectiveness.
- The software radio technology is now an integral part of the various technical assets and systems. The use of this technology should be a fundamental requirement for the

⁴ Tactics, Technics and Procedures – TTP

development of the Hungarian Army's electronic warfare capability, assuming that the benefits of this technology can be further enhanced by the simultaneous application of other developments.

- The acquisition of software radio technology based electronic warfare equipment/systems for the Hungarian Defence Forces can provide significant advantage in later developments.

- The use of software radio technology also affects the task of the different organizational elements, which must be followed when designing the different levels of organizational elements.

RESEARCH AIMS

Nowadays, due to the various federal memberships (NATO, EU, Visegrad Four, etc.), the country and the Hungarian Defence Forces have considerable expectations that must be met. During the execution of the tasks of the Hungarian Defence Forces, the electronic warfare – in case of the presence of a personnel with appropriate qualifications and professional experiences and an advanced technical equipment - would be able to contribute to provide a current picture of the situation for the different levels of military leadership and enhance the offensive and defensive capability of the used unit/units.

In my dissertation, I deal with electronic warfare, I make suggestions in connection with the electronic warfare system of the Hungarian Defence Forces, but it should be noted that the information thereby obtained, can be used in the short-term decision-making system as if they were Signals Intelligence⁵ information. Of course, it is also important that the software radio technology analyzed in the dissertation can be used for specifically SIGINT devices. When examining Hungarian Defence Forces related organizational and technical changes in the previous period, I present and analyze the electronic warfare and the SIGINT reconnaissance organizations as they have been intertwined several times. In our case, concerning the land forces, it is important that the Hungarian Defence Forces now has an Electronic Warfare Company that operates in Debrecen and carries out its tasks under the professional control of the Joint Forces Command, and that the task of the former tactical and operational level SIGINT has fused into the task of the electronic warfare unit of the Hungarian Defence Forces. In the light of the above, when I make a statement on electronic support, it is also equivalent to SIGINT.

⁵ SIGINT

My choice of topic was essentially based on the clearly demonstrated actuality of use of electronic warfare and my experience gained in various military positions, including national, NATO and peace operations. In connection with each position, it can be said that during the various planning tasks and the execution of the ordered tasks, within a short period of time, the question arose, how an element of electronic warfare could be present or support our work.

With my present research, I would like to achieve two goals. On the one hand, I demonstrate that the current electronic warfare capability of the Hungarian Defence Forces can be significantly improved using the benefits of software radio technology. On the other hand, I investigate the development of new organizational elements/capabilities in relation to new tasks to be integrated into electronic warfare elements.

My research objectives are divided into the following parts:

1. To assess and demonstrate the need for continuous development of electronic warfare capability by examining the use of electronic warfare in various conflicts and in different areas of warfare, and the development activities of each nation in this field.

2. In today's advanced military technology assets and systems, it is utmost important to incorporate state-of-the-art technology and applications. In many cases, we are able to achieve results exponentially with the simultaneous integration/introduction of two new developments. My aim is to examine the use of software radio technology in various technical devices and to analyze the benefits of using of software radio technology based electronic warfare technology in the Hungarian Defense Forces.

3. Using the first and second research findings, to determine the perspective tactical-technical requirements for the software radio technology based electronic warfare device, considering the other technical possibilities discussed in the previous paragraphs.

- 4., To examine and develop proposals during the research, for organizational changes to the application of the software defined radio-based electronic warfare system, depending on the specificities of the units and the management levels.

RESEARCH METHODS

To prepare my dissertation, I have applied the following research methods:

- literary research, including the study and processing of international and national literature on software defined radio technology;
- deep analysis of former researches, analysis and processing of result of researches in connection with software defined radio technology and electronic warfare, including the examination of technical developments previously carried out for Hungarian Defence Forces;
- comparative analysis, comparison of the achieved results of previous researches and developments;
- empirical research, the use of my own experience gained during my years in various national, NATO and Peace Operations positions;
- comparison with the results of parallel research, supported by the " ÚNKP-17-3-IV-NKE-16 New National Excellence Program of the Ministry of Human Capacities;
- participation in conferences, relevant professional presentations and events, in various policy development activities;
- processing of research results and publication in different articles, chapters and other publications, as well as lectures and conferences.

THE STRUCTURE OF THE THESIS

In the first chapter of the dissertation, I reviewed the changes affecting the use of electronic warfare, including both the effects of changes in security policy and technical progress. I have stated that security policy changes, the activities of various political, economic and military organizations, and terrorist attacks in Europe today have an impact on Hungary's security situation, and thus on the tasks of the Hungarian Defence Forces. The tasks of the Hungarian Defence Forces can be ensured and supported by different capabilities at various operational sites, including electronic warfare. The basic condition of the effective electronic warfare support is the equipment, which is appropriate for the era. I examined the changes of the Hungarian Army's electronic warfare and SIGINT capabilities, and the results of the proposed / implemented developments in the examined period. I confirmed the role of electronic warfare in the various conflicts and different modes of warfare (symmetrical, asymmetric, hybrid) in the future, and the examined nations are investing in this area. I have investigated the earlier downturn of industries that were capable of manufacturing domestic

electronic devices, and the military industry development initiatives started by the Ministry of Defence.

In the second chapter, I examined the spread of software defined radio technology and its application in different electronic systems. I have found that SDR technology has been used in electronic warfare systems and in systems that can be influenced by electronic warfare. It is important that many developments and researches are underway to take advantage of further benefits. I paid particular attention to examining the results of the Hungarian INTERJAM project. I have investigated the difference between the electronic warfare capabilities currently available in the Hungarian Defence Forces and the software defined radio technology. I made a proposal for the purchase of software defined radio-based electronic warfare equipment.

In the third chapter, I examined the perspective requirements for the electronic warfare asset and system based on software defined radio technology, the viewpoints to be taken into consideration for its acquisition / development, and the possibilities of detection and protection of the SDR-based electronic warfare system. I have found that the software defined radio technology based electronic warfare assets require the extension of security solutions to IT security solutions and that the above solutions also generate organizational changes at both tactical and operational/joint level. To this end, I proposed to provide the necessary electronic warfare / IT staff and to set up an organizational element and the tasks of these elements.

SUMMARY CONCLUSIONS

Analyzing today's conflicts, we can read in many cases about the use of electronic warfare in activities, carried out both by land forces and by the Air Force. The role of electronic warfare due to the development of technical devices and the increasing number of devices based on the use of electromagnetic spectrum, is still unquestionable. In many cases it is featured as a multiplicative, enhancing asset or ability for which different nations devote significant resources to the development, and the results achieved, and the newly developed technical assets are also used in ongoing conflicts. It is also important to emphasize that the possession of electronic warfare equipment is not only an option available for biggest nations, but also - with the proper use of resources - the capability which has to be provided and assured for the armies of the smaller countries.

It is also important that the ability of electronic warfare can be scaled. In many cases, we can only speak of a self-defence capability, such as the possession and use of short-range

jamming devices for radio remote controlled improvised explosive devices. This requires a much smaller amount of financial resource, while for example, an offensive electronic jamming capability - including a complex system of multiple devices - requires much more material and human resource. The operation of the jamming container capable of suppressing enemy air defence could be even more expensive - including the cost of purchasing and operating the carrier aircraft -, but in my opinion, in this case, it has to be taken into consideration that this capability is only available to the larger, resourceful states. In my view, the Hungarian Defence Forces has to maintain an electronic warfare capacity, which corresponds to the level of the three examples.

It is also important to note that the possession of the electronic warfare capability is not only the army's privilege, its components, such as electronic jamming, is used by various civil and law enforcement organizations. Such organizations could be, for example, prison enforcement agencies, security guard, logistic or relief firms, agencies in the various conflict areas. Effective implementation of tasks can be greatly facilitated by sharing experiences and information between different organizations involved in the same task. I am referring to organizations in a given operational area that are in different management/management systems may have different information that might not be available for the other executive organizations. The experience/information sharing between executives eliminates this mistake.

NEW SCIENTIFIC FINDINGS

1. Analyzing the earlier proposals for the development of the electronic warfare of the Hungarian Defence Forces and the benefits of the use of software defined radio technology, I proposed the development of the electronic warfare capability of the Hungarian Defence Forces based on software defined radio technology.

2. I have determined the requirements for software defined radio-based electronic warfare devices/system for the electronic warfare capability of the Hungarian Defence Forces.

3. By analyzing the methods of attacks of the electronic warfare asset/system based on the software radio technology, I proposed the aspects to be taken into consideration when designing the defence, especially in the IT field.

4. I proposed the establishment of the frequency management and the IT/programming capabilities at the operational/joint level and at the tactical assessment-analysis and jamming control centers in order to exploit the advantage of the SDR concept, the fast change of operating parameters of SDR based electronic warfare asset - corresponding to the operational environment -, and to prevent and resolve cyber-attacks.

5. I proposed the establishment and permanent operation of the Electronic Warfare Coordination Center at operational/joint level in order to exploit the software defined radio-based electronic warfare capability of the Hungarian Defence Forces.

RECOMMENDATIONS ON THE PRACTICAL APPLICATIONS OF THE THESIS

1. I suggest to use my dissertation and research results during the planning of the development of the electronic warfare capability of the Hungarian Defence Forces.

2. I recommend to use my dissertation in the education of the officers and senior officers serving at tactical, operational and strategic levels of the Hungarian Defence Forces, and in sustaining their knowledge, since the development of knowledge is one of the most important tasks to keep the level of professional activity at the highest level.

3. I propose to use my dissertation in the military education, including the Non-Commissioned Officer Academy and the National University of Public Service, on the SIGINT and Electronic Warfare specialization, both in the University and Master's degree at the University.

4. I propose to use it as a source literature or as a recommended literature for related subjects, as there is little researchable material available in the field of electronic warfare, because of its sensitive subject matter and importance.

5. I propose to use the conclusions of individual chapters as a basis for further scientific researches, whether in the field of electronic warfare or SIGINT or other areas of expertise.

MY PUBLICATIONS ON THE SUBJECT MATTER

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THE PROFESSIONAL-SCIENTIFIC CURRICULUM OF THE AUTHOR

Lieutenant-colonel József Sándor Horváth serves as a professional soldier at the Hungarian Defence Forces (HDF), Joint Forces Command (JFC), Intelligence Branch, senior officer (deputy chief). His task is to plan and organize the reconnaissance and electronic warfare activity of the JFC, staffs and subunits based on the guidelines of his superiors.

He started his studies in 1995 at the Bolyai János Military Technical College, on specialization of Radioelectronics - Electrical Engineering, radio jamming (electronic warfare) - telecommunications. He completed his professional practice at the Radioelectronics Control Center, Gödöllő and Mór and in Kiskunfélegyháza at the 5th Kiskun Electronic Warfare Regiment. During his practice in Kiskunfélegyháza, he gained an important experience, when he witnessed the handover of the equipment of the former Electronic Warfare Company from Győr between the company and the regiment. During his studies, he spent a month in Germany at a signal battalion. He graduated in 1999 with an excellent degree diploma.

He started his career in 1999 in Veszprém at the HDF 1st Logistics Regiment as an operations officer (electronic warfare). The downgrade of this field reached him here too, in 2000, the electronic warfare task was removed from his assignments, from then on, he was carrying out this activity based on mandate until 2003. After the liquidation of the regiment in Veszprém, he received a position on the proposal of his superiors at the JFC. Between 2007-2012 he organized the activity of the HDF Regional Reconstruction Team (PRT), he worked as a PRT project officer.

In 2012 he has been moved to the Intelligence Branch, as staff officer, where he organized the electronic warfare tasks of the Air Force. Later he got mandate for the task of the electronic warfare of the land forces as well. Among his core tasks the development of the application of the JAS-39 Gripen Electronic Warfare Support System can be found, and the participation in the doctrinal workgroup of the Joint Electronic Warfare Doctrine.

He finished his MSc studies at the Óbuda University, Bánki Donát Faculty of Mechanical and Security Engineering, as Safety technology systems designer with an outstanding qualification. He started his doctoral studies in that year at the National University of Public Service, Doctoral School of Military Engineering, where he obtained the end certificate in 2016.

He has advanced language exams in English and German languages. In 2002 he took part in a German language course at the Language Institute of the Austrian Army's Military Defense Academy in Vienna and obtain an international (SLP 3; 2.5; 3; 2) language exam.

In 2013 he participated in the NATO School Oberammergau Joint Electronic Warfare course. In connection with the JAS-39 Gripen Electronic Warfare Support System, he took part in 2014 in Stockholm on the Radar Warning Receiver Analysis and Library Production Course, and in Linköping on the Electronic Warfare Support Course for JAS 39 Gripen. He attended at the NATO School Oberammergau on the NATO Intelligence course in 2016 and in 2017 in Ramstein, at the NATO Air Force Command on the Air Force Reconnaissance (ISR Practitioner) course. He is a member of the NATO Air Force Armaments Group (NAFAG) Aerospace Capability Group 3 in his "Survivability" working group in Brussels, the Department of Mechanical Engineering of the National Association of PhD Students and the Hungarian Electrotechnical Association.

He has published a number of publications about electronic warfare and is constantly involved in related conferences. At the Óbuda University he attended the Scientific Students' Conference and at the competition of Diploma Thesis of the Scientific Association of Communications and Informatics. As a lecturer, he has participated several times at the Conference of Aeronautical Science. He was invited as a lecturer to London based on his article published in the Defense Review. During his doctoral studies, he verified research articles, with his opinion he helped the research of his fellow PhD aspirant with the preparing of his thesis. In 2017, he successfully applied for the New National Excellence Program of the Ministry of Human Capacity with his research on electronic jamming of civilian aviation.