

Mobile virtual ICT platform in military decision making process

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Abstract. The most important features of the present battlefield are the fastness and aptness of the process of decisions making in the conditions of uncertainty and significant risk. This task is realized by the command and control body which is responsible inter alia for: the gathering, processing, sending, and storing of information. In order to assure the correct realization of the aforementioned tasks, the command and control body should be equipped with proper IT tools which facilitate the process of decision making. The key activity in the transitional period in the process of achieving network centric capability in NATO is to carry out research which aims at finding proper IT solutions. In this article, the author presents the characteristics of the functioning of a hierarchical organization of military character as well as the most important results of research connected with the application of ICT infrastructure (network platform) by the command and control body within the command post. The conclusions of the carried out analysis allowed for the creation and presentation of the concept of a mobile virtual network platform which can be implemented for the needs of the command and control body in the process of supporting the military decision making process.

Keywords: information communication technology (ICT), ICT support, military decision making process (MDMP)

1 Introduction

In the last decade, one can spot changes in the scope of organizational structures and the application of ICT gears in the Land Forces, and precisely in the field of military communications system [1]. The process of changes was grandly caused by the settings imposed on the NATO member states in the process of achieving network centric capability.

On the command post there are separate, diverse tasks for the command and control body and the provider of services, which are linked by one common element i.e. the ICT infrastructure. For the command and control body this is mainly communication platform as well as a platform rendering different service in the process of supporting the military decision making process, for the provider of

services, this is a big challenge to guarantee its proper functioning. As a result of research carried out in both respondent groups, it was settled what were the needs and indolent areas in the scope of the structure and the functioning of the ICT infrastructure. In order to assure the optimum functionality in the mobile conditions, the author suggests to use ICT platform with hardware solution in connection with software enabling the virtualization of the ICT environment.

2 The characteristics of hierarchical organization of military character

Military Decision Making Process is realized in a hierarchical organization of military character. The process is based on three basic elements, namely: human, organizational and technological ones which are interrelated by defined relations within the command and control system [2]. One of the interpretations of the concept was presented by M.D. Mandeles (see Fig. 1).

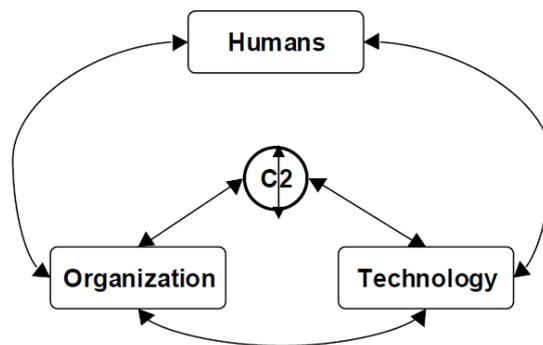


Fig. 1. The concept of command and control system „C2” according to Mandeles M.D. [8]

According to the concept, in reality ‘C2’ organization resembles a system consisting of interrelated elements such as: a human factor, an organizational factor, and a technical factor [8]. The concept was a starting point for deliberation on the influence of human and organizational factors on the command and control system, which was presented in a RTO Technical Report TR-081, NATO Code of Best Practice for Command and Control Assessment, RTO/NATO 2004 [10].

Under this report, command and control system can change alongside with the change of any elements which belong to the aforementioned three categories. Moreover, taking into consideration the fact that the human, organizational and technical factors are tightly interrelated, the optimization of one of them with the other terms equal for the remaining two elements rarely results in an efficient ‘C2’ system.

The Polish literature concerning the theory and practice of command and control [7] presents the following division of the key components of the command and control system:

- organization of command and control (OC2);
- military decision making process (MDMP);
- command and control measures (C2M).

It has been assumed that in a hierarchical organization of military character decisions are taken within one the three components of command and control system, i.e. in the military decision making process (MDMP). The process is of informative-decisive character and is realized by the command and control bodies located in the network of command posts at a given organizational level and it aims at taking a final decision and passing it to the executors [7].

The decision cycle in the military decision making process is realized in accordance with a certain plan of decision making which has been accepted in a military organization in the national dimension, which has been presented below on Fig. 2.

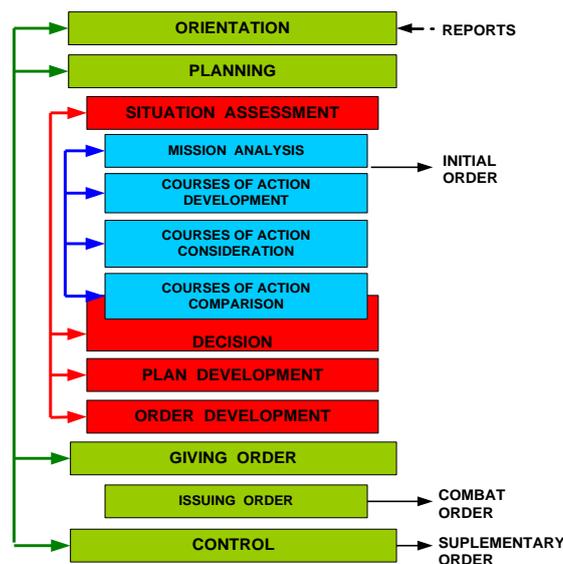


Fig. 2. Scheme of conduct of a command body in accordance with MDMP [7]

It is impossible to separate the military decision making process in military and control system from the structure of command and control body. One of the examples of the present organizational structure in accordance with the norms in force for the command post in a mechanized brigade is characterized below:

- commander and commander's group;

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- chief of staff of the command and control body;
- commandant of command post;
- command and control team with specialized groups;
- planning team with specialized groups;
- reconnaissance team with specialized groups;
- support team with specialized groups.

The functioning of any organization is based on the provision of information. The process of information exchange in such organization requires proper routs for information flow, the so called information bonds (see Fig. 3.) presented below indicate the relations of information flow in a mechanized brigade in a constellation with the superiors and subordinates.

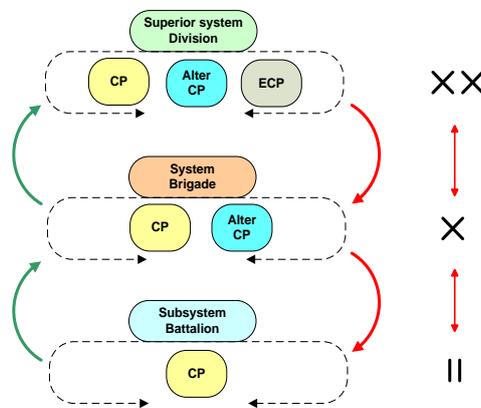


Fig. 3. Information relations in a mechanized brigade between the superiors and subordinates

The subject literature provides their different division, the author uses the division in accordance with the criteria presented below [7]:

- organizational structure (official, coordination, cooperation);
- the direction of information flow (external incoming, internal, external outgoing);
- the direction of bonds (official, functional, informative).

3 The conditioning of mobile virtual ICT platform

The NATO requirements concerning the pursuit of network centric capabilities by the member states emphasize the existence of the transition period between the search for new solutions which meet the network centric requirements and solutions which improve the presently used tools [9]. In the author's opinion it is impossible to avoid this state, which can disorganize the operation and trigger mental problems which are connected with the implementation of new solutions among the recipients.

The carried out research indicates the dissatisfaction with the possibilities offered by the ICT infrastructure which is reflected in tools (applications) used to support the military decision making process, their lack or their unsatisfactory effectiveness.

Research in the scope of transition state is vital for a fluent passage to the new conditioning as well as overcoming mental resistance of the users or recipients to new solutions. Moreover, a cyclic research in this field can help to specify the needs of the interest groups for whom the solutions are created. It is unacceptable to create tools which not only fail to support but even prolong the military decision making process at a tactical level.

In a hierarchical organization of military character it is vital to precisely differentiate the roles of two basic parties which are involved in ICT support, namely: the recipient and provider of services [4].

The differentiation is necessary due to the fact that in the command and control system the body which provides the services has different main tasks than the recipient i.e. the command and control body. Looking at the example of allocation to carry out operations, the command and control body is responsible for the preparation of plans and their realization. While the provider's task is to support, render ICT services which enable the command and control body to achieve its goals.

The research which was carried out in the scope of ICT support was located in the functional area of the command and control system, namely in human, organizational and technical aspect. However, in this article the author presented only part of the research results which refer to the ICT infrastructure on the command post.

3.1 The recipient aspect (command and control body)

The command and control body was mainly interested in using applications supporting the military decision making process. The functioning of IT applications strongly depends on the structure of ICT infrastructure as they are implemented on its basis.

A vital aspect which can be distinguished is the level of satisfaction of the application users, since 82% of respondents indicated different types of problems concerning the application functioning (reliability of software) and only 7% of the surveyed people did not voice difficulties in this scope (see Fig. 4).

As far as ergonomics of the user's interface is concerned, over half of the users (57%) were positive about it while 32% had negative opinion. It shows that, in spite of faults and problems with proper functioning, computer-assisted applications are needed, and further work should be continued in terms of the improvement of the usage quality.

In this case, the applied ICT infrastructure had also influence on the proper functioning of the application, which, during the research process, proved to be incoherent; this might have had effect on the correct functioning of the implemented application.

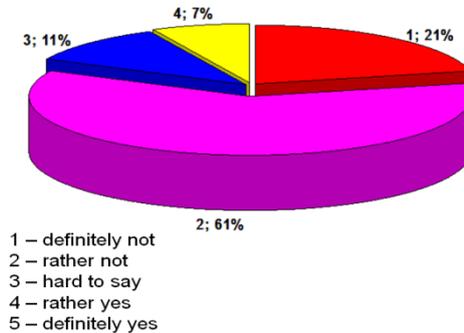


Fig. 4. The division of respondents' opinion concerning the functioning of the application supporting the military decision making process [2]

In the recipient aspect, in the scope of ICT infrastructure functionality in the military decision making process, the opinion of respondents and experts allowed to define a set of needs referring inter alia to the following factors [6]:

- access to the application from any IT point of the network on the command post;
- easy access to information for the organizational sections of the command post;
- easy access to the network resources of the subordinates in case of having proper access rights e.g. for the commander of unit;
- ad-hoc change of needs as far as the resources of the ICT infrastructure are concerned;
- group work with command and control documents, planning and informative documents within the same section as well as different sections;
- surveillance of the realized undertakings within the military decision making process;
- easy and advanced search for information;
- preparing the work plan of the functional sections on the basis of the plan of the chief of staff;
- running and electronic log of combat activities;
- clear set of functionalities, convenient for the operator in the military decision making process;
- simple and clear manuals;
- support of the process of preparation and carrying out briefings;
- surveillance of the reaction on the appearing incidents;
- easy communication within the command post and outside;
- possibility of notification about break-downs or about the need for technical support.

3.2 The provider aspect

In the provider aspect, in the technical area which assures the functioning of the ICT infrastructure supporting the military decision making process the respondents

and experts indicated the need for solution which should guarantee the realization of inter alia the following factors:

- users' access to the ICT network resources from any place of the command post;
- solution's flexibility i.e. assuring ICT network resources in line with the needs of the command and control body (fast configuration);
- guarantee of reliability as far as the functioning is concerned and assurance of the necessary application resources which belong to the command and control supporting system e.g. domain server "Active Directory", "DNS" server, data base server, server for data exchange, etc.;
- assurance of operations reliability (proper resources redundancy);
- easy management of server and client environment;
- explicit monitoring of ICT network resources, reporting, alarming, etc.;
- easily done back-up copy of ICT network resources;
- easy and fast environment recovery;
- limitation of the number of equipment inflicted by the place and possibilities of power supply;
- additionally, assurance of constant cooperation between the command post and alter command post.

4 The concept of mobile virtual ICT platform

4.1 Configuration of virtual ICT platform

The carried out research and the author's experience in the scope of ICT networks implementation [3][5] allowed to prepare the final shape of the suggested solution in the framework of network platform, which enabled the implementation of application supporting the military decision making process based on the ICT virtual environment (presently on the market there are a few leading producers of such technology, inter alia: "VMware", "Citrix", "Red Hat" as well as "Microsoft").

The concept of this solution is based on a proper hardwired platform in connection with dedicated software, which assures the cooperation of physical resources for the benefit of virtual ICT environment (see Fig. 5.).

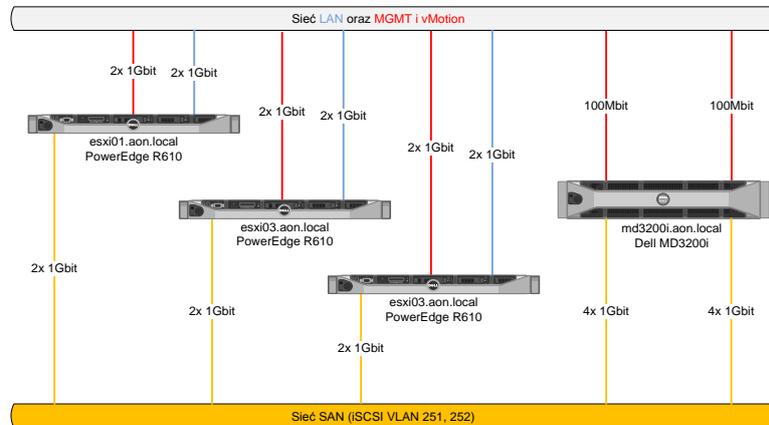


Fig. 5. The physical elements of mobile virtual ICT platform

The environment consists of the following elements:

- virtualization platform - "hypervisor", with task to manage the physical resources (processor, upper memory, disc storage, etc) and provide the virtual elements with access to the resources;
- virtual machines – elements in the structure of virtualization platform reflect physical servers which include varied operating systems (e.g.: „MS Server 2003”, „MS Server 2008 R2”, “Linux” systems);
- virtual desktops - desktops – elements in the structure of virtualization platform reflecting the physical workstations of the system operators, they include operating systems (e.g.: „MS Windows XP”, „MS Windows 7”) [11][12];
- virtual ICT resources – elements of virtual platform which allow for the connection of virtual machines, desktops between one another on the virtual platform as well as communication between the virtual platform and physical infrastructure of the ICT network.

The suggested solution consists of the following physical elements:

- three or two physical servers, the so called 'hosts' with defined resources;
- disc array;
- network switch (physical);
- additional files server to store the spare copies of the virtual environment elements as well as the data bases of applications.

On every physical server there is 'VMware vSphere' software installed, which is the virtualization platform in the form of the so called 'ESXi' servers on which it is possible to create virtual machines. In order to create a virtual pool of resources, regardless of physical resources available on every virtual server, the ESXis are combined into the so called clusters, creating this way one place for data processing, i.e. data center. Owing to that, virtual resources should be treated as complete pools of

resources which are incremented by the sum of physical resources derived from each physical server. Additionally, the architecture of a cluster allows to create the so called High Availability Cluster. This solution makes it possible to fully use the mechanisms which assure the resistance of the virtual environment to the failure of a single physical server as well as the balance of the burden between 'ESXi' servers. The key element of the presented environment is the disc array on which there is space reserved for memory to create virtual machines, virtual desktops, as well as virtual ICT elements. The access to the array is provided by 'iSCSI' technology as well as by physical switches in 'GigabitEthernet' technology. The management of the virtual environment is realized with the use of 'VMware vCenter Server' software. 'VMware vSphere client' is the client enabling the environment management. The installation of 'VMware View' software assures the creation of virtual desktops, i.e. the environment for the system's operators. The network configuration assures the redundancy of access connections of certain virtual and physical elements to the disc resources as well as of the possibility of the virtual platform management. Every physical server should be equipped with a number of network interfaces corresponding with the needs (in the presented solution there are 6 network adapters on physical servers) which participate in the communication between the virtual platform and the disc array as well as ensure access to the physical ICT network. The above presented solution implies additional limitations on the ICT network architecture on the command post. The basic condition is to assure proper bandwidth inside the local network for a faultless access to the virtual environment, and most of all, for the operators to have access to their virtual resources. As a result of the above, the author suggests the following solution:

1. ICT point should be located in the middle of the command post between the teams of the command and control body, and not inside the ICT junction (communications junction). The reason for such architecture is shortening the access route to the virtual platform.
2. Taking into consideration the bit-rate of the connection in the scope of 'PCoIP' or 'RDP' protocols it is advised to apply proper 'Ethernet' technology.
3. In the 'GigabitEthernet' technology (1 Gb/s) the transmission parameters as optimum, the solution meets the needs of the command and control body as far as the number of virtual desktops is concerned.
4. In 'Ethernet' technology (100Mbit/s) the limitation of access to circa 50 virtual desktops.
5. In 'wi-fi' technology – the limitation of access to virtual resources to circa 10 virtual desktops. This solution assumes the virtualization of the ICT environment for the needs of creating virtual machines.

4.2 The solutions functionality

Applying the suggested solution concerning the virtualization of the ICT environment brings inter alia the following benefits:

- the suggested solution can be applied in mobile conditions;
- consolidation and optimization of the ICT infrastructure – optimization of the previous infrastructure by the transformation of physical elements into the virtual ones e.g. physical servers in a virtual machine etc.;
- improvement of activities continuity – assurance of high availability understood as the ability of data recovery and migration of applications at work (“vMotion migration” service);
- optimization of virtual environment – automated allocation of resources by mechanisms which assure even load, power management and resistance of virtual environment to the breakdown of a single physical host;
- dynamic adjustment of ICT resources to the needs of the command and control body – scalability of virtual environment dependant on the pool of virtual resources and not on particular resources of physical servers;
- easy management of the virtual environment by transparent control and scalability of virtual machines network;
- provision of application services in the scope of high availability – assurance of constant operation of the command and control body as well as surveillance of the potential loss of data, security – simplified security mechanisms concerning the security policy on a logical level within distinguished logical spheres of the virtual environment; scalability – the possibility of environment’s calibration due to the functions of central management of virtual machines and hosts “ESXi”;
- open architecture – possibility of integration of solutions provided by other companies which are based on „API” interface which match the producer’s products.

5 CONCLUSIONS

Mobile ICT platform is an innovative solution which assures the rendering of services for the needs of the command and control body by the service provider on a high level. It provides solution to the previous problems notices in the scope of IT tools functionality on the command post for the needs of the military decision making process.

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