

FORMING POSSIBILITIES OF TACTICAL RADIOSYSTEM
OF HUNGARIAN DEFENCE FORCES IN THE MIRROR OF
THE EXAMINATION OF CERTAIN NATO COUNTRIES'
RADIOSYSTEMS

Notice of Doctor of Philosophy (PhD) theses

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THE PROBLEM

The changed warfare principles – which are qualified for making successful military operations in 21st century – are based on a high-tech background.

Organizing the information and data sharing among different command and control level is primary task in Defence Forces of the most country and the developed military communications systems are qualified for realize this central purpose. In modern warfare is primary importance the mobility of forces, the rapid execution and the dynamism of command and control, as well. Because of mobility the commanders often need to use wireless devices to realise their functions, but it neither causes problems in dynamism of command and control, nor reduces the near real-time operability.

In the beginning of 21st century the cooperation capability of the troops has not only in wartime, but the military operations other than war (MOOTW) and disaster protecting came to the front. The inter/intra cooperation is only if suitable to organizations when we can share a lots of available information, and the present radiosystem of HDF is not qualified for this any more in tactical level.

During the system working out in new line came to the front such realization of substantial requirements wich are not included till now in communications of HDF. Over the connection of same systemlevel elements or the real commonality and interoperability to Allies' systems not only appearance at strategic level, but it is also appeared at operational and tactical level.

When I analized, later systematized documents and essays I devised the next hypothesis:

The multifunction applications of military forces are appeared in war and other than war operations, so the development of radiosystem has to has also multifunction character in C2 support. Issue from multifunction character the ring of the system services needs to cover to the cooperation of public safety and need to provide to interoperability in war and other than war operations.

RESEARCH PURPOSES

I regarded as basic research purpose to explore the military applicational possibilities of certain NATO countries' digital radiosystems and made recomandations to accomplish tactical radiosystem of HDF. I was considered the next part-domain necessary to achieve the basic research purpose:

1. To consider the possibilities of digital radiosystems' applications in radio communications of land-forces;
2. Analizing the military radiosystem services to look over the possibilities of users, wich would be built for the communications support of present and future military operations in mobile environment;
3. To determine the possibilities of HDF' combat radiosystem forming on principle with analizing combat radiosystems of certain NATO countries' technical forming and frequency management;
4. To draft proposals for improving the formed combat radiosystem with take into consideration appearing possibilities, needs and demands.

RESEARCH METHODS

Before I've worked my theses out I delimited the areas of research. I ruled out from research the next domains: the examinations of technical parameters of digital radios; the information security methods, function and application of these equipments; the applications of radiosystems at airborne and air operations; to detail directly the proposal technical ideas to organizations of Hungarian Defence Forces; the economical conditions of technical solutions and the reckoning of human resources.

I adopted the observation and induction from general research methods and I used the critical examination of application and typical characteristic of military radiosystems from special research methods of military science research.

I adopted the next research methods to achieve my purpose:

1. I've been searched and worked up bibliography, scientific essays and papers, essays of the degree of master of military studies and PhD theses;
2. I've been analyzed and systematized the evolution of military radiocommunications;
3. I've been made a study of structure, features and specific of radiosystems in present days;
4. I've been concluded part-conclusions from features of examined radiosystems;
5. I've been made recommendations to establish and to improve the tactical radiosystem by systematized knowledge and concluded part-conclusions.

SUMMARY OF ACCOMPLISHED EXAMINES

To achieve the appointed research purposes I divided my theses into three main part.

In the first chapter, after the explanation of thesis' frequent notions I studied the presence and technical development of digital radios. I made an effort to outline the using of radios at tactical level and to exploit their possible services. After the analysis of voice and data transmissions I concentrated on the new trend of radio development: to the software radios. I presented civilian and military areas of developments, the purposes and the technical answers for challenges. I analysed development plans of software radios in certain NATO countries, even the application possibilities of software radios in the future, stressing the importance of their network capabilities.

Conclusions of first chapter:

1. The development of digital radios is more quickly realizable than previous analogue equipments and using the modular technology can reduce substantially the time of occasional mending.
2. Utilizing of COTS elements is becoming more and more important in military communications systems, so the expensive and long time development phases can omit. Appropriation of this elements is acceptable in military radio developments, but can't leave the higher level safety regulations out of consideration.
3. The technological background – which is in the making in developments of software radios – shows over the traditional radio development principles, so these make a more efficient, joint radiosystem forming possible. On the other hand the investigation of this equipments or whole radiosystems is absolutely necessary in electronic warfare.

4. The flexible systemforming possibilities of software-defined radios or software radios are advantageously harnessed in new changes of organization, because the parameters of services are more flexible and more easily way associatable to changed arrangements in new organizations.

In second chapter I occupied with employment of military radios and radiosystems. I discussed the advantages of radiocommunications, the solutions of problems and I presented the possible methods of frequency planning. In the frame of military radiocommunications' devices I analysed the roles and possibilities of the line of sight (LOS), the beyond line of sight (BLOS) radios and the tactical satellite communications, as well as the connection of tactical radiosystem to higher system level. I presented the various Tactical Internets in separated subchapter stressing prospective importance of these networks and to form Situational Awareness (SA) wich is more and more spread in present days. I also examined the role of radiosystem in military operations of the future – emphasizing the TACOMS and SATCOM Post-2000 programs – and analyzing the future of Tactical Internet I made an effort to draft some probable problems, as well as the roles of radiosystems in Network Centric Warfare (NCW).

Conclusions of second chapter:

1. The growth of data traffic – similarly to permanent wired systems – is also observable in military radiosystems. To transmit packet datas are used more and more IP based networkforming in character-oriented datas and the growth of channel capacity provides videotraffic, too. Similarly can't leave the bit-oriented datatraffic out of consideration, its role is determine in the control of weapon systems. This role will present in HDF tactical radiosystem after modernization.
2. The efficient appropriation of tactical radiosystem is only possible with unified frequency management forming. The frequency coordination is not only the civilian-military dialogue, but it is also appeared in responsibility areas. Most of military radiosystems have software-based planning and analyzing devices and probably these devices will employ in HDF.
3. In the case for want of priority in working of tactical radiosystem wont be achieve the purpose of the system working environment. Users are stress the importance of digital theatre of war in vain, using the modern equipments at professional level will brings only in form of an overall will as a result: a right worked out order for tactical radiosystem working. In this is appeared the circles of primary information, order of impotence, qualifications, transmission sequences and the priority of channel access.
4. Over and above the incresing of operational mobility and using the shaped standards the making of the most efficient and most expedient execution forms remains the responsibility of commanders. Making a decision is only by well-qualified leader still on high-tech theatre of war of tomorrow. The training of leaders is cupled with the training of frequency managers, who are contributed to successful operations and they are appeared in radiosystem as a new component. No one takes account this question till now, but in the future it can't get round, if the purpose is a form of effectively working system.

The third chapter was grouped around the tactical radiosystem of HDF. After looking over the problems of present radios I represented the planned new equipments. I analyzed the questions of frequency management and the possible tactical level networkforming with solutions of interoperability. I examined the the applications of tactical radiosystem in certain military operations and in crisishandling. I stressed the

tactical satellite communications in peacekeeping missions and over and above the warfare missions I drafted the characteristics of urban warfare.

Conclusions of third chapter:

1. Expedient to strive to the modular structure and seamless connectivity in technical solution of tactical radiosystem. The possibility of multifunction employment grows, thanks to modular forming which is provide flexible transformation, too. The newest developed digital radios can work as a node element, so the number of equipments can be decrease in transmission and it is yielded loss of carrier capacity by the rapid built-in and employing possibilities. The jamming and interferences of connections to backbone can increase extend with improved network enabled capability (NEC).
2. Creating and using the devices of STANAGs to development of interoperability for Allied and national communications systems, even also radiosystem. Expedient to determine this as a basic requirement for choosing the systemintegrator of tactical radiosystem of HDF.
3. In planned radio equipments are not tactical satellite equipments, but these are included in tactical radiosystem. Coming to the front the support of peacekeeping missions by National Security Strategy of Hungary, so expedient to count satellite equipments in these missions and also in radiosystem.
4. The forming of tactical radiosystem with planned equipments has only a simple voice and data capability, but the needs of growth of data traffic is not provide: there's no possibility of Tactical Internet forming. Need additional technical elements to radiosystem forming by the prospective data traffic growing and my proposals for this I reviewed in separated part of thesis.

After the three main chapter I drafted proposals to establish a modern, digital radiosystem (underlying principles, technical solution and frequency management), for its further development, even utilizing and useabling of my thesis. I strove approach of principle in my proposals to shape tactical radiosystem. I've no set myself the task to proposal the specify of equipments, because I think it is responsibility of decision makers.

SUMMARIZING OF EXAMINATIONS

When I analyzed the shape of digital radios and their services I suggested that the equipments used in military operations of present days are supported executions of users by voice and data transmissions. During my researches I didn't find any hungarian papers or essays of the software defined radios, so I examined this area after I read a lot of foreign publications. I analyzed this way the solution of software defined radios, their services and the possibilities of using new software-based waveforms. I presented the development lines of software radios, even the using areas of this equipments in the future.

By the research of military tactical radios and radiosystems I experienced that their employment is more and more grow and they can implement the multifunction working what I sketched my research assumption. The build-in radiostations, the portable radios, the weapon systems' radios or the satellite radios have got important roles in war and other than war operations. I pointed to possibilities of situational awareness and the tactical picture by analyzing the tactical Internet. This is also projected ahead the shaping of system by basically TACOMS Post-2000, which will be appeared for next

years. I defined those trends which will affect the shape of tactical radiosystem of HDF and I formed my proposals by knowledge of these.

I was established that can be formed a modern tactical radiosystem according to NATO needs by put to use of planned radio equipments of HDF. Although the satellite radios are not part of planned tactical radiosystem, but I took into consideration in my proposals. I analyzed the possibilities of principled shaping and also the frequency management – that were part-domain aims of research – which results was used in my proposals of the shaping of tactical radiosystem. I also set as part-domain aim of the further development of formed tactical radiosystem: I drafted proposals to form the Tactical Internet of HDF.

I achieved the determined basic and part-domain research aims: I made recommendations to form of tactical radiosystem of HDF.

FINAL CONCLUSIONS

1. Taking into consideration the requirement of long life cycle of military communications systems (15 – 20 years), it is practical to strive such forming tactical radiosystem, that can insure the communications support of military operations in long-range. The integrating of new services into system is the easiest way using the built-up principles of open system. The open system network forming insures modular enlargement and easier reparable or serviceable (simple card-changing) in hardware side, and it is yield simple installing of new applications and services, even its flexible configurations in software side. The reliable working of built-in radios can form by peer-to-peer system principle, so the moving of vehicles from each other won't go break down of system.
2. The speed of technical developments makes presence of new equipments possible, these are the software radios which are probably widely used quickly in digital battlefield. Appearing of new equipments doesn't mean to change the current tactical radiosystem equipments to more modern and larger capability software radios, but its presence as a possible version in important communications nodes. The probably growing of data transmission is justified to insert such equipments in tactical operation centers or to use them to collect information for leaders of higher levels. They will appear as an important segment of joint operations, so they will probably appear in the signed groups of HDF to ensure interoperability in multinational operations.
3. Expedient to use the possibilities of frequency reuse to exploit of efficient and undisturbed frequency spectrum: it can be use to separate the frequencies in geographically or using the cooperations, dialogues and agreements under limited circumstances (inside of country borders or megapolis). Expedient to control the using of frequency in certain military operations among and below responsibility areas which demands the using of frequency hopping radios. To control frequency spectrum demands qualified specialist in the planning of battlefield operations. The training of frequency managers and using their knowledge is indispensable in military operations of the future, so they are also overriding importance in the planning of military operations of HDF.
4. Expedient to take into consideration the demands of connections between tactical radiosystem of HDF and TETRA radiosystem. The tactical radiosystem will be a multifunction capability system and it has communications support to war and other

than war operations, even to crisis handling. It will insure to realize the demands of National Security Strategy of Hungary – in communications relation.

5. My proposals to form tactical radiosystem of HDF are met requirements of today's tactical demands, so I considered necessary to draft the possibilities and lines of enlargement or developments in future. I see the development of information system – which is run on radiosystem – in the forming of Tactical Internet. I think the capabilities enlargement of tactical radiosystem is made to realize the Situational Awareness and the tactical picture possible. The common interpretation of this tactical picture is appeared in sure decisions and it is yielded successful operation executions, too.

NEW ACADEMIC RESULTS

1. Making the summarizing of examined systemforming clear the services of modern, flexible tactical radiosystem insure the demands of users – mainly in communications supporting of command and control – and on the other hand the growing datatraffic possibilities make the tactical picture, so the common interpretation of this make sure decisions to execute operations.
2. Declaring by examining of software radio developments is reinforced the support of joint operations and organizations by this type of radios, even the changes of user demands can handle flexible by software applications, than in the earlier radiosystems.
3. The proposals of tactical radiosystem shaping of HDF – with the findings are attached to -, that is converted into reality the communications support of command at tactical level, and the simple shaping of Tactical Internet of HDF.

PROPOSALS FOR THESE UTILISING

- Taking to development strategy as a basis in the technical form of tactical radiosystem of HDF;
- Utilizing as a suggested reading in education of specific subjects or in specific education of PhD instructions of National Defence University;
- Utilizing in further examinations of tactical radiosystem of HDF and to make essays, papers, lecture notes and competitions.

LIST OF PUBLICATIONS

Publications

1. Miklós Hóka: Evolution of private networks. Conference publishing 2000, MZ NDU
2. Miklós Hóka: Communication support of the activities other than war through the TETRA mobile radio system. Új Honvédségi Szemle 2001/9
3. Miklós Hóka: Ideas to shape of combat net radios (CNR). Conference publishing 2001, MZ NDU
4. Miklós Hóka: New challenges and possibilities in radio communications (The Joint Tactical Radio System). Conference publishing 2001, MZ NDU
5. Miklós Hóka: Employing military message handling systems (MMHS) in command and control support. Conference publishing 2001, MZ NDU
6. Miklós Hóka: War of sensors. The Network Centric Warfare. Új Honvédségi Szemle 2002/2

7. Miklós Hóka: Questions of cooperation in mobile communications support of disaster protections. Bulletin of NDU 2002, MZ NDU
8. Miklós Hóka: Interoperability of tactical radio systems. Új Honvédségi Szemle 2002/6
9. Miklós Hóka: Different aspects of tactical information sharing. Conference publishing 2002, MZ NDU
10. Miklós Hóka: Different aspects of tactical information sharing. Új Honvédségi Szemle 2003/3
11. Miklós Hóka: Application of State-of-the-art technology in military radio communications, part 1. Haditechnika 2003/2
12. Miklós Hóka: Application of State-of-the-art technology in military radio communications, part 2. Haditechnika 2003/3
13. Miklós Hóka: Tactical Internet. Mobile communications in the 21th century AARMS volume 2, issue 2 (2003), MZ NDU
14. Miklós Hóka: Characteristics of urban warfare communications in 21th century. Conference publishing 2002, MZ NDU
15. Miklós Hóka: One picture of the future battlefield communications: the Tactical Internet. Conference publishing 2003, MZ NDU
16. Miklós Hóka: Results of electronics evolution on tactical mobile communications. Conference publishing 2004, MZ NDU

Studies

1. Miklós Hóka: Application of operational and tactical radio systems in peace- and military operations, as well as to support of fighting in the mirror of command and control, cooperation and interoperability. Doctorandorum of National Defence University 2001/1, MZ NDU
2. Miklós Hóka: Interoperability in the system organizing of military communications. Kard és toll - Selection from studies of military scientific's PhD 2002/2
3. Dr. Miklós Sándor (PhD) -Miklós Hóka: Improvements in military radio systems – Software Defined Radio (SDR). Kard és toll - Selection from studies of military scientific's PhD 2003/1

Conference presentations

1. Evolution of private network. Scientific conference, MZ NDU, Budapest, 04 October 2000
2. Presentation of own research theme. PhD conference, ZM NDU Budapest, 14 October 2000
3. Employing military message handling systems (MMHS) in command and control support. PhD Conference, MZ NDU, Budapest, 16 November 2001
4. Ideas to shape of combat net radios (CNR). Multinational Scientific Conference, MZ NDU, Budapest, 28 November 2001
5. Different aspects of tactical information sharing – the Tactical Internet. Multinational Scientific Conference, MZ NDU, Budapest, 30 October 2002
6. Tactical Internet. Mobile communications in the 21th century. Presentation in english on Multinational Scientific Conference of Robotics. MZ NDU, Budapest, 28 November 2002
7. Characteristics of urban warfare communications in 21th century. Multinational Scientific Conference, MZ NDU, Budapest, 15 October 2003
8. Results of electronics evolution on tactical mobile communications. Multinational Scientific Conference, MZ NDU, Budapest, 15 September 2004
9. The principle of Network Centric Warfare and its technical background. Multinational Scientific Conference of Robotics. MZ NDU, Budapest, 24 November 2004

Lecture notes

1. Miklós Hóka: Basics the NATO principle radio communications of land forces, MZ NDU 2003

Others

1. Presentation of own research results in National Meeting of PhD students. St Stephan University, Gödöllő, 12-14 April 2002

CURRICULUM VITAE

I was born in Budapest, on 19th March 1960.

I completed college course at Máté Zalka Military Technological College in 1982, as radio commander and communications engineer.

Between 1982 and 1998 I was served in Székesfehérvár, at Nagysándor József signal regiment, in different assignments.

In December 1996 I've got an opportunity to duty at Hungarian Engineer Contingent, where I supported the engineer rebuilding works of Bosnia and Hecegovina, as a radiostation commander, in unit IFOR, later SFOR. I was recognized by the possibility of look out to foreign radiosystems to need to use an up-to-date, digital radiosystem, and a few years later I continued this line in my science research.

Between 1998 and 2000 I was studying in Miklós Zrínyi National Defence University, where I was taken a degree in manager of military technology. I continued my study as a Ph.D. student in the same place from September of 2000, and finally, in 2003 I requested absolutorium out to make my thesis.

I was appointed chief of training in Signals Command of Hungarian Defence Forces, on 1st September 2003, and since then I'm in duty here.

I'm a member of next trade associations:

- Communications and Informatic Science Association
- Puskás Tivadar Fellow-soldier Association

In 1998 I joined in science life of National Defence University and this year I was presented my research work about TETRA system, I won supplementary prize for this wich was handed to me by Chief of Communications Group. After this I entered for University and National Science Student Competition for three times, I was well placed.

Several times I edited Ph.D. transactions, as well as I took part as a tutor in dissertations made by students of National Defence University.

I have english intermediate level language knowledge, even french basic level knowledge, both of them extended military specific.

I made 16 science publications (2 in english) and 7 in-dept studyes or applications. I presented 9 scientic conference papers (1 in english) and I've written a lecture notes.

I regularly published my researchs of thesis, I made them know to public opinion of scientic and trade.

LTC. Miklós Hóka