

## INTELLIGENT BUILDINGS – BUS SYSTEMS, MyHOME

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### **Abstract**

The paper is devoted to the implementation of smart building control system and the application of modern control at the user level. It provides a brief analysis of the situation on the Slovak market. Moreover, it studies a structure of the current intelligent solutions and compares different products offered by commercial companies. The paper also elaborates the characteristics of smart system MyHome by Legrand. It proposes and projects possible solutions to the standard living space. Drawing and configurations of individual devices of the projection were synoptically designed by software developed especially for the selected system. The proposed solution (along with a clarifying of the specific requirements of the systemic configuration and installation) can help to realize the implementation the specific project.

**Key words:** Intelligent building, Low-energy house, bus systems

### **Introduction**

The issue of intelligent buildings is particularly extensive area including areas such as automation, information technology, ergonomics and many others. There are many technical solutions for intelligent control and independent automatic control. Nevertheless the applications remain the same (except only few exceptions) and are composed by all electric appliances. Typical applications include lighting, movable parts (as blinds, rolling shutters, awnings, gates as well as ordinary windows) and doors or control of plugs circuits. Control of heating, ventilation and air conditioning has become the standard in domain of intelligent management [1].

### **The available intelligent solutions offered by commercial companies**

Selected systems specially designed for small to medium sized houses (100 – 200 m<sup>2</sup>) was analyzed. There are many different manufacturers with various portfolios of products. For comparison, there are four most affordable, best-selling and most widely used systems used in Slovakia.

#### **Nikobus**

This system provides basic control of particular lighting, blinds and appliances in smaller living spaces. It's based on a partially centralized bus system. It uses bus consisting of twisted cable 2x2x8mm<sup>2</sup> with Niko-Bus protocol. Three types of controllers are available: switching, dimmer and rolling shutter. Mutual cooperation between the various components is realized by programming (by using a programming adapter connected to the bus or in a simple programming environment, PC-logic and PC-link). [2]

### **Domintell**

System Domintell provides all of the benefits of intelligent lighting controls, heating, ventilation, air conditioning and it almost doesn't know functionality limit. This is a partially centralized bus system, working with RS-485 interface. Each group has to use the central control unit, which control all other components. This differs from the competition and represents almost the maximum which can be achieved in the management of buildings (in selected segment).

The programming and configuration process of the complete system is limited by the programmer. This is a disadvantage for the user, but on the other hand, it provides more sophisticated options of controlling. Programming is provided with PC connected via USB to a central control unit. [5]

### **Inels**

Intelligent electric installation INELS is also a partly centralized bus system. It is intended mainly for switching and dimming, and also to monitor and control processes of living spaces. The system works with CIB bus. Configuration of the system is provided, as in the case of Domintell system, via connection of the PC to a central unit. Inels Designer & Manager provides a graphical intuitive processing software environment intended for programming of the system. SCADA Reliance home is another software tool, which allows you to create graphical user interfaces for touch screen control panel. The advantage of the solution is the OPC server (Object Linking and Embedding for Process Control) which can communicate with other systems in the house (OPC clients). [7]

### **My Home (Bticino)**

My Home uses partially decentralized system with bus SCS (Sistema Cablaggio Semplificato), which communicate by its own protocol. It allows the transmission of four different signals (by frequency modulation) - data, audio, video and power supply of connected device. The access to media is provided by CSMA / CA ("Carrier sense multiple access with collision avoidance") [9]. Bus communication protocol is open source OpenWebNet protocol especially developed by Bticino. The greatest advantage of the used protocol is that it is independent on the used technology. This means that is possible to connect any device with the management software via Ethernet, serial port RS-323 or an USB port directly into the home automation system and manage it by using the prescribed control word.

The system consists mainly of switching elements representing user interface bus, control elements (actuator - located in the cutout box) and the controlled appliances (lamps, motors, etc.). All devices are connected to the bus from one two-wire direct bus, where both wires are connected to the device. Each device contains its own configurable address and settings. Configuration is done through plug-ins or specialized software. Components communicate with each other only through a common address. *Example: The light switch element sends a request to the bus to switch actuator with the same address as the switch element, which responds and turns on the contact to the power cable of a desired light.*

### **Limitations of the intelligent systems**

Limitations of the intelligent systems can be divided into logical and physical restrictions. Logical limitations are caused by the limited number of addresses of the elements. In the contrary, physical limitations represent the maximum length of a bus, the maximum distance between two points and the maximum number of devices. Physical limitations are defined by

the absorption of the electric current of each device, used bus, necessary power supply as well as the character and the strength of the transmitted signal.

In case when there is not sufficient number of addresses (for any reason), the logical limit is exceeded or the maximum length of bus is not enough, it is necessary to expand the system. This is possible due to the interface that according to configuration allows logical or physical extension.

### **Comparison of Systems limitations and their expandability**

#### **NIKOBUS**

Maximum number of switching units (available only switching, dimmer and roll) is 20 and the number of switches is not limited.

#### **DOMINTELL**

The system works only with single control and switching unit (at the same time). It is possible to choose the bus speed of information transmission in 200 kb/s or 10 kb/s. The maximum transmission distance depends on the speed: 1200 m at 200 kb/s and 50 m at 10 Mb/s. The signal amplifier for long and overloaded lines or to expand the number of modules connected to the control unit from 256 to 600 is available.

#### **INELS**

The system operates with one bus or two buses, both of them with maximum length of 550 m. Each bus is capable to connect 32 devices. If we connect another master unit to one of buses, the number of plug-in elements will increase into 128. The maximum number of devices in the expanded system is 192.

#### **MY HOME**

The maximum number of addresses is 81. The maximum distance of total extended cable is 500m. The length between the power supply and the most distant device may not be more than 250 meters and the total absorption of the system must be less than 1.2 A, which is the current provided by a single power supply. The system can be extended to 810 logical addresses. This kind of expansion is most applicable for integration of various systems from home automation to control heating or alarm. Physical limitations, limits of the source and the transmitted signal can be avoided by using of four interfaces for expansion (it comprises five separate sections).

### **System proposal**

The standard family house (one floor, 110 m<sup>2</sup>) was chosen for the design using intelligent system MyHome. As the target attribute, was selected control of lighting and rolling shutter. The choice was based on the effort to show the best demonstration of the principle of configuration and options of My Home bus system. Control process is based on the control components located in the area, while the actuators are located in the cutout box. Communication is provided by bus with tree topology. The procedure of creation of the proposal was implemented in the program Tiplan 3.3 specially designed for the electric installation by the company Bticino.

Due to the fact that all devices in the system are connected to one common bus, it is necessary to assign a specific logical address to the each device. The physical configuration, namely the allocation of the addresses, can be implemented manually by individual devices or by using Virtual Configurator program.

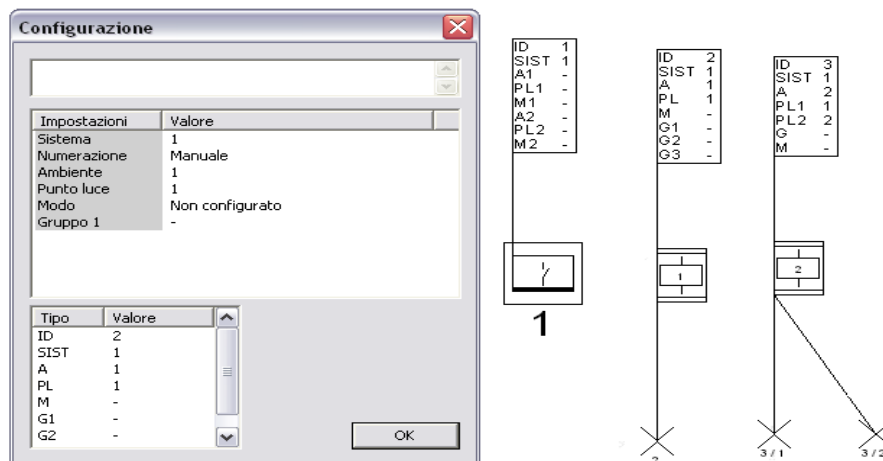


Figure 1: Example configuration DIN module with two relay (ID 3) in the program Tiplan 3.3

LCD touch screen (TS) control panel is also embedded in the proposal. The inclusion of the touch screen panel supposes more controlled systems more sophisticated installation. In the case of simple control of lighting and rolling shutters, LCD TS does not fully use its potential. On the other hand, it offers comfortable control from one place, making an easy button for a larger group of actuator, which is not possible in conventional switches. Tool TiDisplay Color 2.0 provides a fast, user-friendly interface with a warning about the errors. Thanks to the interface with TS panel with USB port, the software is intended for end users.

### Possible variations and improvements of the system

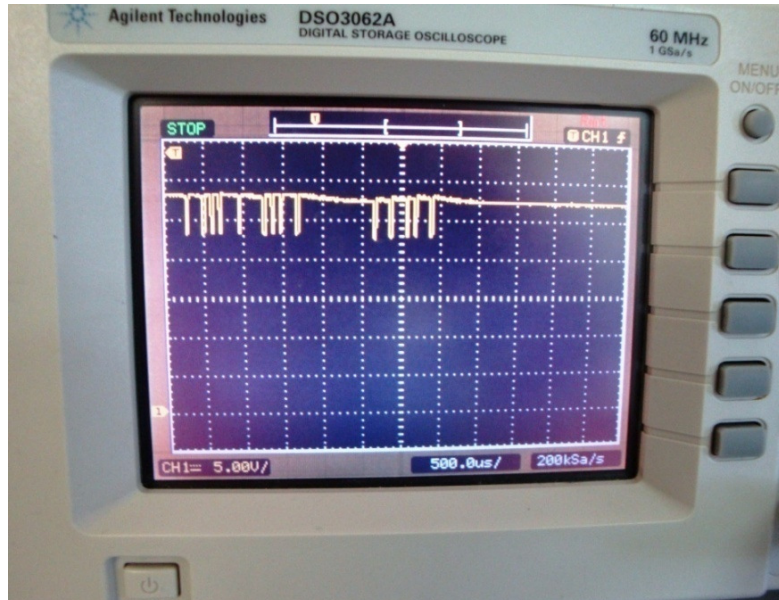
The usage of switches with radio frequency receiver for remote control is one of the possible improvements which are not too costly, but highly increasing the comfort. Another way to increase the comfort is to add dimmers instead of the relay actuator. This approach expects lightings able to dimmer and also replacing only one module relay actuator with dimmer. Dimmers are important components that increase the life-time of lighting. Addition of new switching devices anywhere on the bus and possible replacement of existing devices is no problem in the used system MyHome. In the term of comfort, it is advantage to use the server enabling management through the internet or mobile phone. Besides the classical system involving lighting and other appliances, it is possible to integrate more My Home subsystems such as communication system, alarm system, sound diffusion system and thermo regulation systems

### Testing of the used devices

To verify the gathered information, the principles of installation and configuration of MyHome devices, we choose a simple connection of actuator and control unit. It was used a two-relay actuator F411 / 2, double switch L4652 / 2 F425 and memory module. All of the elements are identical with the elements of the created proposal. Similarly was used the power supply protected by circuit breaker embedded in a plastic panel.

In a first step, we measured voltage of the bus. Results match the table value (27.04 V DC).

Test consisted of a trial connection of a switching element, the actuator and the power supply with the bus. Consequently the theory of addressing of commands depending on the configuration of devices was tested. Also the possible usage of motor rolling shutters was tested. In each experiment measurer indicated connection between associated output contacts of the actuator. Similarly the functionality of the memory module after power supply failure was tested.



*Figure.2: Voltage characteristic (Agilent DSO3062A)*

## **Result**

The proposed solution provides superior control of lighting and rolling shutters with many advantages. Primarily, it provides a simplified installation by using a bus system. It also allows easy expandability and implementation of new features and functions. Thanks to “intelligent” elements, more complicated functions (normally difficult to obtain) are easily achievable than before. This involves particularly the switching of groups of lamps in one key, switching of individual lamps and groups from many places, the central control touch screen panel and recovery/not recovery of the activity of selected elements after a power supply failure. Selected system with established functions and design concept is also clearly cheaper than a comparable system using conventional wiring. Software Tiplan is suitable for elimination of the errors of logical addressing and configurations. **The final proposal help during the physical implementation of the project, where the big advantage is the precise statement of the necessary components (list of the material).**

**Verification of tested elements, simple connection of the switching device and the actuator, has shown the prescribed behavior of basic characteristics of the logical addressing as well as the memory module features (in terms of voltage on the bus). Finally, we can conclude that mentioned cheap and relatively simple bus systems are reliable and effective solution of electrical installation of family houses (small or medium), which will gradually replace the "classical" solutions just because of low prices, feasibility and their subsequent scalability.**

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