Possibilities of Applying Video Surveillance and other ICT Tools and Services in the Production Process

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Abstract **- The paper presents the possibilities of applying Video surveillance and other ICT tools and services in the production process. The first part of the paper presented the system for controlling video surveillance for and the given opportunity of application of video surveillance for the security of the employees and the assets. In the second part of the paper an analysis of the system for controlling production is given and then a video surveillance of a work excavator. The next part of the paper presents integration of video surveillance and the accompanying tools. At the end of the paper, suggestions were also given for further works in the field of data protection and cryptography in video surveillance use.**

Keywords **- Video surveillance, ICT tools, Data protection, Cryptography in video monitoring.**

1. Introduction

Before deciding on the implementation of video surveillance it is necessary to fulfill the preconditions which are the basic part of the planning process. These preconditions include legal, technical, economic and organization component, and it is primarily important to take care of the reasons for implementing video surveillance. An investor needs to consider the aim of implementing video surveillance, the desired results, the laws, and only after creating the study of technical feasibility and economic justification can one start with the project documentation and project implementation. The study has to answer a range of questions, such as the value of the assets which need to be protected; whether it is the protection of people and business processes, if so it is required to estimate its benefit and obligations from the aspect of legal procedures and standards within the conducted business activities and how to offer an optimal solution. Technical questions that need to be answered are: the conditions of lighting; how cameras are to be placed in relation to light flow; what the cameras are going to surveil (wide, directed or the turning is required); which lenses to choose for the cameras; determining the type of supply and predict protection against undesirable power, atmosphere and other kinds of destruction; what types of cables to use from supplying and transmitting the data to ensuring the appropriate earthling; determining the manner, the length of recording, the format, quality, compression, resolution, speed. It is also necessary to include limits like budget, time, legal obstacles, organization, exploitation, technical (the existing infrastructure such as computer network and security infrastructure) analyses of the existing resources (human, material).

All these questions can be viewed through economic perspective if video surveillance is used to enhance the security of the assets and the working process [1,2]. However, if it is necessary to use it for enhancing the security of people, the employees, it is required to determine that apart from economic reasons, there are also legal and moral obligations, because to preserve one person's life is equal to preserving the entire human kind, i.e. priceless.

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2. Using video surveillance for surveilling and controlling

The aim of implementing video surveillance with the center for telemetry is to ensure:

- Enhancing the security of the employees in the production process [3];
- Preventing thefts;
- Surveillance and control of the production process;
- Monitoring critical spots in drives via video surveillance cameras;
- Integration of video surveillance elements of all drives in a single system;
- Recording (storage) videos of video surveillance for a period of time set by the law;
- Organizational and technical connecting with the remaining parts in the company with the aim of realizing protection measures on operational, tactical and strategic level;
- Surveillance and control from a central surveilling spot;
- Notifications, administration and optimization on locations responsible for it.

While the project documentation was being created, it was necessary to consider the actual situation from the security aspects, the existing resources, regulations and trend, infrastructure and objects.
The implementation should be directed towards performing the aforementioned aims, with clearly set limits (budget, time, resources, laws...).

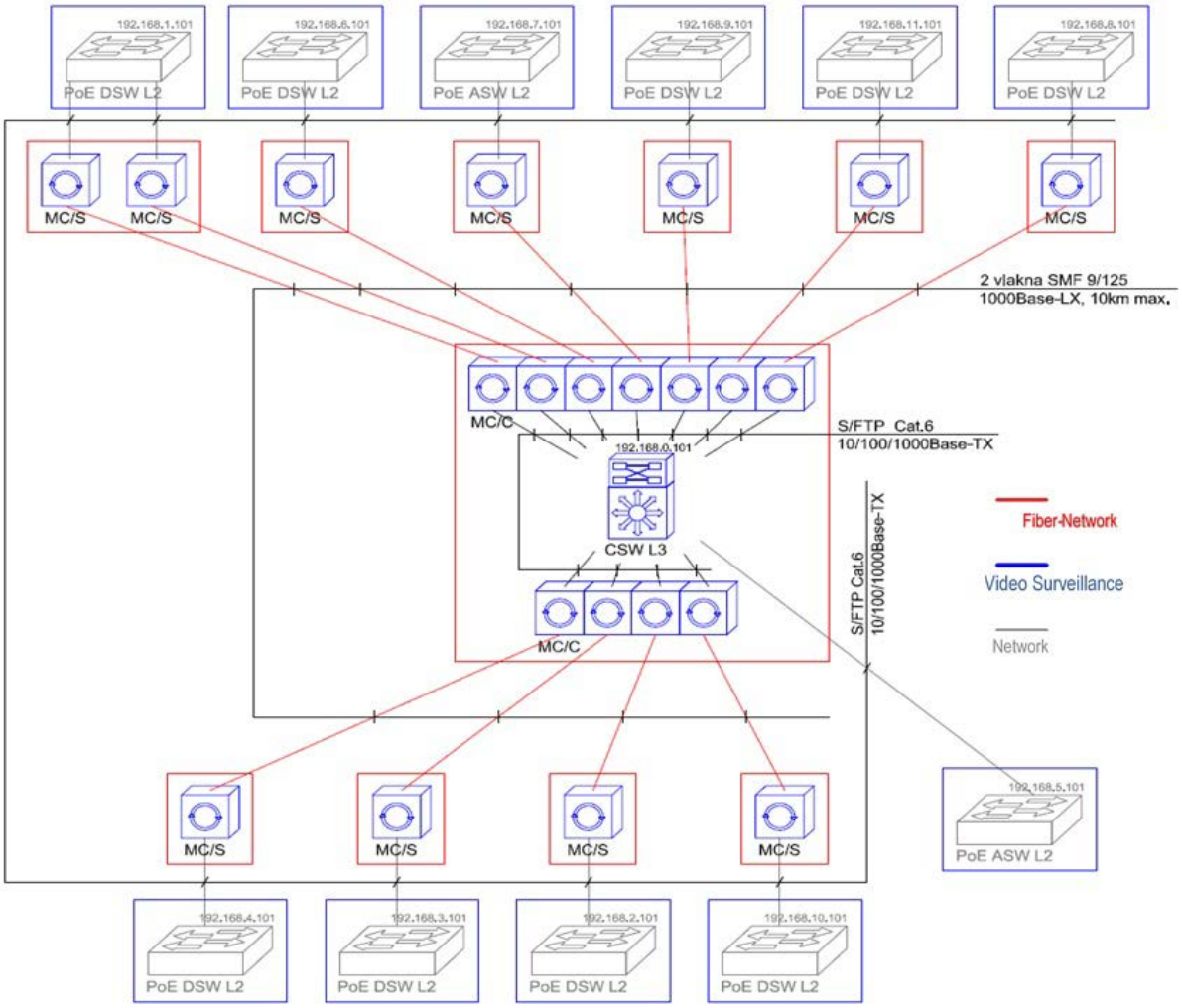

Figure 1. Infrastructure, video surveillance, optical and computer networks

Locations of planned or implemented video surveillance in RMU Banovići are:

1. Work units „Bešin“ and „Gunpowder storage“;
2. Work units „Central storage“ and „Čubrić“;
3. Work units „Grivice“ and „Food storage“;
4. Headquarters of the RMU;
5. Organizational unit “Separation”;
6. Organizational unit „Railway transport“.
7. Several locations for surveilling the production process with the accompanying tools;
8. Integration in the central surveillance system and the operational center.

All these locations have the necessary infrastructure and objects - space for placing the video surveillance equipment. The infrastructure includes:

- Access for cable routes (access to ways of placing the cables);
- Access to connection points of the local computer network;
- Access to connection points for power distribution;
- Access to connection points for equaling potentials;
- Access to locations for setting video surveillance;
- Access to locations for setting active and passive network equipment.

All video surveillance equipment is placed in appropriate installation boxes, which, apart from ensuring the necessary microclimatic conditions, protect from an unauthorized access to video surveillance equipment and protect from negative climatic conditions, dust etc. Apart from the communication infrastructure, implemented inside computer network on the level of the company, which is also used by other ICT services and users consisting of optics, UTP/FTP/STP cables and the accompanying equipment and protocol, it was also necessary for each camera to have an optical cable and/or FTP/STP cable, which, besides transmitting information, also performs power supplying (Power over Ethernet). Each location with the implemented video surveillance also has devices and equipment for video surveillance such as L3 and L2 switches with support for SPF or media converters (MC), for connection with optics (SPF), devices for uninterruptable power supply (UPS), IP cameras with the objective, different boxes for equipment montage, network 8/16/24 channel video recorder, backup equipment [4]. The system equipment consists of central controlling computer with software, monitors and software for centralized control and surveillance of video surveillance system.

3. Application of video surveillance for the security of employees and assets

In RMU Banovići, video surveillance system was implemented on several locations which are through network infrastructure integrated into an integral surveillance system, which is connected to the server and the center for surveillance and control in real time.

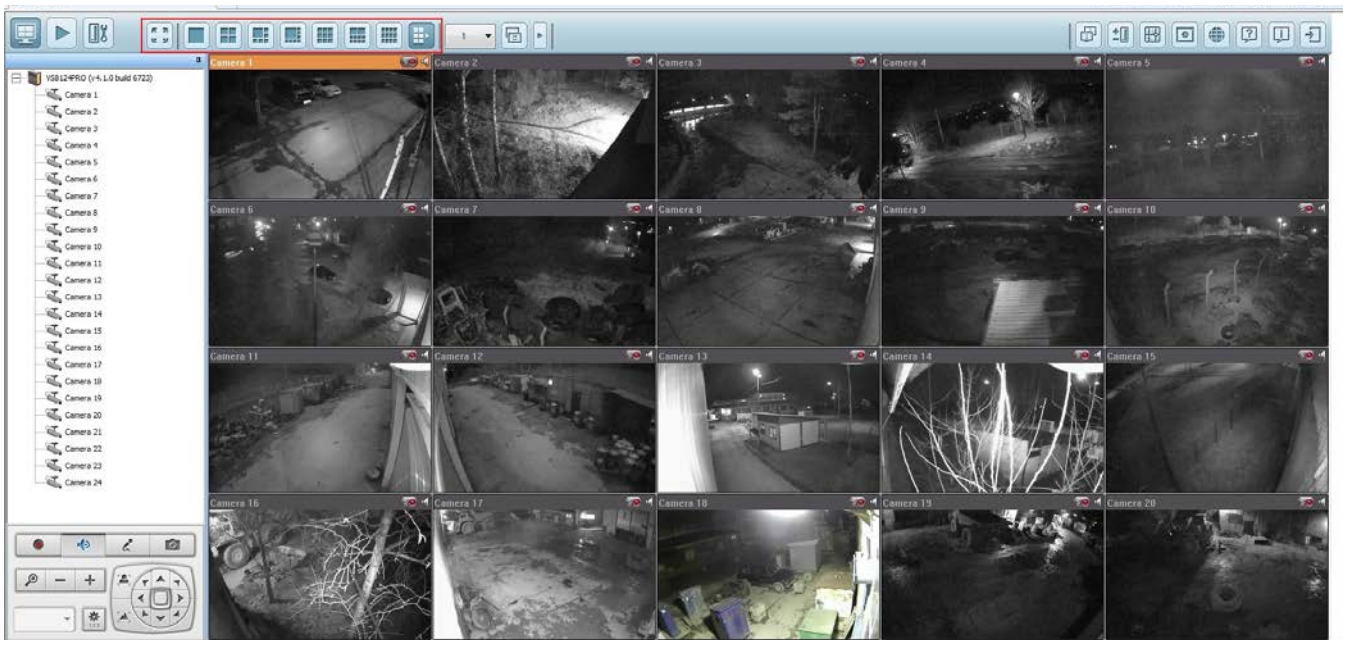

Figure 2. Cameras in software surroundings at different locations

Video surveillance system is a complex system which consists of the following elements:

- IP cameras; boxes IP66 close to cameras for installing PoE splitter and connections with IP cameras;
- LAN cables which transfer the signal from IP66 boxes to local boxes; local boxes for different converters, PoE adapters, devices for uninterrupted power supply, switches and appropriate connection cables;
- fiber optic lines which transfer signal from local boxes to media converters in a rack box in server room; rack box in the server room where one can place patch panels for fiber optic lines, cable conduit, QNQP NVR (Network Video Recorder), chassis with media converters and the corresponding supply units;
- LAN cables from server rooms to the dispatcher center; video wall in the dispatcher center consisting of 12 professional monitors, size 42", organized in two units of 6 monitors (4+1+1); two separate computers which are connected to QNAP NVR in the server room with LAN cables, and each of them sends video signal from video surveillance to six monitors. Maintaining this video surveillance system is very complex and includes maintenance of every single element previously mentioned.

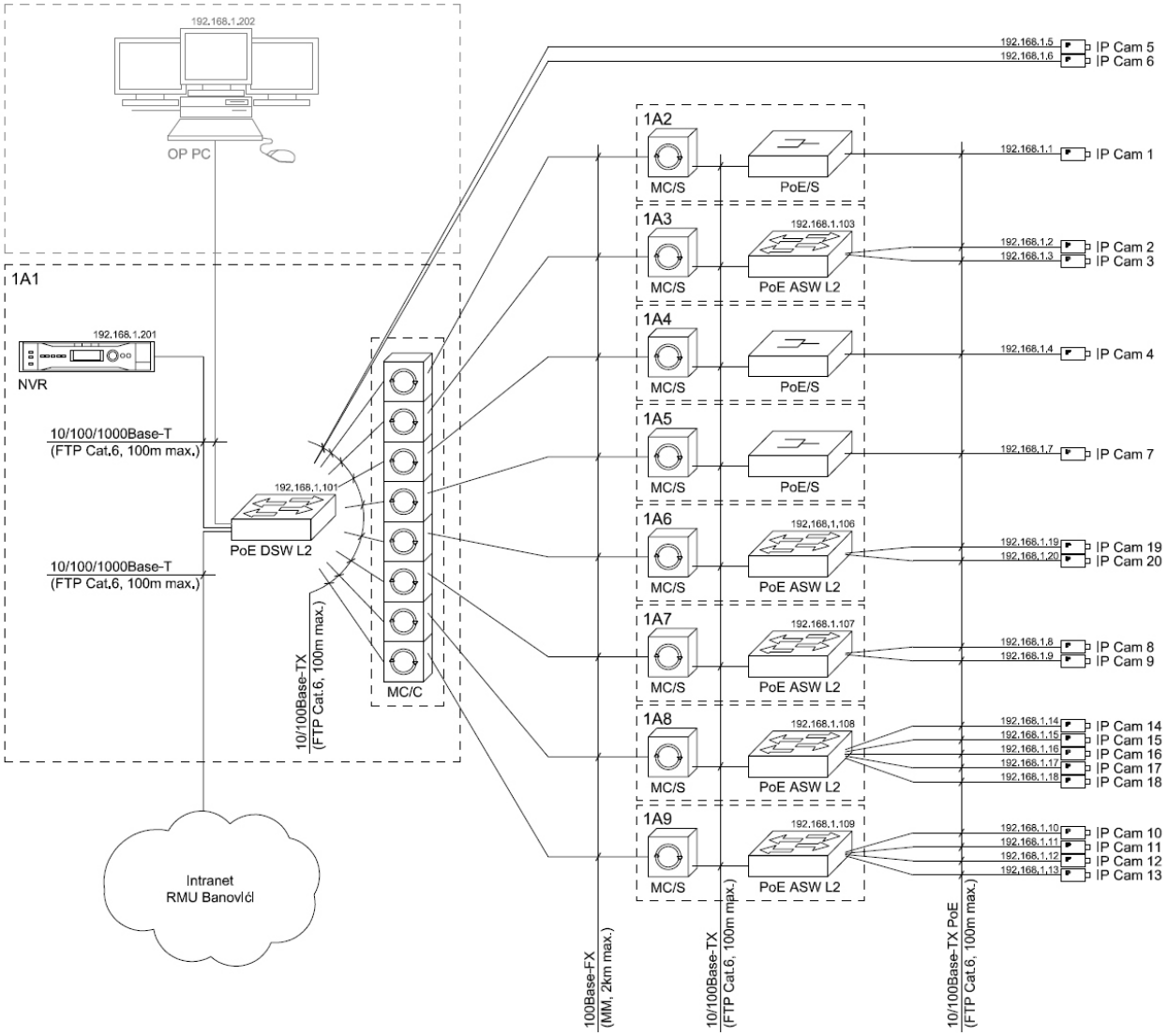

Figure 3. Video surveillance on the location of Bešin and connection with the Center for control

Additionally, it is also necessary to analyze the influence of data flow onto bandwidth occupancy. Current cameras mostly use MPEG4 and JPEG standard for transmitting digital signal during simultaneous real-time monitoring and recording, of maximal speed up to 30 fps (frame per second) and picture resolution of 640x480. Maximal bandwidth needed for receiving live picture and recording picture at the aforementioned parameters is 5 Mbps.

On the location of the operational center and the central video surveillance via system software for control and surveillance, the possibilities for real-time simultaneous monitoring of 72 video surveillance cameras are enabled. The operational center is realized on the location of Bešin. Distribution switches L2 (Managed Switch) are on all locations via SM optic fibers of transmission speed of 1 Gbps connected to central switch L3 (Core Switch). The system of video surveillance in Bešin consists of 20 IP cameras which are connected to an appropriate server, and which is accessed from a computer in the center for surveillance and control.

4. Using video surveillance system for surveilling and controlling production

To ensure the surveillance it is necessary and sufficient to integrate it with the ICT components. However, for the process of control it is also necessary to ensure communication between the sensors and the actuators [5], programmable logical controllers, and these systems, together with video surveillance, ought to be realized in the form of SCADA system (*Supervisory Control and Data Acquisition*).

Integration of SCADA system with video surveillance, apart from using common sensors, also use ICT infrastructure, and can be realized through a common application. To show common parameters of the system of control and surveillance within a common application for surveillance and control (SCADA), ActiveX controls are used, with which it is possible to control, in the context of parameters, the inflow of information, positioning them within graphical surroundings. Both systems use common Ethernet platforms and IP protocol for controlling communication through a common network infrastructure. For the presentation of these data, the surroundings are created independent of development platform such as HTML and CMS pages. To access creating this application, it is necessary to create the project based on HMI (Human Machine Interface), which possesses graphical surroundings with control elements [6,7]. Besides, there is communication and the exchange of information between computers and cameras, with two kinds of data, which can be determined as video flow and a still picture. The moving picture serves for video surveillance and enables an operator to have an insight into important parts of the process surveilled in real time (surveilling production process). Still picture primarily serves the operator to compare changes and possible mistakes in the production process under surveillance. These applications mostly use desktops, set of commands, parameters in starting projects, tags and VBA or JavaScript code.

In practice, within the system of production automatization the operator can only see the end desktop, while all other activities are performed automatically, which minimizes human mistakes. Using ActiveX control it is possible to create an application which through video surveillance monitors the process in real time, and with commands through PLC, sensors and actuators chooses commands, such as stop or move, speed up or slow down. The desired characteristics have to be recorded into the memory so that they can be put in ActiveX control.

If the same commands are used frequently, they can be stored into a subprogram (macro) to enhance the process of control and surveillance. Video control consists of the comparison of a new picture with a referent one, thus, comparing the color intensity of each dot of the new picture to a referent one. Today's cameras, within themselves, possess the ability of detecting changes in the picture, and using these cameras disburdens the computer with SCADA application, disburdens network infrastructure, reduces the processing time, which makes the entire system faster, more efficient, but also, more expensive [8].

Figure 4. Surveillance and control of the transport of coal

5. Video surveillance work excavator

The purpose of the video surveillance using broadband camera mounted on excavators is transferring images from the excavator dug in the dispatching center in order to provide visual control room within the excavator operation, greater operator safety and equipment and increasing productivity software. Due to the specific conditions under which it operates, all equipment used in the system for video surveillance of vehicles should have protection against vibration and shock (shock absorber system) and water resistance moisture and dust class IP 66. Advances in information technology enabled the customer system CCTV to via Wi-Fi or 3G / 4G network have access to the status of the machine and its position (picture and sound) in real time [9].

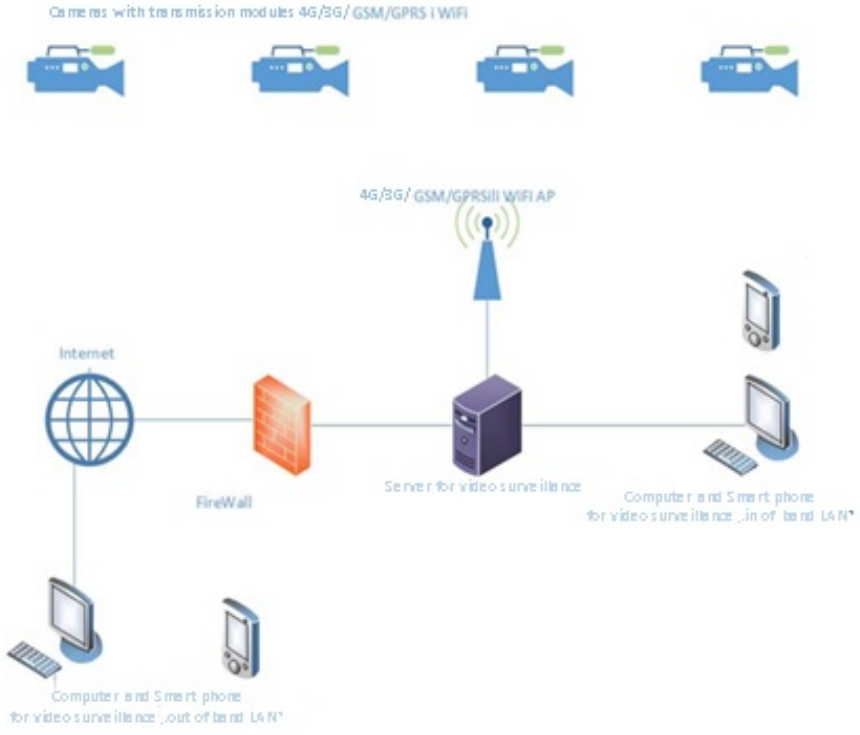

Figure 5. Scheme of the video surveillance system: Author's project in “RMU Banovići”

6. Integration of video surveillance and the accompanying tools

Telemetry center for surveillance and control which integrates video surveillance and the accompanying components for the security of people, assets and production is implemented at the location of Bešin. Each location possesses a local NVR. The maximal load of bandwidth of the LAN between video cameras and one Access switch L2 and Distribution switch L2 is 25%. The maximal load of bandwidth of Intranet RMU and the LAN between NVR and Distribution switch L2 is 10% [10].

The connection between Distribution switch L2 at the location of Bešin and Core switch L3 at the location of RMU Headquarters is realized with 2x1000 Base – LX on SM optic fiber, which gives the total capacity of LAN between these two locations of 2 Gbps (2000 Mbps). System software for video surveillance enables an operator's simultaneous surveillance of 72 video surveillance cameras (direct access to a camera or access via NVR).

It is also possible to have an access to live monitoring of the picture from cameras via web browser, with direct approach to the camera (via IP address) or the corresponding recorder (NVR or DVR). Considering the assumption that there will be 24-hour recording of the picture from all cameras to the corresponding recorders, and that there will be a constant monitoring of 72 cameras [11], the following conclusion can be made: a maximal load of bandwidth of the LAN between Distribution switch L2 at the location of the Operational Center, and Core switch L3 at the location of the Headquarters, will be 360 Mbps (72 x 5 Mbps), for the needs of monitoring the picture from the cameras. If the operator also uses a web browser to monitor additional cameras, each additional camera will use 5 Mbps of bandwidth, which brings us to the assumption that the total amount of the used bandwidth will be 360 Mbps, which is around 19% of bandwidth capacity between the Operational Center and the Headquarters.

Considering the assumption that in a particular moment all cameras from one location could be monitored via surveillance software, the occupancy of bandwidth can be doubled at certain locations (recording picture + live monitoring), which results in double amount of occupancy of the bandwidth of the LAN of certain locations, and the Intranet RMU and the LAN between the NVR and the Distribution switch L2.

Mostly, with the cameras, there is also the software for their control, as well as the other components, servers, computer network, dispatcher center and the accompanying equipment. However, for bigger video surveillance systems, which are combined with other information systems, data bases, control systems, it is necessary to choose, develop and implement the integral software for surveillance and control in real time, which will ensure better reliability, efficacy and efficiency of these systems.

When choosing and implementing this software it is important to observe and recognize the following benefits:

- adjustability (support of a large amount of equipment), the freedom of choice (support for different platforms of video cameras),
- reliability, firmness and stability (referent), the potential of efficient use of the existing IP networks, economic data storage (minimum speed, optimization, minimal space),
- extraordinary performance, flexible remote access (compatible with different platforms),
- the openness of the construction under condition of the achieved security level,
- Licensing per video channel, camera, quick export of the recorded material, the ensurance of upgrading for upcoming devices, i.e. it is under constant development from the aspect of support and security, with the ability of different reports and analyses.

The integral software for remote surveillance and control using video surveillance and other systems, ought to have tools, or, at least, coordination with the tools for maintaining the system, quality integration, regular, preventive and corrective administration, different options of remote operations, fast and rich search, export, the security of data and the entire system. The project, presented through the case study, states that the software purchased and implemented is "brand name".

7. Further works in the field of data protection and cryptography in using video surveillance

The security of the video surveillance and the data is of special importance and becomes even a bigger challenge [12], due to the more frequent use of the ICT technologies, continuous increase in knowledge in this area, emergence of different software tools, as well as the increased value and significance of these systems in everyday life, the possibility of damage in case of some undesirable effects from the aspects of security and protection.

Protection measures at the level of ICT infrastructure are primarily the implementation of the system firewall, and the firewall at the level of servers and cameras, authentication and encryption systems, which serve for defining the access rights and coding respectively.

Authentication is done at the level of the server and the cameras, with defined rights and roles when accessing certain system resources. Encryption is done by using schemas and rules to code the data which are transmitted through the ICT infrastructure [13]. Some of the available techniques of encryption are SSL, WEP, WPA the last two being used for wireless communication [14]. The use of SSL requires installation of HTTPS certificate on the computer.

One of the security mechanisms within these systems is also VPN (Virtual Private Network), which is created as a security tunnel for transmitting data between two transmission points. Firewall usually has integrated authentication, authorization, antivirus, antispam, filtrated traffic, IP address, control of certificates, IDS (Intrusion Detection System), and IPS (Intrusion Prevention System) for all users, applications and protocols, which are controlled by defining security policy at the level of firewall, operation system server and/or video cameras. The access usually requires the use of user accounts with a login and a password. The password has to contain more than eight characters which include different characters, symbols and numbers. Finger scanners and biometric scanners, as well as smart cards can be used for the authentication of access. It is also important to ensure that the computers have access to this system, that they are updated with antivirus and antispam protection, and that, when accessing this system during the authentication, they are checked for the purpose of enhancing security levels. It is important to establish security policy with clearly defined rights and responsibilities, to ensure necessary resources, to conduct constant updating of software and hardware to develop the awareness of the users and to work constantly in the area of security.

It is necessary to explore the constant potential risks and invest in new knowledge and resources, and also update them to maintain the high level of security. Legislation from the aspect of the protection of personal information and business, the information systems needs to be implemented and constantly improved. Security measures have to be implemented during the work on landlines, as well as protection against atmospheric discharge and climatic effects, the effects of wind and temperature, heavy rain, fog, snow, harmful radiation, falls from high spots, high voltage and under voltage strikes, explosives, and the protection when handling and exploiting electric devices and installations.

8. Conclusion

The main aim of implementing video surveillance with the center for telemetry is enhancing the security of the employees in the production process, preventing thefts and surveillance and control of the production process. Additional benefits can also be integration of video surveillance elements of all drives in a single system and monitoring critical spots in drives via video surveillance cameras.

Of special importance is the implementation of standards in the area of physical protection, protection against undesirable atmospheric conditions and voltage. Benefits of integrating the above mentioned systems of video surveillance and accompanying tools and using the Center for surveillance and control are numerous, and they influence the increase of the security of the employees and the assets, enhancement of efficacy and efficiency, the control of production, faster reaction and preventive measures in case of maintenance and failure, they influence the fulfillment of legal and moral responsibilities, the increase of income, the reduction of costs and competitiveness of the products.

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