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Video Signals Integrator Prototype System

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INTRODUCTION

The project's main goal was to develop the concept, implementation, and commissioning of a distributed, modular system integrating video signals (VSI). The project aimed to increase public safety, prevent and eliminate threats related to terrorist attacks or natural disasters [1], and increase the security of mass events, particularly: 1) Increasing the effectiveness of cooperation between state services, including the Police; 2) Improve people's safety in public places; 3) Improvement of security in places where large numbers of people gather (e.g., shopping centers, subway, places of worship, sports stadiums, stations); 4) Enabling efficient management of given operational groups from any command points. The fulfillment of the above functions nationwide required, among others: 1) Signal Acquisition, Encoding, and Transmission via Ethernet over the OST112 network; 2) Provide scalability in the whole country's target range by integrating c of at least 300 video integrators devices and at least 100 control consoles for active users; 3) Integration with various monitoring systems and analog and digital cameras (including mobile ones - e.g., placed on drones); 4) Implement various hardware and programming interfaces to the existing monitoring systems to add new solutions; 5) Creation of three levels of access for users: administrator, active user, passive user; 6) Ensuring long-term support hardware and software through the use and development of technology; 7) Independence from functionally and technologically closed solutions.

VIDEO SIGNAL INTEGRATOR PROTOTYPE MODULAR CONSTRUCTION

As a result of the project, a prototype of the VSI system consisting of three modules was obtained [2]:

1. Video signal concentrator module is the point of acquiring, processing, and distribution of audiovisual signals [3]. It implements the following groups of functions: Supports up to 8 video inputs; Support for video standards such as: HDMI: 1080P25, 1080I50, TVI - 1080P25, TVI - 720P25, PAL - 576I50 (using scaling), Hardware encoder compatible with MPEG-4 AVC / H.264 standard; Support network protocols such as IP cameras, SDI links, and fiber optic links (long-range IP cameras); Camera control (PTZ); The ability to remotely manage the system by 1) loading the working system from an SD card; 2) loading the diagnostic system from the onboard QSPI memory; The ability to remotely update the device software (including reinstallation), remotely monitor and diagnose the device, and remotely restore the regular operation of the device. The following design features of the module were obtained:

The housing is compatible with the standard AMC cassette and the communication module of the increased mechanical strength (Fig. 1); It is possible to add an extension module in the form of a card in the RTM standard (Fig. 2); The central executive part is mounted on a replaceable plate in the AMC standard (Fig. 3); Replaceable signa acquisition modules were designed in the FMC standard (Fig. 4); H.264 / AVC encoding technology is implemented, and H.265 / HEVC is available; A 64-bit multitasking Linux operating system such as Petalinux with its open-source extensions is used [3].

2. Central System Module was created as a prototype. The VSI Central System is the point of reception and distribution of audiovisual signals. The Central System performs the following groups of functions: Supports the processes of authenticating and issuing VPN certificates for the rest of the system; Supports registration processes of new signal sources; Provides API for system consoles; Provides integration with external VMS systems; Provides administration console, for signal management. The sample of the Central System from the trial series includes nearly thirty programming components created in C ++ and Java, including: AV servers (e.g. RTSP); VMS adapters; Test components (e.g., stream generators, test consoles); APIs and user interfaces

3. **User console module** were prepared as three functionally and structurally separate prototypes of user consoles : 1) Operator's console - based on a PC with Windows and a 50 'monitor, providing support for up to 4 screens and a joystick. The operator console provides: Displaying a grouped list of available streams; Simultaneous display of 16 video streams; Changes to the configuration of the stream display system on the screen; Displaying the location of the stream source on the map (Fig. 6); Control of PTZ camera; Joystick interface; Switching screens; Creating signal catalogs; Providing contact details of the person responsible for the console copy (no editing possible); Providing contact details of the person responsible for the video stream (no editing possible); Automatic login to the Central System and download the stream list from the server. 2) Set-Top-Box passive user console - a dedicated hardware module with the Linux operating system, which works with an external monitor via the HDMI interface and is equipped with a dedicated remote control (Fig. 5). The Passive User Console provides: Access to 16 video streams (4 groups (A, B, C, D) with four streams each; Displaying 4 degrees of blush simultaneously on the screen; Controlling PTZ camera; Switching screens; Unattended startup (automatic login to the system and download the stream list from the server); Remote control by remote control. 3) The Administrator Console, based on a web browser, enables the configuration of the VSI system.

VIDEO SIGNAL INTEGRATOR PROTOTYPE TEST RESULT

The chapter below presents an example of the prototype of the VSI system [5]. Performed tests in a real Police network environment OST 112 in the coverage area of the whole country. The tests consisted of launching the Central System, which included: Eight servers in 3 locations (Warsaw, Szczytno, Olsztyn); 3 test cameras (Bosch, Axis); Connection to the VMS system of the city of Warsaw; Connection with the VMS system of the city of Olsztyn. The tests were conducted using 160 real (from the cities: Szczytno, Olsztyn, and Warsaw) and simulated (looped) audiovisual streams. Final tests were carried out in conditions similar to real ones, taking into account the configuration that allows the target number of consoles and data collection points to be connected to the VSI. The methods of simulating the full load of the VSI system and the various configurations used during its operation were used. The tests were aimed at assessing the device's resistance to long-term use to confirm the reliability of the hardware layer of the VSI system. An exemplary state of operation of the prototype of the VSI system is shown on the example of the observation made from the level of the operator console (Fig. 6) and the Set-Top-Box console (Fig. 7).

Fig.1. The housing complies with the standard AMC cassette with a communication module with increased mechanical resistance

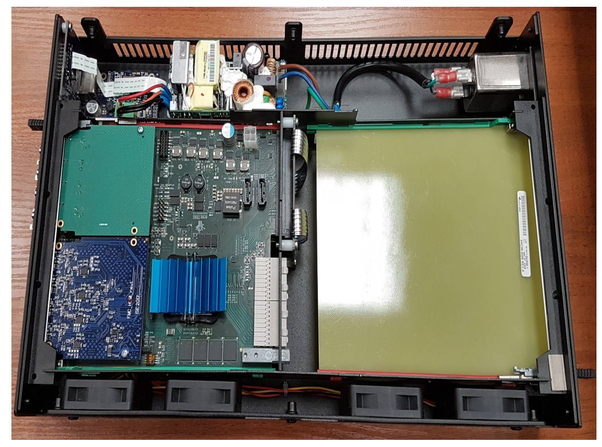


Fig. 2. AMC centerboard layout (left side) and optional RTM expansion board (right side)

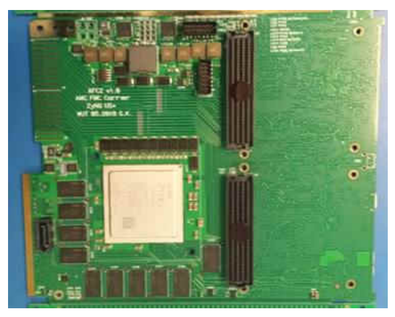
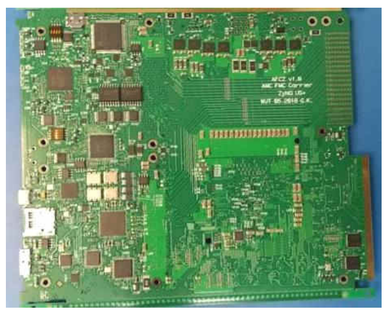
(front)   (rearview)

Fig. 3. Central executive part in the form of an exchangeable board in the AMC standard

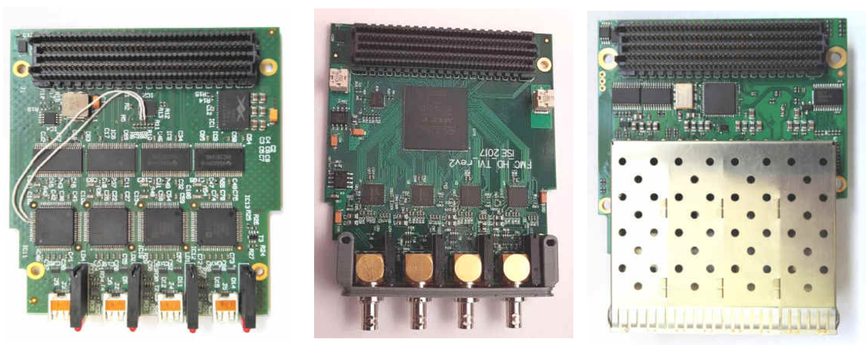


Fig.4. Interchangeable three types of overlay plates are made in the FMC standard

Fig.5. SetTopBox - top view (left side) and remote control (right side)

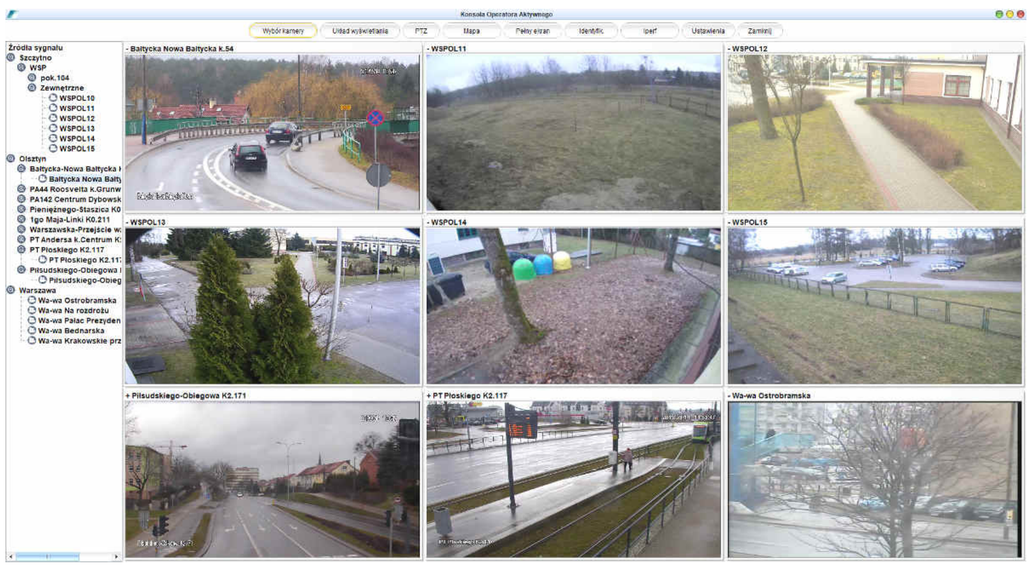


Fig.5. An example of observation from the operator's console

Fig.7. An example of observation carried out from the Set-Top-Box console

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