

Methods of Software Integration of Alarm Systems

Jan Valouch

Faculty of Applied Informatics
Tomas Bata University in Zlin
Nad Stranemi 4511, CZ 76005 Zlin
Czech Republic
valouch@fai.utb.cz

Abstract—This article describes software integration methods of integrated alarm systems. The key output of the article is the proposal of classification of functions and methods of software integration for integrated alarm systems. The methods of software integration are based on linking of separate applications via a communication bus, and their control, management and visualization are providing by software products, which are installed on an external computer (server, client PC) or at unattended control centers equipped with the necessary software. Integration of the alarm systems is a modern way of using the current technological capability elements of intruder alarm system, camera systems, access control and hold-up alarm systems.

Keywords—Software, closed circuit television, integrated alarm system, Integration, Intruder alarm system, non - alarm application.

I. INTRODUCTION

Integration of alarm and non- alarm applications is solved by various technical solutions, starting with a simple connection of input / output contacts to sophisticated software solutions.

Integrated Alarm Systems (IAS) is defined according to relevant technical regulation ČSN CLC / TS 50398 as systems having a one or more common devices at least one of which is an alarm application [1]. The alarm application designed to protect life, property or environment:

- intruder and hold-up alarm system (I&HAS),
- closed circuit television used for security and surveillance (CCTV),
- access control system (ACS),
- social alarm system (SAS),
- fire detection and fire alarm systems (FDAS),
- environmental alarm systems and lift alarm systems.

The above systems can be integrated with each other or with non- alarm applications (lighting, heating, air- conditioning, ventilation, irrigation, building management, energy management). [8]

At present, the issue of integration is described only in a single technical standard: ČSN CLC / TS 50398 Alarm Systems-Combined and integrated systems-General requirements. This document, as the name implies, describes only the general requirements for IAS and basic types of configurations. In terms of software integration support,

document describes only the software of evaluation elements. [6]

The software of each system may affect other software application. It is therefore appropriate to ensure the separation of software already in the design of system (separate modules and documentation). It is also appropriate to describe the possible mutual negative impacts for normal operation and fault condition of system. [1]

In terms of needs of formulation and the subsequent drafting of an integrated alarm system is an important factor of the selection of appropriate elements- method of technical solutions interconnection systems. Therefore it is necessary to categorize - to classify the different techniques of integration and to create a basic guide the preparation of implementation IAS. Classification of technical solutions of integration is also important for evaluating the effectiveness of alarm systems. Currently, this problem is not described in any of the literature or technical regulations. Selection of appropriate methods for integration is an important point of the system design as the first phase of the setting up the IAS, especially due to its feasibility, requirements for operation, adequacy of financing costs and particularly the possibility of any further expansion of the system. [2]

The technical ways of interconnecting the individual applications can be divided into the following basic groups:

- hardware methods of integration,
- software methods of integration.

The hardware (HW) methods of integration are based on the interconnection of systems through their inputs and outputs and on the technical parameters of alarm systems, which may include, in addition to the basic security functions also specific-expanding elements (modules) to control alarm or non alarm applications (lighting control, heating, access control, etc.). Hardware integration methods can be divided into the types:

- IN/ OUT integration,
- I&HAS - integration element,
- ACCESS - integration element,
- CCTV - integration element,
- Automation system- integration element.

The proposal of classification SW integration methods is

presented in the following sections of article.

II. MATERIALS AND METHODS

The proposal of classification of functions and methods of software integration for integrated alarm systems is based on the analysis of the following issues:

- basic forms of system integration,
- technical requirements for integrated alarm system,
- technical requirements for the process of integration of alarm applications,
- possibilities of software products,
- customer requirements for building automation.

The processing of the proposed classification is based on the analysis of the following types of documents -technical standards- I&HAS, CCTV, ACCESS, SAS, technical product specifications, installation manuals of relevant systems and their elements, legislation- definition of technical requirements for the components IAS.

Integration of alarm and non- alarm applications can generally be included in the field of system integration (although this is mainly associated with information systems), which is understood as the delivery of services based on connecting heterogeneous subsystems into one functioning whole. Basic forms of system integration are divided into the following types:

- technology integration,
- functional integration,
- integration of user interface,
- data integration,
- methodological integration.

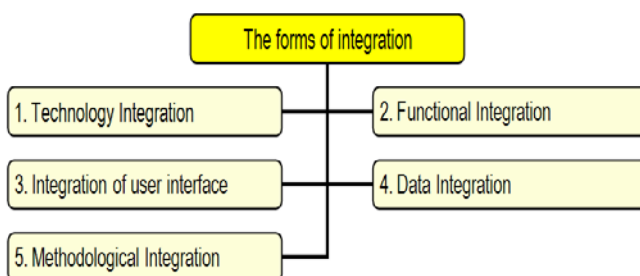


Fig. 1: The basic forms of System Integration

Integrated alarm systems can support the fulfillment of all the above types of system integration. The following Tab.1 gives examples of applications Integrated alarm system, classified in terms of the aforementioned forms.

The software products can support of the fulfillment of all the above types of system integration. The key document in integrated alarm systems is a technical standard ČSN CLC / TS 50398 Alarm systems - Combined and integrated systems - General requirements. Although the standard issued as early as 2005 and then 2009, not many interested companies (distributors, installation companies) this fact is not known or have only general information about the issue of the CEN /

CENELEC, which has the status of technical specifications and its acceptance by the national standards of members of the CEN / CENELEC is not required (only an obligation to ensure notification of the existence and availability of CLC / TS 50398). The standard solves the issue of definitions of basic terms and describes basic types of IAS configuration, system requirements, requirements for documentation and training.

Table 1. Examples of applications of Integrated alarm systems

Form	Application
Technology Integration	Integration I&HAS, CCTV, ACS, SAS + control of lighting, heating, blinds, air conditioning...
Functional Integration	Integration of Access card functions: Entry - Exit Registration / Registration of manufacturing operations.
Integration of user interface	Combined control of alarm and non-alarm systems - control panels, applications for mobile phones, technology "smart home".
Data Integration	SW products for the personal identification, evidence of entry, attendance, export to the wage systems.
Methodological Integration	Implementation methodology of registration and movement of visitors, registration of persons and vehicles, escorts, the presence of visitors, blocking entry of undesirable persons.

Technical standard ČSN CLC 50398 generally only specifies three IPS configuration:

- Type 1 can be applied for the combination or integration of two or more single-purpose (dedicated system) alarm systems and single purpose non-alarm systems that are connected to a common complementary device (Additional Facility) – i.e. a device not required by the standard (e.g., signaling panel, PC),
- Type 2A can be applied for the combination or integration of alarm and non-alarm systems that use (in accordance with the requirements of the standard) common transmission paths and common devices. Fault in any of application has no negative effect on other applications.
- Type 2B is defined well as type 2A with the difference that a fault in any of application can have a negative effect on other applications.

The technical standards (ČSN EN 5013x series) for each type of alarm applications (I&HAS, CCTV, ACS, SAS) describe the integration of very briefly. Each application must primarily comply with its own standards (I&HAS, CCTV, ACCESS, SAS, see ČSN EN 5013x series) and must meet specific requirements for system integration [3]. Common components used under integration must then comply with all relevant application standards. In the case of differing requirements of the standards must be used the most stringent requirements relating to the operation of the system.

III. SOFTWARE INTEGRATION

The methods of software integration are based on linking of separate applications via a communication bus, and their control, management and visualization are providing by software products, which are installed on an external computer (server, client PC) or at unattended control centers equipped with the necessary software. Alarm systems and non- alarm applications can also be connected to the server via the network (LAN, WAN). PC client is connected to the application via the serial interface or USB port for simple applications. User access to the main functions via your computer or via mobile devices is a common element of integration with the use of software products.

Software products ensure the implementation of functions integrated alarm systems. These functions support of integration of activities, data, user interfaces and technologies. I propose the following classification of functions:

- system administration,
- programming
- user management,
- monitoring,
- visualization,
- technology Integration,
- control
- automation
- management of attendance
- registration - visits, entrances
- evaluation of events
- monitoring of events,
- logistics support.

This classification of functions is intended to support of the system design, system realization and evaluation of the effectiveness of the integrated alarm system.

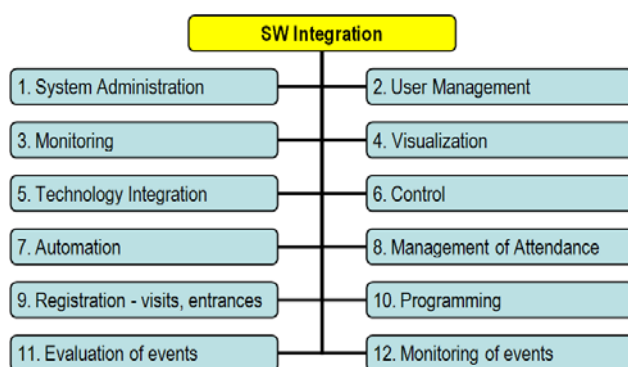


Fig. 2: The Software possibilities of integration of alarm systems

Software products provide multiple functions for integrated alarm systems. From this perspective, I propose the following classification of software products to support of the integration of alarm systems:

- software of control panels of alarm systems,

- software for user administration,
- security software,
- visualization software,
- integration software.

A. Software of control panels of alarm systems

The Additional programs delivered to the various types or line of control panel IAS providing local or remote connection panel (control unit) with a PC in order to realize the basic functions - programming, monitoring, evaluation and event logger. These programs serve the need for installation and service companies. Here we talk about integration from the perspective of a central evaluation and event activation of control panels, that can be hardware linked to other systems.

B. Software for user administration

These programs ensure user settings of control units (control panel) connected systems. In the area of security is usually a control panels I&HAS, which are complemented by access control system superstructure. The user has, in addition to basic functions (evaluation, monitoring, archiving events), especially possibility:

- setting up user profiles, create descriptions of subsystems zones, terminals,
- creating time schedules of access,
- allocation and registration of identifiers (cards, fingerprints)
- filtering of event history (type, time, place, and person).

C. Security software

This type of software combines security and logistical functions. Software is intended to ensure an overview of the situation in buildings. Software can ensure the following tasks:

- integration of management methodology of access and entry,
- records of persons and vehicles in the object
- saving of event history,
- a current overview of movement of persons and vehicles in the object,
- overview of the movement of assets,
- asset management,
- creating a "black list" database of unwanted persons, vehicles and companies,
- combination with fire
- protection and work safety,
- records of postal items,
- automatic printing of access cards,
- visual records of processes in the object.

D. Visualization software

The visualization programs provide in contrast to programs for user management other comfort function- transparent visualization of system status in real time. The operator can monitor system status and controls selected functions - on / off surveillance subsystem or zone, opening doors, turning on the

camera or control PGM outputs [4]. Software uses a building floor plans (buildings or outdoor space - there are also software for visualization of perimeter protection) with a graphical showing of the locations of individual components (detectors, cameras, card readers, terminals, etc.).

E. Integration software of systems of buildings

Interconnection of security systems and other technology of building are implemented through software product, which is installed on the server. These systems (alarm and non-alarm) are controlled by the client PC through a web browser [5]. The individual systems are connected in a LAN. Integration software is an additional service, allowing for example:

- setting the automatic links between systems, visualization of systems,
- local and remote control, systems management and users
- control activities of operator,
- management of attendance in continuity to payroll system,
- definition of roles and rights of users (employee, operator, manager, receptionist, etc.).

Failure of activities of integration SW may adversely affect the functionality of the connected systems. [10] It is therefore for appropriate ensure integration of important system bindings by the hardware level. Integration software usually consists of separate modules that can be combined according to customer requirements (IAS, HAS, CCTV, ACCESS, FDAS, attendance, the map interface etc.)

IV. HARDWARE INTEGRATION

For the sake of comparison of software and hardware methods of integration, the following section briefly describes the basic hardware methods to integrate alarm systems.

A. Integration IN / OUT

Technical systems integration solutions labeled as IN / OUT is a way of interconnection systems through their inputs and outputs. The parameters of individual components of alarm systems (eg control and indicating equipment, control units, access control systems, CCTV recording devices, cameras, etc.) allow you to realize the integration of heterogeneous systems to ensure mutual transfer and sharing of information of the sub-systems (I&HAS, CCTV, ACCESS, control of lighting, heating etc.) [9]. This information is then used to control (change state) connected systems in accordance with preset configurations. IN/OUT integration is especially useful for small applications, but it is realizable also in larger projects. Such solutions, however, are technically demanding and limited as the maximum number of programmable outputs or the number of connectable modules. In terms of overall system design with respect to its management, control and visualization capabilities is IN/OUT the weakest variant of integration, but due to wide possibilities of creating a concrete implementation of customer-requested features (such as turn off selected power circuits in the building after arming IHAS)

is a frequently used. The advantages of IN / OUT integration:

- systems are not negatively affected by each other,
- failure of one application does not have an impact on other applications,
- interconnection of the systems is feasible regardless of the manufacturer and communication protocols.

Other hand, the disadvantages of this solution can include:

- hardware requirements on the number of inputs / outputs,
- decentralized management system.

B. Intrusion and hold-up alarm systems as the integration element

Extensive alarm systems are based on the groups of modules that are connected on the bus. These groups include alarm components (motion detectors, opening, glassbreak etc.) and also can include elements of access control system and elements of automation, allowing control of connected non-alarm technology of buildings. Control panel is the central element of the system in which can be implemented functions of access control system or other alarm and non-alarm applications [7]. This control panel in conjunction with SW product ensures communication with the system operator and the central control and visualization technology building. All elements of the systems - modules are technologically identical, and therefore there is no compatibility issue. Central control and administration here may seem as an advantage and disadvantages at the same time. Failure of the control panel has resulted in malfunctions of most of the connected technologies. Smaller applications can be realized using control panel of IHAS, which generating signals for home automation systems (such as X -10 ... control of electrical equipment signals transmitted by power lead 230 V).

C. Automation system as an integration element

Automation systems used to control technology in buildings (lighting, heating, blinds, irrigation, etc.) contain a central control with PLC (Programmable Logic Controller) controllers and can be used also to security object. Modern automation systems use technology systems of intelligent wiring. These are built on the platform of the wire bus to which they are connected sensor (temperature, humidity, buttons, microphone, detectors ...) and action elements (switches, relays, warning device ...). Individual elements of technology of building (lighting, air conditioning, blinds, heating, boiler ...) can then be controlled locally, remotely (GSM, web) or can centrally set timetable for their activation and reciprocal links.

Intruder Alarm system can be connected to the systems of intelligent wiring through a transducer, which ensures two-way transmission of signals between the control panel IHAS and the control unit of wiring system, which further ensures links with other technologies in the building. When arming the system after the departure of persons from an object such as might occur to turn off lights, locking doors, turning off selected socket circuits. In the case of intrusion can be

programmed central unit for turn on lights in the building, pull blinds etc. In another variant is possible to create a security system on the platform of the system of intelligent wiring without the use of control panels IHAS. In this case, the detectors (motion, open, glass break, vibration, etc.) are connected to other sensors to the bus and based on an assessment of their condition control unit run the program - the transmission of messages on alarm receiving centre, activation of warning devices, etc. Such a method of security cannot be certified in accordance with the line of technical standards EN 50131. Smaller applications can be realized with the use of PLC control systems, which are primarily designed to monitor and control of technologies of building, but their inputs / outputs can be connected to the relevant elements of alarm systems.

V. CONCLUSION

The aim of the article was to present the proposed classification of software products and its functions for support of integration of alarm systems. SW integration methods can be classified according to their basic functions, which SW products can provide. Proposal of classification is based mainly on the analysis of technical requirements for integrated alarm systems and possibilities of software products.

The importance of the deployment of software products for the integration of alarm systems:

- central control of events and alerts in the system, the central management of user data,
- ability to integrate products from different manufacturers, the implementation of on-line service,
- reducing of false alarms,
- better overview of the situation in the building,
- obtaining before-alarm information,
- faster response to emergency events, user control and operators, operative changes of system,
- standard (graphical) user interface, reducing the cost of supervision in the building, maintenance, training, human resources, expansion the possibilities of connected devices.

The benefits of processing classification of software products and its functions to support of integrated alarm systems:

- starting material for preparation of technical report to support of the interpretation of technical standards in the field of integrated alarm systems,
- basic assumption to selection of integration methods in the design of integrated alarm system, [5].
- better orientation in software products to support of the integration of alarm systems,
- establishment of criteria for evaluation of the effectiveness of the integrated alarm systems,
- support of the process of comparison of hardware and software integration methods.

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