



Ethernet and TCP/IP as Standards for Building Automation

PC-Control in the office of the future

Even the market for technical building equipment is being seized by the PC and the software revolution. The property developers FOM and the tenants Microsoft of the new administrative headquarters of Microsoft in Germany have made a trend-setting decision: PC-based control technology, Microsoft operating systems and consistent Ethernet communication were chosen as the fundamental technologies for the building automation. This new technology was implemented using automation components from Beckhoff.

What was required of the automation scheme were the integration of all the building technologies into a unified facility management and unlimited flexibility in the division of the office areas. Thus by moving the partition walls it is possible, anywhere in the building, to set up a working space with its own lighting, heating and ventilation. Multi-purpose, adjustable cooling and heating units can be installed at any given place in order to cater for the requirements of the newly-created area. The chief attraction is the fact that the

staff, using workstation PCs, can control room functions, such as lighting, room temperature or raising or lowering of the blinds via web sites.

Printing and heating controlled through one cable network

In the past, when automation in a building was affected, changes of use, simple expansion or new functions led to considerable expenditure on engineering and installation. Conventional wiring, and even the bus systems traditio-

nally used for building automation, often gave rise to insurmountable hurdles. The integration of IT and automation techniques employing PC-based control technology and communication standards like Ethernet and TCP/IP offers a whole series of advantages. Ethernet has proved itself as an universal communications' medium for office networks and was now also selected for the building automation. In Microsofts headquarters the two data worlds of office and building are thus fused together. The advantage: When everything

In the new Microsoft headquarters in Unterschleißheim intelligent building control is achieved using PC control, Windows operating systems and Ethernet technology..



from the actuators and sensors, through the PC, up to the administration level runs under one protocol, duplicated data maintenance is eliminated. Adaptations and conversions become superfluous. The availability of hubs capable of industrial application and the development of suitable application protocols extend the Ethernet's operative range up to the input/output level and thus to an application range typical of Beckhoff Bus Terminals. This means that not only distributed sensors and actuators, but also intelligent components such as door terminals or web cameras, communicate directly with supervisory PC controllers via network cabling.

Beckhoff have exploited the advantages of PC-based control technology in the field of machine automation for years. Beckhoff have played an important part in the development of this „new automation technology“, which has become a standard in this field. The experience gained in machine construction and process engineering can now be transferred to the intelligent control of buildings. The following Beckhoff system components were used in the Microsoft headquarters to provide straightforward and flexible automation of

the building:

- Industrial PCs as master and building computers
- TwinCAT software PLC for central and distributed building control
- Bus Terminals as intelligent I/O terminal strip with Ethernet TCP/IP interface

Consequential decentralisation with Ethernet bus terminals

Put into concrete terms, the new Microsoft headquarters in Germany consists of 2 main- and 9 office buildings with an effective area of 27,600 square metres, in which more than 1,300 staff work. Each building is served by one industrial PC using TwinCAT automation software and Microsoft Windows 2000 operating system to control the central functions of the building and to co-ordinate the distributed Ethernet terminal strips. Each of the 11 building computers is connected via the network with the building administration's central computer.

All data points - at Microsoft there are about 12,000 on more than 200 Ethernet couplers - relating to the areas of HVAC (heating, atmosphere and ventilation), safety, access etc. are collected via the electronic terminals. The

wiring for the highly modular 2 and 4 channel Bus Terminals is performed locally in terminal boxes. In each of the four-storied office buildings, all largely identical, 4 Ethernet bus terminal systems are installed in terminal boxes on each floor. The 16 stations per office building communicate with the central building master computer via Ethernet.

Sensors and actuators are connected directly to the flexible I/O system. The Bus Terminals are endowed with multiple functionality; all relevant industrial signals are supported. Apart from digital and analog input/output signals and RTD inputs for reading the temperature there are serial interfaces e.g. for communication with the door terminals of the access control. Even the lighting and motors for the blinds are connected directly to the system using relay output terminals.

Intelligent I/O terminal strip with PLC functionality

The Bus Coupler links the bus system to the modular, extendable electronic terminal blocks. He recognises the terminals to which it is connected, and performs the assignment of the inputs and outputs to the words of the process image automatically. Bus Terminal

The wiring for the highly modular 2 and 4 channel Bus Terminals is performed locally at the terminal boxes, or in a central control cabinet. The open system permits fast, easy addition of building functions at a later time. All the sensors and actuators relevant to industry and building automation can be directly connected to the modular I/O terminal strip.



Controllers are bus couplers with PLC functionality, programmable in accordance with IEC 61131-3 with 64 kbyte data memory, 96 kbyte program memory and 512 byte for remanent data.

The Ethernet TCP/IP BC9000 Bus Terminal controllers take over data pre-processing on the individual storeys, thereby relieving the higher-order control system from routine tasks and reducing network communication. Signals for light, temperature, shade or HVAC control are handled directly in the controller so that if there should be a network failure all functions affecting safety remain intact. Central data, for example for imparting set control values or access control data, are communicated through the bus coupler via the TCP/IP Ethernet using the TwinCAT automation software.

PC-Based Building Automation

The TwinCAT software system turns any compatible PC into a real-time controller with a multi-PLC system for central building control and distributed control of individual rooms. When programmed in accordance with IEC 61131-3 a comprehensive standard library on building automation can be accessed.

All central and distributed control levels are connected via the Twin-CAT ADS (Automation Device Specification) integrated consistent communication system. Twin-CAT ADS manages and distributes all messages via TCP/IP connections. This allows all Twin-CAT server and client programs to exchange commands and data, to send messages, transfer status information. The configuration and integration of the Ethernet Bus Terminal Controller is carried out very simply using the TwinCAT System Manager just as with „classical“ fieldbus devices. All Ethernet PC cards are supported.

The demands for intelligent facility management are many-sided, and will only grow as time goes on. PC-based building automation with Ethernet generates increased flexibility and improved convenience here. Through the consistent system compatibility it is possible to fit devices to any desired part of the building, now or later. For example intelligent door terminals using the Windows CE interface to provide text messages, access control, services or ordering procedures. Remote control of the building's functionalities is even possible using Handhelds. The Plug and Play ideal can be said to have been attained when

authorised users can use a PC at any location to obtain data from the complex building system and to affect it. Thus the building control system can automatically send out up-to-date situation reports or error messages by e-mail. Openness based on PC standards and Microsoft technologies makes this possible.