

Reaching high

Frankfurt Maintower: Bus technique on 60 floors

[Hint: This building is located near to the river Main. Therefore it is called Mainower.]

The skyline of the Main metropole Frankfurt has become richer around another building of the superlatives. The Maintower built by the Hessisch Thüringischen Landesbank, is not only the fourth highest building of Europe but can offer Europe's most extensive bus installation in an individual building also. The LCN bus of the company Issendorff, Sarstedt, is used.

Heaviest demands are made to the building automation on altogether 60 floors in the Maintower. 2560 windows operated electrically and just as many shades have to be steered. Almost all of more than 5000 lights in the building can be dimmed individually and a fully automatic daylight dependent light regulation with individually adjustable set points ensure optimal energy usage in the offices and an ergonomic work environment.

Technology wasn't saved up for the nine meeting centers also. Illumination, flax walls etc. are equipped with particularly extensive control functions in this area, for example all light circuits have 60 or 100 scene memories. In this application the installation bus is directly coupled with the media technology. There are further couplings to the fire fighting/ reporting equipment and to the air conditioning controllers.

The described control tasks are carried out in the Maintower with the LCN bus. The decision for this system has been made due to his technical possibilities and, as an essential criterion, his data transfer performance. The LCN units have extensive periphery, helping to fulfil demanding tasks in a simple way. All installed UP modules are already equipped to support the IR remote control receiver, precise temperature measuring and motion detection with radar sensors.

The segment bus with its 1000 to 10000 telegrams/s offers sufficient transfer capabilities, to carry not only bus commands, but also all messages. Additionally proven acknowledging and reporting functions make the complete supervision of the building possible.

Cell structure makes flexible room usage possible

Five suburban storeys and the five first floors above the ground – some with double height - form the base building of the Maintower. The real tower extends only on the floors six to 54 with his clear-cut halfway round halfway square silhouette. The cross-cut corresponds a square reaching the middle of a circle. The office cells are arranged at the outer edge of this geometric figure and each have a window, window shades and two lights respectively.

Today, the cell structure is very common in modern buildings because it offers a high degree of flexibility at the division of the floors. The separation walls are installed at the very final stage of the construction to give the required office sizes. Any time, changes are possible without problems so that the expensive area can always be used optimally.

Such office structures seem to be exemplary for use of bus technology: In the ideal case the electrician not even needs his screwdriver after rearranging a wall. By means of a notebook the logical wiring can adapt to the new conditions with a couple of keystrokes.

If all to be do would merely be switching, bus installation, however, would not pay - despite the advantages mentioned above. The bus becomes more economical than conventional installation technology only if the client makes higher demands on his electrical installation.

High demands on the electrical installation

A high end building like the Maintower needs a particular high end installation. So in each room a light regulator was proposed. A light sensor in every office cell measures the brightness in the middle of the room. It adds so much artificial light to the daylight, that a constant room brightness is achieved. The lights close to the wall will be driven high faster than those at the window. This minimises die brightness difference between wall and window.

The 60 [today 100] scene memories of the LCN modules open interesting light-technical possibilities at night besides the lights comfort during working time. So whole strokes can be recalled with a single command on the surface of the entire tower at night. The representation of a scene for all 5000 lights only takes about ten milliseconds.

Working at good atmosphere - every season

As a further special feature of the Maintower is the ability to open all windows individually in all stories. This gives the employees a degree of comfort and liberty that is unusual for sky-scrapers. During summer the air-conditioning system can be relieved by the fact that the windows open automatically in the morning to cool down the building.

The high wind pressure in great height almost would have let this concept fail: It was necessary to limit the opening of a window to its own protection in dependence of the wind speed. The manufacturer of the tower's windows, however, couldn't install the required position sensors.

With the help of LCN the problem finally was solved. The operating current of every window motor is detected by current sensors. By this way the end switches of the window motors are used to detect two positions. Every bus module can perform a test drive to measure the time needed to open and to close its window fully. From this time on the module registers every movement and so always knows the current position. A central computer computes the maximum travel depending on the wind speed outside. It sends commands to all LCN modules controlling windows and tell the individual maximum position. This way the windows get a "virtual stop".

The central weather computer in the cellar supplies the results for the maximum possible opening of the windows for every point of the facade in dependence of wind speed and wind direction. The required data is supplied by a weather station installed at the antennas of the Hessian broadcast [local radio station] 47 m above the 200 m high vantage point. Due to the great load by wind and weather the station is built up three times redundantly. The measuring results are measured by LCN's universal A/D converters. With a resolution of 10 bits precision they are transferred over the segment bus to the computer in the cellar.

Segment bus forms the backbone of the electricity installation

The segment bus forms the backbone of the complete electricity installation in the Maintower. A twisted pair cable runs as distribution network vertically through all storeys. In each floor a segment coupler connects the local bus with the rest of building. This structure makes sure that on one hand the bus is able to work in every floor for itself. On the other hand all bus members can communicate with every bus module in the entire building any time.

The easy serviceability plays an important roll in a so extensive electricity installation like that of the Maintower. For this reason the bus should adapt to the building topology, so that the structure of the installation remains easily comprehensible. At LCN every bus segment has a number, in the Maintower this is the number of the storey plus ten. This information makes it easy for an electrician, to find his way - even after years.

Complex messaging system ensures complete supervision

The building supervision plays an important roll in office buildings. LCN modules scan continuously all their inputs and outputs, generate status messages and send them to the segment bus. All messages are permanently available to all tableaux and visualisation PCs and to coupled foreign systems.

The Bosch fire reporting system for example communicates this way with the installation bus. In case of danger, the bus is informed about the location of the fire. Depending on this information the bus drives the windows to predefined positions and damps the fire, long before the fire fighters arrive.

Conclusion:

The Maintower is exemplary for use of bus technology because of its flexible office structures as well as the extensive requirements on the electricity installation. The installed bus system convinced the customers due to his high integration and transfer performance as well as the simple handling.

Interview:

Electricity plumber Andreas Lederer gives the LCN system good marks

Installation and programming of the LCN system in the Maintower were created by the electricity plumbers Andreas Lederer and Michael Ploch. G&H asked Andreas Lederer for his experiences:

G&H: Mr. Lederer, you have installed and programmed the LCN system in the Maintower. Which previous knowledge regarding bus technology did you have at the beginning of the project?

Andreas Lederer: I had previous knowledge in the systems Luxmate and EIB.

G&H: How long did the training phase last?

Andreas Lederer: The training phase lasted about two weeks.

G&H: How do you judge the technical possibilities of the LCN system?

Andreas Lederer: According to my judgement the technical possibilities of the LCN system are so various, that one should only use this technology in the office and business buildings. Also and primarily for reasons of the safety and the building supervision.

G&H: How do you judge the handling?

Andreas Lederer: The handling is excellent if the user can handle the system.

G&H: What did the support by the company Issendorff look like during the training phase and during the project?

Andreas Lederer: The support was and is very good. Both during the training phase, a one-day training by the Issendorff company was sufficient and at the project company. At problems a contact person was always available.

G&H: How do you judge the flexibility of the system? Could you cope with short-term changes during the installation phase?

Andreas Lederer: I judge the flexibility of the system as very good. During the installation phase we could react to short-term changes at any time.

G&H: Where do you see problems or limits of the LCN system at the use by the building technology?

Andreas Lederer: Problems with the system haven't appeared yet. I think, that this system can still be used more versatily in the building technology.

Statement of the building site supervisor:

Hermann Krämer (company ESA Frankfurt), senior supervisor for the entire electrical installations at the Maintower resumes his experiences with the LCN bus as follows: "Of course some had been sceptically, whether the LCN system can fulfil all expectations in our house. After thorough exam, however, I was convinced by this system and from the beginning I ordered to install the data wire as our sole transmission line. I have been fully confirmed. Even more: Some of the wishes of our customer could only be fulfilled so extensively with this system.

In the meantime we have installed LCN into our own ESA main building also. With some experience in the area of installation busses I can remark that the system is most efficiently and can be installed easily and reliably by us".

The technique of the LCN system:

The goal during the development of the LCN system has been to combine flexibility and functionality on one side and simplicity on the other side. All modules are connected over an extra wire of a standard power cable [in Europe called NYM cable]. Via this path and the neutral conductor the modules exchange data among each other.

The modules work independently. They need neither a separate power supply nor any other special supply. In addition, they always offer several functions simultaneously: Two switching/dimming outputs and two or three independent inputs make it possible to get by with a few modules and low wiring effort.

Besides sensors and actors all modules contain several timing circuits, a computational function and a counter. They are also equipped to read and process analogue values. All information and values can be interrogated remotely.

Multi Master Bus

The LCN system doesn't need any master controller, because the intelligent modules are able to negotiate their data traffic. Every single module can steer the bus as a "Master". The system can be expanded to big building complexes. The limit is 30000 modules, with are able to support 10000 to 60000 rooms per object.

Structure

Up to 250 modules are connected through only three wires (phase, neutral and data) and form a segment. [That is enough for 100-500 rooms.] This lower bus level, which is easy to install, is sufficient even for medium sized buildings. For very big buildings up to 120 segments can be coupled.

Addresses

In order to make every module addressable, each one is assigned an own address number [called ID] between 5 and 254. The assignment is done by the installation software LCNP. For this action it is not necessary to have physical access to the module. The PC can be attached to the bus at an arbitrary location.

If several net segments are coupled through the segment bus, the segments get numbers between five and 124. Groups are only formed if several modules shall process the same command simultaneously. Additionally, LCN supports direct addressing, because in most cases there is a point to point communication between two modules.

Data transmission

The average transfer rate is 100 telegrams/second, the segment line even carries 1000 to 10000T/s. This corresponds to a data transmission of 9600 Bd or 300 KBd to 2.5 MBd. The data line may be wired arbitrarily in the building. The maximum length is 1 km per section and can be extended with distribution amplifiers. In addition, optical transmission via plastic and glass fibres [2km/section] are possible.

Configuration

Every module "knows" the attached appliances in order to control them correctly. Dimmable lights are dimmed, gas discharge lamps are driven by an algorithm called Powerswitch. During programming the modules get all of the essential information about the attached appliances and sensors connected. Additionally all keyboard functions are entered and stored permanently.

Keyboard

Pushbutton keys of nearly all brands can be attached to the modules. The key tables are freely programmable: From a simple toggle switch to complex management of 32 [today 64] modules / groups. An own IR remote control system with computer controlled transmitters is included.

Visualisation

All conditions on the bus can be shown directly as real time reports by tableau modules. LCN can indicate not only 2 but 4 states: "on", "off" and "blinking", "flickering". That is why the modules can represent "first value" and "final value" reports according to DIN simultaneously. All states can be logically evaluated, the result as available on the bus. Both, the key operation and the evaluation can be carried out hierarchically – the size of this logical network is not limited. The results can generate commands and can take intelligent control of the bus.

With the help of the visualisation software LCN-W [running under Win98..XP], all states and conditions in the building can be shown and can be controlled by the customer.

[Additional hints of the translator in brackets.]