AUTHOR'S SUMMARY OF PHD DISSERTATION

ZRÍNYI MIKLÓS
NATIONAL DEFENCE UNIVERSITY
Doctorate Council

ATTILA BLEIER

Modernization of the fixed communication system of the Hungarian Army

Author's summary and official reviews

Budapest
2010

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Scientific Leader:

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1. THE DEFINITION OF SCIENTIFIC PROBLEM

My research topic is the modernization of the fixed (a.k.a. backbone) network Communication and IT network of the Hungarian Army, with special focus on traffic shappings of the fixed network and the benefits of using the unified IP/MPLS (Internet Protocol – Multi Protocol Label Switching) network technology in the backbone communication network of the Hungarian Army. The fixed network of the Hungarian Army is the data transmission network for transport services, that connects the sites of the Hungarian Army currently using time division multiplex transmission network technology. The fixed network is built up using microwave network communication devices. The latest renewal of these devices have happened in the early 2000's. Current technologies used in the fixed network has been described by Károly Fekete in his PhD thesis in more depth. My research is partly based on the research described in this work. Beside these the technology changes in the non-military telecommunication (e.g. the technology migration to the unified IP network) and the deployment of high-availability IP based devices, and their wide-spread use in civilian service provider networks have influenced me to do my research.

After carefully studying the documents and materials both in the Hungarian and International scientific community, I have come to the following conclusion and hypothesis:

- It is just as crucial to analyze IP based information technology networks as time division based telecommunication networks have been analyzed in the past
- It is important to use such traffic analysis the fixed network of the Hungarian Army
- The traffic patterns of the fixed communication network, the topology and the network relations can be modelled in software
- Based on the results of the traffic analysis using scientific modelling a long term evolution of the network topology can be determined.

2. RESEARCH AIMS

One of the basic research aims based on the above is to study technologies used in Service Provider networks and to adopt these to the special environment used in the Hungarian Army. Part of this research is to make a recommendation for network elements used in the fixed network in the future.

In order to reach my research goals I have set the following mid-term goals:

- to examine the special military communication and IT requirements that the fixed network should fullfill

- to determine methods that help in modelling traffic situations

- to determine present and probable future traffic requirements

- to study the possibility of using a common Ethernet/IP/MPLS based network technology model in the fixed communication network of the Hungarian Army

- to make recommendation for the physical and logical topology of a fixed communication network

- to suggest network technology parameter settings

- to determine a migration path from the present network structure to a future one

It is important to state that I'm not considering part of my research the following:

- General technical parameters of the IP routers (only up to the level that is required for setting a fixed communication network, as these parameters have been defined by NATO (North Atlantic Treaty Organization) STANAGs (Standardization Agreement) and IETF (Internet Engineering Task Force), IEEE (Institute of Electrical and Electronics Engineers Inc). standards.

- General Introduction of Ethernet / IP / MPLS technology (it is a well known technology used in civil and military networks as well) – The technology has been publicly researched in many papers

- Any organizational aspects of the suggestions in the Hungarian Army

- The economic and material impact of the suggestions

- human resource requirements of the suggestions

I finished my research, documentation, gathering data and information for my studies in December, 2009.

3. METHODS OF RESEARCH

In order to fulfill my research goals, I studied the available scientific and informational material in the library of the Zrínyi Miklós Defense University, the related PhD and doctoral theses, the books, articles related to my research topic. I have studied the IP/MPLS technology standards and recommendations from both the civil and military groups. I've read the material (mostly foreign) in connection with my research topic in the scientific media. I have consulted with the operational and military personal in my research area, including the personnel operating the fixed network in the army and the operation crew of different civil networks. I participated on Hungarian and international conferences where I held presentations on the results of my research, and I have gained deeper knowledge on the network trends in the world. I used my experience in IP/MPLS backbone technology design at different Hungarian backbones (Magyar Villamos Művek Zrt., Magyar Telekom Nyrt., Telenor Zrt., Émász Kft.).

I used both secondary and primary research methods such as:

- I researched and conducted the scientific material in connection with my research topic, the scientific works, and PhD theses
- analyzed the development of IP/MPLS networks from 1st generation network developments to 2nd and 3rd generation IP network developments
- I've studied the network services used in the current IP/MPLS networks and how they work
- I have concluded consequences from the IP/MPLS backbones examined the different properties of the fixed backbone networks and their usage
- I have conducted primary network research and design in several civil backbone networks (Magyar Villamos Művek Zrt. Magyar Telekom Nyrt. and Telenor Zrt., Émász Kft.), and I used my experience when making a suggestion for the fixed backbone network of the Hungarian Army
- I've modeled the traffic situations using tools of computing (computers, networks etc.) and I automated where it was possible.

4. THE EXECUTED RESEARCHES IN DIFFERENT CHAPTERS

The first chapter contains an overview about the requirements being set up by the Doctrine for my field of research – the fixed communication and information system of the Hungarian Army. I also examined whether the fixed communication system of the Hungarian Army

fullfills these requirements or not and whether it contains the answer for the challanges that has been asked also in this chapter. In this chapter I highlighted that the Doctrine defines the communication adn information system of the Hungarian Army as a war support system and I proposed a new approach for the relationship between the supported party and the support. This has been defined in detail in the following chapters. I also defined the main paths (system integration, combat engineering security and information security) paths by which the requirements for the communication and information system of the Hungarian Army is to be defined. I called the attention that the Doctrine defines information operation as a task of the communication and information sysmtem. The Doctrine defines those basic principles that helps deploy and operate the communication and information system of the Hungarian Army.

These principles make possible that high availability networks design, deployment and operation currently being used in Service Provider networks are to be used at the deployment of the fixed communication system of the Hungarian Army, considering that the special requirements of the Hungarian Army is taken into account. Further parts in this chapter is dealing with the actual development plan, which contains only rough paths does not include actual system development details, which I consider a serious problems. Furthermore it defines the some basic military communication terminology. The last part of this chapter deals with the proposed solution, and I giving a migration path to solve the problem before. In the first chapter I describe the present network, how it is built up and its specialities, and I define the structural and service problems of the fixed communication system. It is built up inhomogeneous network elements and technologies and the network resources are not properly utilized. Data transmission speeds are low, and the LAN-s are separated. The fixed communication system has service quality and restoration problems and the lack of network level measurements. I define the following actions in order to improve the network quality:

1. Isolation of the network making an unified network

2. solving capacity problems

3. Making the network QoS capable, making call controll based on IP

4. Deployment of IP/MPLS in order to improve availability utilization and service parameters

In the second chapter I'm seeking an answer to the question whether military IT applications demand a certain set of changes in the communication and IT system of the Hungarian Army. I payed closer attention to the traffic situation in the network with 3 traffic examples, and simulated using a computer model the three situations. The three situations defines 3 development stages of the IT and military IT systems and their bandwidth demands respectively. The network is simulated against such traffic demands and it is proven that the network is not capable of fullfilling future traffic demands in the present state, without major changes in the architecture and design both in terms of reliability and bandwidth as well. The fixed network has to be upgraded.

The 3rd chapter is the proposed network built up for the future fixed communication system, its network elements and its suggested topology. In this chapter I thoroughly determined the technologies to be used in the fixed network communication system of the Hungarian Army using high-availability routers and Ethernet microwave devices. The requirements for the proposed Ethernet microwave devices has been defined throughout the chapter. These network devices proposed a unified, reliable platform to propose services. The new generation IP/MPLS network devices provide 99,99% reliability, and these devices make MPLS VPN services possible. These virtual private networks separate organizational units, and we can differentiate and provide different service levels for the military IT applications. The service levels on the network are provided using paths (a.k.a label switched paths LSP-s). LSP-s are defined either autmatically in case special path are being used then by hand. The requirements for the IP/MPLS router devices have been defined in this chapter, and also the network level IP/MPLS parameters up to a level of depth that is necessary for the high level design of the system. I called the attention that the network services can be easily assured using the services of an external IP/MPLS service provider. In this chapter I examined that what sort of migration path is required from the present network to a modern, 2nd generation network to a more future proof network. Throughout this migration path each network layer are recreated at a higher quality.

The annexes contain the materials that are required for further understanding (so the tests and device parameter settings that are being used throughout the primary applied research).

5. CONCLUSIONS

To reach my research goals the PhD thesis has been cut into three chapters. The first chapter defines the requirements based on the Doctrine and describes the present situation, the second chapter models the bandwidth requirements for the possible scenarios and proposes a method for the traffic situation analysis in the future. A rough estimation is provided here using 3 scenarios, and a computer based model and a possible computer based modelling is proposed. In this chapter we are using a scientific method to :

- to estimate the utilization scenario using different traffic scenarios
- how certain traffic situation can be modelled on a packet network
- what sort of congestion and overutilization problem may occur in a network modell
- how these congestion problems are reflected in the real network
- how the fixed network reacts to the increased demand from the application layer

The 3rd chapter contains suggestions for the new fixed and IT network. This chapter defines a proposal for the fixed and IT network topology, clearly defining the technology as well as the type of network elements to be used in the fixed network. The set-up is started with the theoretical network layers and a typical backbone site device will be determined. In my understanding the classical transmission and IP based where the transmission network provides point-to-point connections over fiber, wavelength or microwave connections.

6. NEW SCIENTIFIC RESULTS

Suggestions have been given for the new network topology – using mathematical methods to analyze capacity problems in the network. I did traffic analysis in the network, I made predictions for the network traffic. The simulation included traffic situations that has occured in the past - a realistic estimation for the current network utilization and predictions for the future network utilization. I determined bottlenecks in the network the technology causes of the capacity problems. I designed the network using current network technology and devices on a device level. I also determined the requirements for the network devices on a network layer, its settings on a network layer. I determined the suggested services and I simulated on a test network the suggested deployment of network.

I consider the following a new scientific result:

1. Clarifing the problems int he fixed network of the Hungarian Army both considering technological and network capacity situations. Clarifing that on the present technological level the network is not futureproof and not ready for transmitting data for military IT applications e.g. 3D radar images. The network topology, and its devices are outdated and it is to be reconsidered.
2. I consider a primary research result that I made predictions on the traffic and modelled the network using 3 traffic cases. I'm considering a primary applied research result that the traffic modell of the network has been created and it is made reproducable. This way it creates a way for a more detaild traffic analysis of the network. Both the described and applied method for traffic analysis and the result of the traffic analysis is considered a primary research result.
3. I'm considering a primary and secondary research result that the fixed network of the Hungarian Army has been created the parameters and settings have been thoroughly determined, and a migration overview has been suggested.
4. I'm considering a secondary research result that the service provider infrastructure has been examined, its possible usage for the purpose of the Hungarian Army has been examined. I also called an attention on protected critical information infrastructure
5. I'm considering a primary research result that the network has been moved to a service based approach and I also created the possible technology for a service based network approach where each layer (service, network, transmission) is defined in SLA agreements.

7. PRACTICAL AVAILABILITY OF THE NEW SCIENTIFIC RESULTS

The thesis can be used in practice for the deployment of the fixed network of the Hungarian Army – either as a network development strategy tool or design the traffic for the network of the Hungarian Army and rethinking its capacity situations. The paper is highly suggested to be used when considering the design of the new fixed network.

8. RECOMMENDATIONS

It is highly recommended to be used at the Doctoral schools of the Zrínyi Miklós Defense University as a study material. It can be used as a training material for technical subjects network theory at a University level as well. The material can be used at creating studies applications and for making university notes.

9. PUBLICATIONS' LIST OF ASPIRANT RELATED TO THE TOPIC OF DISSERTATION

- Vezeték nélküli képátviteli rendszer (Wireless picture transmission system). Bleier Attila, dr. Rajnai Zoltán., Kard és Toll, p. 118-129, Budapest : ZMNE, 2007, Vol. Communications 2007. ISSN: 1587-558X .
- Optimization of a transmission network. Bleier Attila, dr. Rajnai Zoltán. Kommunikáció 2007, p. 264-285, Budapest : ZMNE, 2007, Vol. Communications 2007. ISBN: 978-963-7060-31-1.
- Bleier Attila, dr. Rajnai Zoltán. Bolyai Hadmérnöki Phd konferencia: Új generációs hálózati megoldások alkalmazása a Magyar Honvédség stacioner hálózatának modernizációjában (Using new generation network solution at the fixed communication system of the Hungarian Army). Bleier Attila, Budapest : s.n., 2009.
- Traffic Optimization in a backbone. Attila Bleier, dr. Rajnai Zoltán. 309-328, Budapest : Zrínyi Miklós Nemzetvédelmi Egyetem Publishing Office, AARMS, 2008, Vol. 7/2. ISSN 1588-8789.
- The challanges of the 21st century and the requirements of the Hungarian Army. Attila, Bleier. Budapest : ZMNE, Communications 2008. ISBN 978-963-7060-11-1.
- Magyar Honvédség elvárásai és a XXI század kihívásai. Attila, Bleier. Budapest :Kommunikáció 2008 ZMNE, Communications 2008. ISBN 978-963-7060-57-1.
- Új generációs hálózati megoldások alkalmazása a Magyar Honvédség hálózatának modernizációjában. (Using new generation solutions in the Hungarian Army) Attila, Bleier. Budapest : ZMNE, 2009.., Hadmérnök, IV./2. kötet, old.: 19-28. ISSN 1788-1919.
- Technical problems in the IP communication systems of the Hungarian Army, ZOLTÁN RAJNAI, ATTILA BLEIER, Budapest : Zrínyi Miklós Nemzetvédelmi Egyetem Publishing Office, AARMS TECHNOLOGY , Vol. 9, No. 1 (2010) 15–23, . ISSN 1588-8789

10. ASPIRANT'S SCIENTIFIC- PROFESSIONAL CV

Personal data	**Time and place of birth:** Budapest, november 9, 1975 **Address:** Gerenda u. 11, 1163, Budapest, Hungary **Telephone**: +36 30 343 6135 **E-mail:** attila.bleier@gmail.com
Education	**2007 - 2010 Zrínyi Miklós Defense University**, PhD Student **1995 – 2000 University of Veszprém (Pannon University).** Master of Science Information Technology **1990 – 1995 Trefort Ágoston Bilingual Technical High School,** High School Diploma, Computer Mechanic
Work Experience	2000 - Currently Kapsch Ltd. , **Technical Team Leader** – Carrier Solutions (2007 –) Leading the presales support team of (5 Persons) , proposals and project implementation, technical negotiations, vendor connections **Customer Solution Manager** (2003 – 2007) IP, Datacom, Software Solution design, creating technical part of proposals, making customer solutions, data communication networks, network management system design, project team leading IP, datacommunication and network management systems. Major projects: Magyar Telekom Nyrt. (almost all data communication network layer, network design and project leading) Telenor Zrt. (IP RAN aggregation layer design, project leading) MVM Zrt. (DCN network design, project leading, HA-IP network design) BKV Metró 2 Telekommunikáció/IT– Network management and IT solution design **System Engineer (2000- 2003)** IP, data communication and software, IP, support of data communication systems and software Data product support (Nortel,Appian data products), Network management systems (Nortel, Lucent, Appian) in different environments (Linux, Solaris, HP-UX, Windows) supporting different software products (Webforgroups group application, HP Openview) **Major projects:** OVF (Frame Relay, integrated data and network design), Erste Bank Magyarország(Nortel data network design), Matáv (data, Appian trial projects), MVM (Network management system implementation)
Trainee programs	May 2005 – Sept. 2005 On the job training, Bécs, Ausztria technical presales support training at Kapsch CarrierComnál, 4 months of on-the-job training

1999-2000 ELTE Information Technology Center
IP Multicast network implementaion on streaming multimedia Cisco routers and Linux/NT servers, Streaming multimedia solution tests (RealSoft and Microsoft products), IP Multicast implementation on internal routers, IP Multicast service support
1998 -1999 Nokia Magyarország (Ösztöndíj)
WAP – WTP protocol data type definition using (ASN1, SDL), a development and test of the WTP layer of the WAP protocol stack using ASN1 protocol development language. WAP servers and emulated client tests WAP szerverek és emulált kliensek tesztje

Languages

- Hungarian (nativ),
- English(Advanced level(C1)),
- Intermediate german (Középfokú nyelvvizsga(B1)), Zertifikat Deutsch – sehr gut)

Technical courses

- Nortel Passport Multiservice Switch 4400,Nortel Passport Multiservice Switch 6400/7400/15000, Nortel Preside Network Management System
- Alcatel-Lucent Anymedia és NAM Element Management system
- Keymile UNEM Element Management System
- Appian adathálózati termékek és elemmenedzselő
- Deverto TSS software softswitch
- Product Introduction Training
- UMTS Introduction training
- IP DSLAM
- Leadership training
- Project organization (IQSoft John Bryce education center)
- Ericsson/Redback Edge IP routing/BRAS
- Juniper Network Sales Specialist
- Juniper Network Certified Internet Specialist
- Cathegory B driver's license

Other

- Programming languages: C, Python, SQL
- Operation systems :Unix(Linux,HP-UX,Solaris), Windows 95/98/NT/2000/XP
- Programs: Microsoft Office,Visio,Project, Network and Element Management systems(HP Openview NNM)
- Protocols: ATM,FR,SDH/PDH, LAN/WAN, SNMP, TCP/IP, VoIP
- Sports (kenu,sízés,labdarúgás,squash)

Hobbies

- reading
- Internet
- languages

Date. 2010, September 15.

Signature