To the question of the development of servers of real-time management systems of electrical engineering complexes on the basis of modern automation systems

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Abstract. The article is devoted to the research and implementation of modern telecommunication technologies electrical of engineering complexes in the electrical industry in order to increase their reliability. It analyzes the latest technical developments in the field of automation, such as information technology, communication technology, etc. The following methods are used: induction and deduction analysis and synthesis, statistical modeling. As a result of research on the basis of modern automation systems, an energy-efficient microprocessor automation system has been developed to control the operating mode of complete transformer substations with a voltage of 6-10/0.4 kV, which serves to create servers for real-time control systems for electrical consumers. When creating Automated control systems for the energy sector of an enterprise, it is possible from the information management system - IMS, for example, from the enterprise's mini-computer at the enterprise's dispatcher station; har-monics in the voltage curve, as well as other necessary information.

Keywords: Common information and communication space, Telecommunication technologies, Multi-agent systems; Cell femsota, Inter-body, Sensor networks; Video conferencing; Markov chain.

1 Introduction

A distinctive feature of the modern stage of development of society is the increasing contribution of information and communication technologies to accelerating the development of science, technology, economy, social sphere and various industries. In recent years, in world practice, the most general principle for the development of management systems at various levels (from national-scale management systems to

corporate and individual enterprise management systems) is the focus on the creation and use of a single information and communication space state (SICS) [1-8].

The transition, which has begun abroad, to servers of real-time control systems (SCADA) and the next generation of digital relay protection and automation devices (DRPA) with integration within a single information complex of functions of relay protection, measurement and commercial metering of energy efficiency, regulation and control of an electrical installation [8-10] is aimed at improving the reliability of power supply to consumers. Often, protection terminals perform the function of lower-level controllers.

2 Materials and methods

ACS (Automated control systems), providing comprehensive protection of substation control at a modern level. In this case, they provide control on site or from remote dispatching points (DP), control of the position of primary equipment, measurements, signaling, recording and transmission of oscillograms. In addition, the ACS allows the user to record / change settings using a password, receive reports and keep an archive of events, monitor the status of primary equipment, etc. [9]. In a generalized form, the evolution of technologies (for the considered class of systems) can be illustrated by the data given in [4-7].

Fast Ethernet, Gigabit Ethernet and 10G Ethernet are used as high-speed backbones capable of supporting high volume traffic. Comparison of these standards RS-232 and RS-485 is given in [4-7; 10].

3 Results and Discussion

Numerous technical implementations of modems from different manufacturers, representing some generalized structure of a modern intelligent modem, are shown in Figure 1 [6].
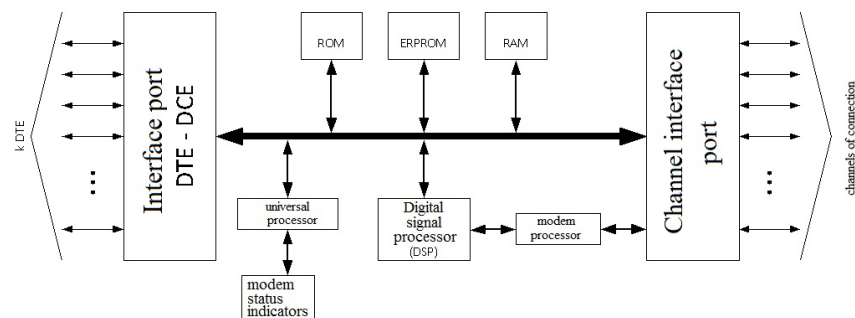
Fig. 1. Block diagram of an intelligent modem.

Local Area Networks of the IEEE 802 Committee. Local area networks, standardized by the Committee of 802 of the Institute of Electrical and Electronics Engineers (IEEE), are a family of local area networks, built on the basis of datagram data transmission technologies. Such networks are based on Ethernet networks built on separate standard technologies, such as IEEE 802.3, IEEE 802.3u, etc., although other networks standardized by the IEEE 802 committee are used [2-10].

WLANs are mainly used in concatenated LANs, where high-speed Ethernet networks are the backbone, such as in the APCS of oil and gas industry. An example of such a network is shown in Figures 2 and 3.
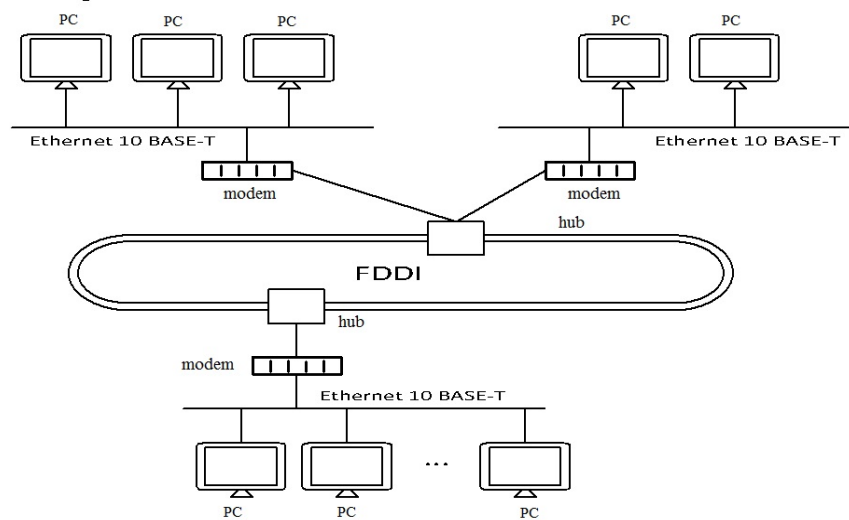

Fig. 2. TCS with FDDI backbone information subnet.

Classification of wireless networks of the IEEE 802 committee and their possibilities are shown in Figure 4.

It is clear that wireless communication lines are used where it is impossible or impractical to establish wired or fiber-optic communication lines.

Wide use of servers of real-time control systems (SCADA) in electrical installations of consumers provides [6-9]:

— reception / transmission of television information in any protocols;
— reception / transmission of data from the daily dispatch list (DDL);
— processing of incoming information, formation of a real-time database (RTDB), archiving;
— control of the control room (digital instruments, symbols, mnemonic diagrams, information boards);
— cyclic copying of RTDB to file servers of the local network (LAN), etc.
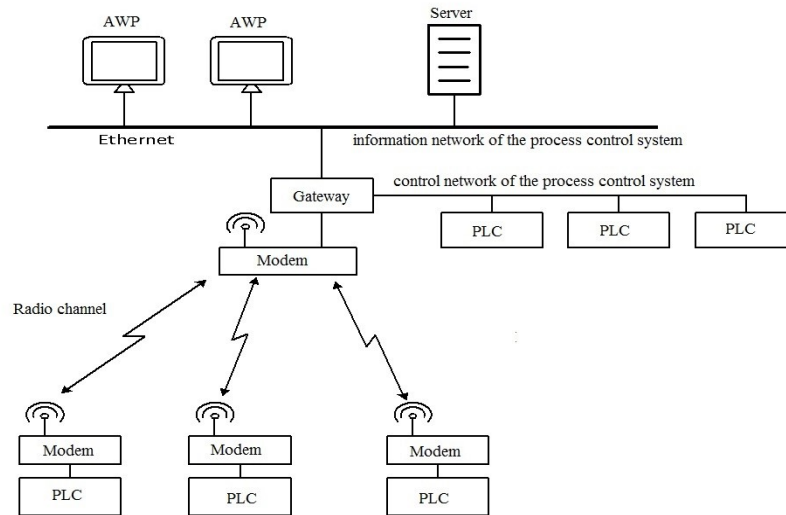
Fig. 3. An example of a telecommunications network with WLAN subnets.

Fig. 4. Classification of wireless networks.

The TMS elements considered above are implemented in the OT-A3-12 applied project "Development of an energy-efficient microprocessor-based system for auto-mating the control of the operating mode of complete transformer substations with a voltage of 6-10 / 0.4 kV". The ongoing scientific applied project relates to the study of automation of complete transformer substations with a voltage of 6-10 / 0.4 kV.

Currently, research has been carried out and continues in this area, various circuit solutions have been developed.

The introduction of the communication Bus COM module into the automation system, which serves as an additional function of data transmission, implemented in the sectional input cells from the transformer and from the Masterpact NT backup source AB, allows to provide, when creating an ASUEnergo enterprise, the possibility of a top-level information and control system, for example, from a mini-computer of the dispatching office of the enterprise, control (either through a PLC or bypassing it) installed on the supplying substation AB, transfer to the upper level data of measurement, alarm, automation, registration, monitoring of harmonics in the voltage curve, as well as other necessary information , for example, the state of AV switches in various connections of the KATP, the presence of voltage at the inputs and sections of the KATP buses. Thus, the functional capabilities are expanded, the reliability and performance of the KATP are increased.

The main elements in the laboratory installation of the developed automation system for controlling the operating mode of complete transformer substations with a voltage of 6-10 / 0.4 kV are: ARDUINO UNO microcontroller; TONGLING JQC-3FF-S-Z relay module with technical characteristics - 5 VDC, 10A 250 VAC, 15A 125 VAC, 10A 250 VAC; Relay 12 V DC Omron MY4N-j; Relay 220 V AC Omron MY4N-j; Power supply 5 V DC AC adapter), model XC 313 with a voltage of 5 V at a current of up to 2 A; Power supply 12 V DC RS-300/120-S325 12V / 3A (analogs: AD PV16, P30B-3P2J); Signal lamps ART AD 16-220 D / S31 AC 220 V 20 mA.

The diagram of the laboratory installation of the developed automation system is shown below in Figure 5.

To be able to control power consumption, manage power consumption, accumulate information about the loads of the busbar sections of the STC, integrate the Masterpact NT H1 circuit breaker into the dispatching system, an additional communication bus function COM is used [9], implemented in the sectional input cells from the transformer and from a backup source, AB Masterpact NT. For these withdrawable units, an additional data transfer function is provided by:

- communication module installed in the device, supplied with a group of sensors (microcontacts OF, SDE, PF, CH) and a set of communication with XF and MX control electromagnets;
- communication module, installed in the chassis, supplied with the group of sensors (contacts CE, CD, CT).

Each installed unit has an address that can be assigned to it using the Micrologic control unit keypad (Modbus) or remotely (Batibus).
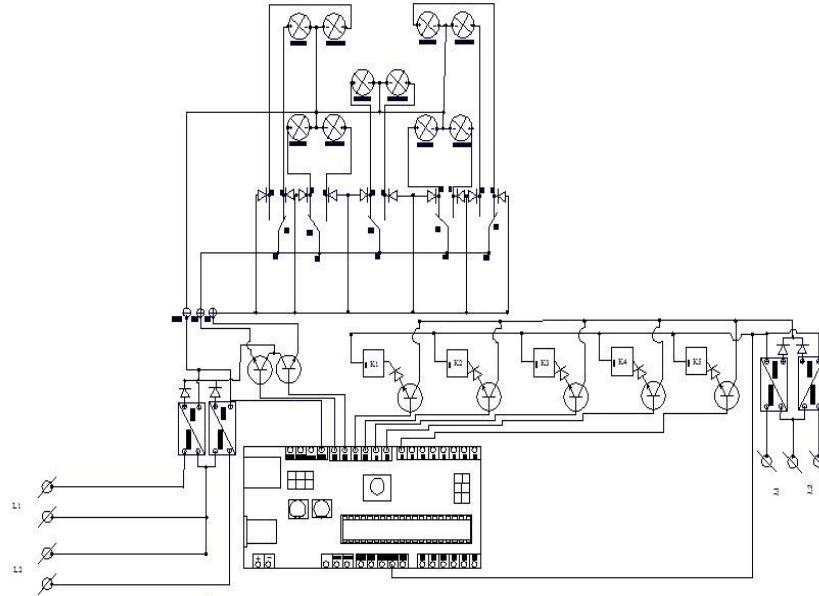
Fig. 5. An example of a TCS network with WLAN subnets.

4   Conclusion

Thus, according to the results of the study, the following conclusions can be drawn:

— The analysis made it possible to identify promising information technologies that largely determine the appearance new generation control systems;
— It has been determined that the created mathematical model of the functioning of a telecommunication system in a complex interference environment and conditions of exposure to damaging factors is a theoretical basis for substantiating requirements in the design of networks and communication systems special and dual-use;
— RU-0.4 kV STC equipped with a PLC, providing comprehensive protection of substation control at a modern level, can perform the function of the lower level of ASU energy. In this case, they provide automatic control on site or from remote control rooms, monitoring the position of primary equipment, measurements, signaling, recording and transmission of oscillograms, etc;
— In the development of the theory and improvement of the methodology for the design of power supply systems for industrial enterprises, an important place is taken into account in such developments of the currently existing consumers in electrical installations and the modern servers of real-time control systems (SCADA), microprocessor-based registration systems being introduced into operation practice emergency events, collection and processing of data on the operation of relay protection and automation; communication systems of new complexes

with the computer "core" of the integrated monitoring and control system, as well as information display systems at the workplaces of operating personnel and personnel of relay protection and automation services;

— Thus, when creating an ASUEnergo enterprise, it is possible from the I&C of the upper level, for example, from the mini-computer DP of the enterprise, to control (either through the PLC, or bypassing it) the automatic switches (AB) installed on the supplying substation, transfer to the upper level measurement data, alarm, automation, registration, monitoring of harmonics in the voltage curve, as well as other necessary information, for example, the state of AV in various connections of the KTP, the presence of voltage at the inputs and sections of the buses of the KTP, etc.

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