**ZRÍNYI MIKLÓS NATIONAL DEFENSE UNIVERSITY**
**Doctoral Council**

**Author's Guide**
**to the doctoral (PhD) dissertation**

**entitled**

# The technical possibilities of the development of the stationary communications systems of the Hungarian Defence Forces

**by**

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## Outlining the scientific problem

The development of signals equipment and systems of the Hungarian Defence Forces has all the controversial features of the political technical development of the Hungarian society and of its positive and negative tendencies. Until the 1970's stationary signals was primitive and hardly catered for the basic needs of command and control. Then, thanks to the outstanding development program of the 1970's and 1980's the Hungarian Defence Forces had the most modern territorial signals system of the country incorporating a digital microwave network as well. For a while this territorial stationary signals system, based on complex signals centers, was able to manage the structural and relocation changes of the armed forces without significant reconstructions.

One of the characteristic phenomena of the change of social system was the Telecommunication Act passed in 1992 and the so-called partial privatization in the whole communications system that followed. In a few years wired and radio-communications were fundamentally transferred and a buyer's market was established. In that period of time stagnation or limited development were characteristic for all sectors of the armed forces including signals of course. This situation was changed by Hungary's NATO accession in March 1999, the elaboration and approval of the basic principles of restructuring, and an increase in military budget. However, these changes were disproportional with the time elapsed since the accession and with the requirements towards the country.

By today, however, new questions have come up: various development trends marked by the principles and practice of civil telecommunication and the necessity to choose from the nearly unimaginably rich selection of services the one that meets the very specific needs of the command, control and communications in the armed forces. Moreover it should be in accord with the foreseeable development of field

signals equipment and signals organization structures based on NATO standards (recommendations).

Because of all these factors I considered a study on development potentials of the stationary communications systems of the Hungarian Defence Forces, a scientific analysis of the various solutions, and shaping a theoretical concept on a high-speed communications system that takes into consideration the accelerated progress in the field of information technology and telecommunication, incorporating the options of further development as necessary, timely, and possible.

## Research objectives

I considered an exploration of the technical structure and building of a modern stationary communications system as a fundamental research objective on the basis of the latest achievements and prospective trends of development of information technology, the real requirements of the military leadership, and the impact of legislative, civil and military environment.

For achieving this fundamental research objective I regard the analysis of the following partial fields as necessary:

1. an analysis on the pace of development of civil and military communications technologies as related to each other, reflected by the social and technical progress of the past period of time, and an assessment of the fundamental development tendencies;
2. an exploration of operational characteristics of stationary military communications systems incorporated in closed network linked to public networks working in an environment of effective laws;
3. to articulate the expectable military command and control requirements under the conditions of modern network warfare and the needs towards stationary communications systems;
4. to highlight the most important characteristics of the current stationary communications system of the Hungarian Defence Forces and to analyse how

it is capable of meeting foreseeable needs in modern information transmission at a high level;

5. after the analysis of long-range communications and information technology networks that follow the global development trends and are compatible with the current stationary communications system, to outline the theoretical concept, possible type, and structure of a high-speed military communications system with integrated service provided.

## RESEARCH TECHNIQUES

From the scope of my research I excluded the branch-responsibility issues of closed networks, the concrete organizational matching of recommendations and their needs of human resources. The research of economic pre-conditions was focused on strategic questions and did not address concrete financing issues.

From general research techniques I applied observation and induction, while from the special research methods of military science I utilized the critical analysis of the present stationary communications system and the analysis of lessons learned from its practical operation.

For achieving research objectives the following research techniques were applied:

1. I studied and processed special literature, scientific works, candidate, PhD, and doctorial thesis works.
2. I analysed and systematized the legal background of the closed communications system in the Hungarian Defence Forces.
3. I studied the technical structure, characteristics, operational features of the current stationary communications system.
4. with the use of mathematical modeling I examined the traffic situations at a massive traffic load which I compared with practical data.
5. I drew partial conclusions on the characteristics of the current stationary communications system.

6. I analysed the most important features of the up-to-date and prospective communications procedures.
7. on the basis of the systematized data and partial conclusions I outlined a principal recommendation on the further technical development of the current stationary communications system.

## A CONCISE SUMMARY OF THE ANALYSES

For achieving the outlined research objectives I divided my dissertation into four major parts:

In Chapter 1 – following the Introduction – I give a brief outline of the most important notions used in my dissertation and give a definition to the notion of stationary communications system in the Hungarian Defence Forces to be used by me. I give a historical overview of the development of military and civil telecommunication and information technology. I summarise the impact of globalisation, convergence, and integration of the stationary communications system in the Hungarian Defence Forces. I give an in-depth analysis of laws and regulations related to civil telecommunication and information technology, national defence, defence preparation, and stationary communications system in the Hungarian Defence Forces. At the end of the chapter I draw a conclusion on the technological potential of further development of stationary communications system in the Hungarian Defence Forces – possible and justified on the basis of law.

### Results and conclusions

1. Developments in civil telecommunication were followed by military communications developments in a relatively short period of time (3-10 years). The time elapsed between the introduction of new telecommunication in information technology systems based on fundamentally new principles, is rapidly decreasing.
2. In stationary communications systems besides the full use of networks based on different principles (circuit-switched versus module-switched) an

establishment of higher transfer capacity and spread of digitalization can be witnessed. The military communications networks built by the turn of the millennium incorporate up-to-date but principally rather different solutions.

3. Various telecommunication and information technology networks and the services provided by them require an increasing data transfer speed. Users' need in higher speed, complex, primarily multimedia applications can be met by converging communications networks thus stationary communications system is continuously integrating. It should also be taken into consideration that stationary communications system in the Hungarian Defence Forces – as for its functions and technical structure – must be linked to an increasing number of military and civil communications systems.
4. One of the special aspects of globalisation – which is typical only for the Hungarian Defence Forces – can be an integration of stationary and field communications systems. in a further stage of convergence an integrated establishment of defence (NATO - national) and governmental (other closed type) communications systems can be forecasted.
5. Special literature shows that besides its own field (mobile) signals equipment every armed forces uses – to a certain extent – the public and other networks of a country, utilizing their transfer routes or telecommunication/information technology services. As it comes from the new Telecommunication Act it will be the legislators' task to elaborate a detailed regulation of defence-related preparation of telecommunication and information technology, in close cooperation with the involved military authorities, on the basis of legislative authorizations. These rules and regulations will have only an indirect impact on the development of stationary communications system in the Hungarian Defence Forces but their influence will be undisputable as one of the determining objectives of the preparation of telecommunication is to meet the requirements of national defence.
6. As the establishment, operation, and development of closed communications systems are regulated by Government Decree 50/1998 (III.27.) its restructuring and modernization can be expected but no situation can be expected that would terminate the legal ground of stationary communications system in the Hungarian Defence Forces as a closed network.

In Chapter 2 I give an analysis of the stationary communications system in the Hungarian Defence Forces and of the most important communications systems linked to it. I examine the potential development trends. I summarise the features of the National Information Backbone Network, NATO communications system and public telecommunication systems, which have an influence on the operation of the stationary communications system in the Hungarian Defence Forces. Drawing conclusions at the end of the Chapter I outline the potentials in further technical development of the stationary communications system in the Hungarian Defence Forces taking into consideration the current characteristics and foreseeable further development of the related communications systems.

**Results and conclusions**

1. The stationary communications system is a centerpiece in the command and control of the Hungarian Defence Forces. It consists of sophisticated, multigeneration equipment significantly differing both in technical terms and development levels. The topography of the stationary communications system in the Hungarian Defence Forces is fundamentally determined by the restructuring of the Hungarian Defence Forces with its increasingly sophisticated topology.
2. The most important transfer network of the stationary communications system in the Hungarian Defence Forces is its microwave network with its extremely limited nx2Mbit/s transfer speed. The telecommunication network management of the increasingly overstructured microwave network is growing difficult and there is little opportunity to establish circuits for a multilevel network management.
3. The information system of the Hungarian Defence Forces consists of multigeneration, inhomogeneous hardware and of local area network solutions. Its data transfer networks normally have low-level data traffic but have many endpoints concentrated in garrisons and command posts. As “Burst” traffic is typical for data transfer it is supported by line-switched stationary communications system in the Hungarian Defence Forces with low

efficiency. The process of connecting remote Hungarian Defence Forces LAN islands into WAN network has begun.

4. The circuit principle of the newly established National Information Backbone Network of the Hungarian Defence Forces is different thus it is not supported by the current N-ISDN network. As opposed to the integration characteristic for telecommunication and information technology solutions a separate network was established as a solution. The National Information Backbone Network of the Hungarian Defence Forces and the internet Backbone Network of the Hungarian Defence Forces load the limited power stationary communications system of the Hungarian Defence Forces in various relations, primarily with 2 Mbit/s. To date on the basis of the information technology developments it can be stated that the WAN bandwidth necessary for them is growing at an accelerating pace.
5. Although the NATO communications system is based on the separation of communications and information networks, convergence is increasing particularly in the field of LAN networks. The experimental testing and introduction of prospective, high-speed, highly reliable information transfer procedures have begun.
6. Currently the territory of the Republic of Hungary is covered by several wired and mobile service providers simultaneously, offering similar or identical services. Today the domestic service providers use the most up-to-date procedures worldwide (WDM, SDH, ATM, IP) and in the years to come cutting edge developments in telecommunication and information technology are expected to follow.

In Chapter 3 I explore the new, higher quality requirements of the military leadership towards the communications system. Using simulations I examined how the channel-engagement probability of the current communication system changes during a gradually increasing complex multimedia information load. I analyse the most important characteristics of those communication models and modern technologies that may prove to be suitable for further technical development of stationary communications system of the Hungarian Defence Forces. In conclusions I point out the potential and reasonable trends of further development of the stationary

communications system of the Hungarian Defence Forces – on the basis of technical points of view.

**Results and conclusions**

1. As the communications requirements of the military leadership changes the stationary communications system of the Hungarian Defence Forces should provide robust services, much larger bandwidth, and data-transfer speed than the current system. This can be supported by an adoption of system and technology that stood the test and is widespread in the civil sphere.
2. The convergence of telecommunication and information technology applications is parallel with the convergence of standards, proposals, and models.
3. From the aspect of global interoperability the stationary communications system of the Hungarian Defence Forces must meet the most important civil and military communications standards and proposals. Due to the emphasis on the global convergence of communications and information technology the prospective stationary communications system of the Hungarian Defence Forces is to provide a high-level service independently from the type of transferable materials.
4. The conditions for the technical link to communications systems based on various principles should be provided primarily by a full support to civil telecommunication and information technology standards. Therefore, an integrated and unified stationary communications system is in the interest of the Hungarian Defence Forces, however, it can be realized at different development, technical-economic levels.
5. The stationary communications system of the Hungarian Defence Forces should have optical fiber or SDH microwave transfer as a medium. If optical fiber is chosen it is reasonable to select DWDM mono-mode optical fiber allowing the building of an optical Backbone Network for the stationary communications system of the Hungarian Defence Forces without built-in amplifiers. Above the ATM Backbone Network an extremely good quality

platform-independent integrated stationary communications system can be established with an MPLS using VPN protocol.

In the **conclusion** of my dissertation I assess the alternative opportunities of the practical further development and the economic risk factors. I also point out the differences between various feasible opportunities. I outline general theses and conclusions, summarise the new scientific results of the dissertation and make recommendations for the utilization of the findings of my thesis work.

## SUMMARIZED CONCLUSIONS

1. NATO requires, Telecommunication Act XL of 2001 allows with its liberal telecommunications policy, the legal background and Government Decree 50/1998 (III.27) also allows the establishment and operation of the stationary communications system of the Hungarian Defence Forces replacing a separated communications network, operating on the basis of traffic or logical separation. Therefore the modernization of segmented closed networks with low development capacities can be managed with a further development utilizing the public communications system of the country based on similar principles.
2. On the basis of effective rules and regulations the further technical development of the stationary communications system of the Hungarian Defence Forces is possible into an integrated closed communications system with high-level multimedia transfer capabilities which is structurally linked to the NATO integrated command and control system, is technologically and physically separated, virtually separated from public network segments but technologically is similar in its solutions.
3. The technical communications system of the stationary communications system of the Hungarian Defence Forces basically meets the current national command and control requirements but it lags behind both the advanced level of operational communications systems in the allied states and t Summarized conclusion that of the civil telecommunication. Therefore the technical further development of the stationary communications system of the Hungarian

Defence Forces is possible on the basis of the current state of Hungarian telecommunication and due to the growing internal contradictions within the stationary communications system of the Hungarian Defence Forces is an increasing imperative.

4. The close convergence of army communication and information technology applications should be realized with a high-speed technical modernization with guaranteed service level supporting voice- and data-transfer with integrated communications solutions. The solutions applied during the technical improvement should be capable of an initial integration of the current PDH and N-ISDN-based networks of the stationary communications system of the Hungarian Defence Forces and also of its gradual replacement with an option of prospective technical developments.
5. The reasonable improvement of the stationary communications system of the Hungarian Defence Forces would be supported by a high-speed communications system underpinned with a feasibility study. This would be based on the current stationary communications system in the Hungarian Defence Forces and the up-to-date public communications infrastructure of the country, which would first supplement then replace the current system. The new system will be capable of transferring all types of data with high service quality and will be fully integrated as telecommunication and information technology networks are concerned both on technological and structural aspects, physically separated and capable of the establishment of linked public and other closed networks.

## I REGARD THE FOLLOWING AS NEW SCIENTIFIC RESULTS OF THE DISSERTATION:

1. On the basis of my analyzing the development trends of communications technologies in the past period of time I determined the general features of civil telecommunication and information technology developments and their pace of application in military communications systems.

2. I explored the characteristics related to the effective legal environment of the stationary communications system of the Hungarian Defence Forces linked to public networks and functioning as a part of closed network.
3. I outlined the typical features of prospective command and control requirements and the expectations of the military leadership towards a stationary communications system.
4. By analyzing various features of the current stationary communications system I proved that the stationary communications system is incapable of providing a high-quality service in high-speed, real-time information transfer.
5. I analysed the characteristics of the current and prospective stationary telecommunication and information technology networks and on the basis of my findings elaborated the architecture of a new type, high-speed, integrated communications system.

## RECOMMENDATIONS

1. I recommend the findings in my PhD thesis work for the shaping of stationary communications system of the Hungarian Defence Forces, and for executing development tasks of the signals services.
2. I recommend my PhD thesis work for a use in training in the PhD School of Zrinyi Miklos National Defence University, in the five-year-long basic and post-graduate university trainings, in teaching professional academic subjects, as recommended literature.
3. I recommend if for further professional use in preparing studies, applications, and university textbook on the stationary communications system of the Hungarian Defence Forces and on the communications infrastructure and legislative environment of the Republic of Hungary.