ROCKET-SPACE DEVICE ENGINEERING AND INFORMATION SYSTEMS
Vol. 3, Iss. 1, 2016, pp. 36–40

Radio Engineering Equipment Control Using a Database "Linter-VS" in OS MSVS

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Abstract. According to the growth of modern computers performance, increase of random access memory and memory of disk drives, it is possible to use database management systems (DBMS) for solving the control tasks in complex systems. The article describes the control of a radio engineering complex including, for example, an antenna system, an irradiator control system, a receiver, etc. A control with the use of database tables under "Linter–VS" DBMS installed in OS MSVS is organized. Each device included into the radio engineering complex and also peripheral devices are certain "entities". This entity can be represented in the database in the form of several tables. A table "commands" and table "states" must be present. Auxiliary tables related to a particular entity can be present. It is expected that the controller, located on the side of the controllable device, controls the entity, for example - the antenna system. It is shown that the controller communicates with a database by means of a proxy. The proxy connects a device interface with the controller and makes queries to database tables. The queries to the "commands" table are decoded into controller's commands and transmitted through the device interface. Responses are made through it, which after decoding are transferred into the "states" table. Due to such commands and data transfer, the number of controllable and control entities is practically unlimited. They can be both local and remote. It is stressed that DBMS controls the registration of registered users in the database. Unregistered users are not served by DBMS.

Keywords: automation, radio engineering, complexes, database management system (DBMS), automated control system, GNU/Linux operating system, standard RS-485, linear algorithms

1. Summary data about OS MSVS, Linter–VS and RS–485 interface

OS MSVS, based on GNU/Linux, is a multiuser multitask network operation system (OS). It functions on the hardware platforms Intel, SPARC (Elbrus-90micro), IBM S390 and MIPS (Baget series complexes by Korund-M company), supports the multiprocessor configurations (SMP). It contains mandatory access control means, lists of access control and a role model.

Database management system (DBMS) Linter–VS 7.0 is for creation of information and operating systems for work with various information, and for creation and support of the databases based on the relational model of data. This DBMS is based on the "client-server" architecture. The technology gives real advantages for users and becomes the prevailing way for data processing.

RS-485 (Recommended Standard 485 or EIA/TIA-485-A) is a recommended standard for data transmission on a two-wire half-duplex multipoint consecutive symmetric communication channel. The standard describes only physical levels of signaling (i.e. only the first level of an interrelation model of the open OSI systems). The standard does not describe a program exchange model and exchange protocols. RS-485 was created for expansion of physical capacities of the RS232 interface on binary data transfer.

2. A general interaction scheme

A general scheme of the organization control is given in Fig. 1.

The main knot in the equipment control is the server of the remote database (DB). In tables of the DB, there are high-level control commands of the equipment, such as setting the equipment to specific operating modes in certain time. The commands are the records in the DB which contains columns with a number of an operating mode, time of its performance (time of starting the mode and time of finishing the mode) and variable data (exact values of frequency parameters, data on an azimuth, etc.). Also on this server there are tables of the data received from each equipment (including telemetry, digitized signals from receivers, etc.). An approximate table of high-level commands is provided in Table 1, and reply data are presented in Table 2.

Table 1. An approximate table of high-level commands

Mode number [OC]	Starting mode	Finishing mode	Variable data
1	00:00	01:00	Null
2	08:45	09:45	188
…	…	…	…

Giving the instructions for an operating mode in certain time is regulated by the operating program installed on the server, which, following the algorithm, gives the control server of the equipment definite lines with commands.

However, the server of the remote database is connected with the server of the equipment management not directly. Between them there is a real time communication server and autonomous control of the equipment, which can be a technological personal computer (PC). The mission of this server is in synchronization on operating time of the equipment and giving the commands to it. The autonomous control of the equipment in case of the refusal of the remote control equipment is possible via this server. Thus, two managing entities are generated: a remote control server and independent control server. The organization of an access to the control server of the equipment is arranged so that for it (server) there is no difference in the commands which are written down from the independent or remote control server – selection of the operating knot is made according to the commands of the diagnostic program, which interrogates operability of a communication channel with the remote database.

On the very control server of the equipment there are sets of entities – the programs that are terminal automatic control machines which give commands to the equipment controllers, thereby carrying out a final part of a control algorithm.

On the control server of the equipment there is also a DB, where values of the table of high-level commands are duplicated. These values are analyzed by the program – a finite-state automatic control machine for definition of performance of the mode and time when it should be carried out.

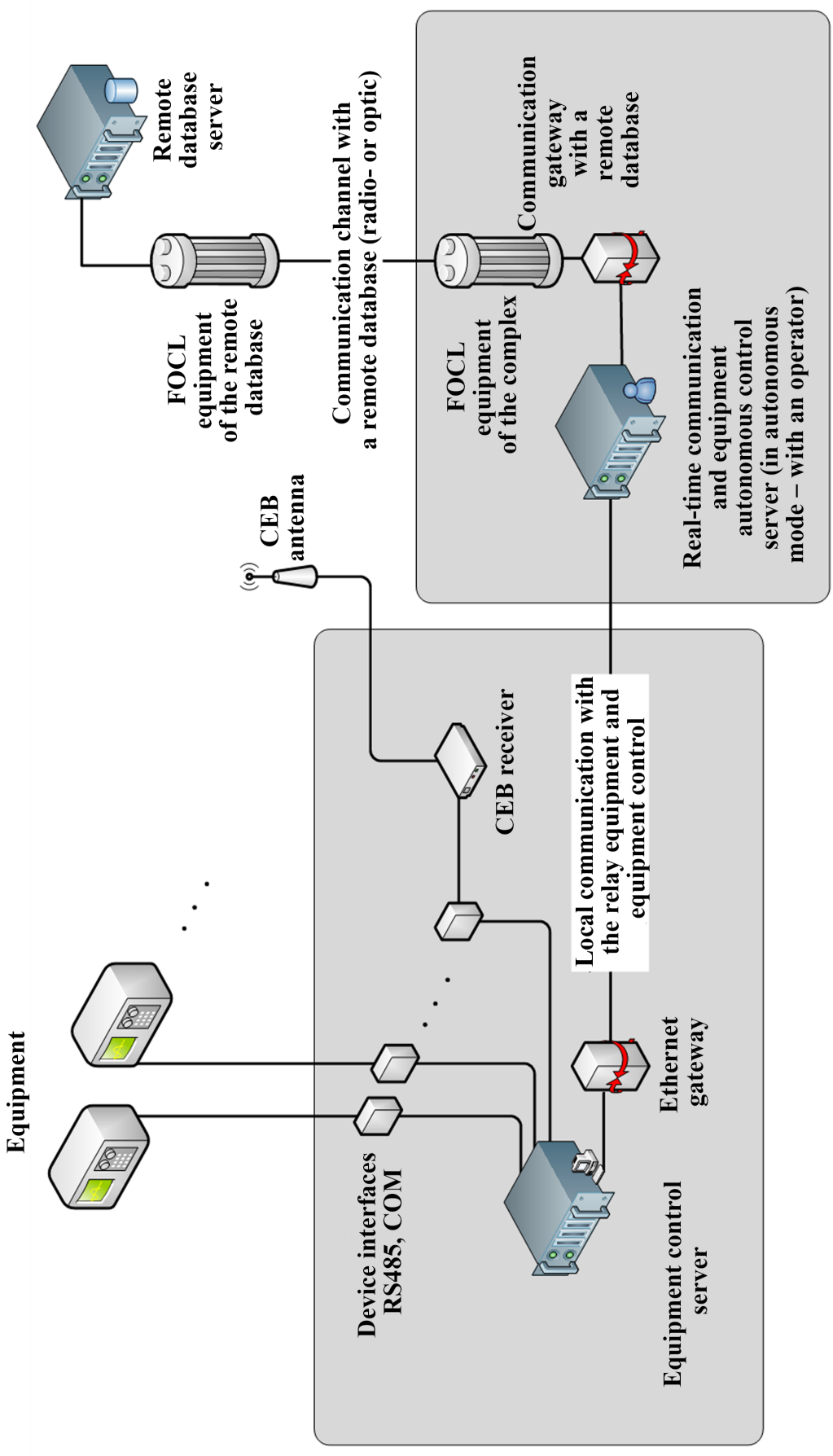

Fig. 1. General scheme for control of RTR

Table 2. An approximate table of response commands

Number [OC]	Good condition	Good condition 2	Result 1	Result 2	Result 3	Performed
1	Yes	Yes	443	98	10	No
…	…	…	…	…	…	

Commands to the controllers are in tables – "dictionaries" of the database, which is on the same PC (the control server of the equipment), which exercises control. The table containing commands to controllers (low-level commands) has also columns with numbers, the sequence of which (from 1 to *n*) presents a linear algorithm of performance of these low-level commands to the controller. The finite-state automatic control machine correlates the columns to numbers of the modes with the corresponding lines from the table of high-level commands. The program, changing according to the set algorithm of commands from the tables of low-level commands, carries out set-up of variable values. The example of low-level commands is given in Table 3.

Table 3. Tables of low-level commands

Number [OC]	Command	Command response	Mode 1	Mode 2	Response mode
1	009EA0	009EA1	null	2	1
2	100000	100001	1	1	null

As a result of fulfilment of every high-level command, each entity will give the response information in the form of the DB table (telemetry, digitized signals from receivers, sign of performance/not performance and so on). These results can be immediately transferred to the DB of the remote server (Table 3).

The operating machine (the control server of the equipment) via RS-485 interfaces in the half-duplex mode will exercise terminal control. The UART controller of the device exercises control of the reception-transmission mode automatically, which is a physical port RS-485.

3. A relations structure of the entities to the database of the control server of the equipment

An access to the data being contained and appearing in the database of the control server is carried out through the authorized connection of an entity according to the unique login and the password (a so-called global role). Authorization is a set of rather strict rights, therefore there are group roles for their variation (for example, one entity can only read data of the certain table, other entity can read, write and delete data). Each such group role has one corresponding global role. Differentiation of the rights is shown in Fig. 2.

4. Advantages and disadvantages of the method of equipment control

Advantages:

1. Using OS MSVS solves a problem of unauthorized data control due to the organization of the mandatory access both on a certain machine and on a complex in general. This is the key moment for radio engineering complexes as at obviously incorrect control of the equipment the probability of its refusal is possible.

2. Using DBMS Linter–VS 7.0 supplements a protection system from an unauthorized access as it has a pam (a method of authorization). This method authorizes the user of DBMS only if this user is registered in the system on the same machine.

3. One of the methods of the organization of data exchange via input-output devices, which is implemented in systems of GNU/Linux architecture (which MSVS OS is), is a so-called teletype (TTY). The teletype is the terminal in the form of the file for standard input. It significantly simplifies transfer and reception of data from any devices at a low level (just at the control level of controllers).

4. The RS-485 interface exchange allows one to exchange data at distance to 1200 meters that is advantage if the equipment is removed from the place of control (high ramps, removal of the equipment for the topological reasons, large-size antennas, etc.). Besides, this protocol supports small exchange speeds (for example, 9600 bauds) that promotes information transfer with minimum losses. The speed of 9600 bauds is sufficient for control of the equipment because low-level commands, as a rule, have the size of no more than 100 bytes (as well as the reciprocal parts containing semantic loading).

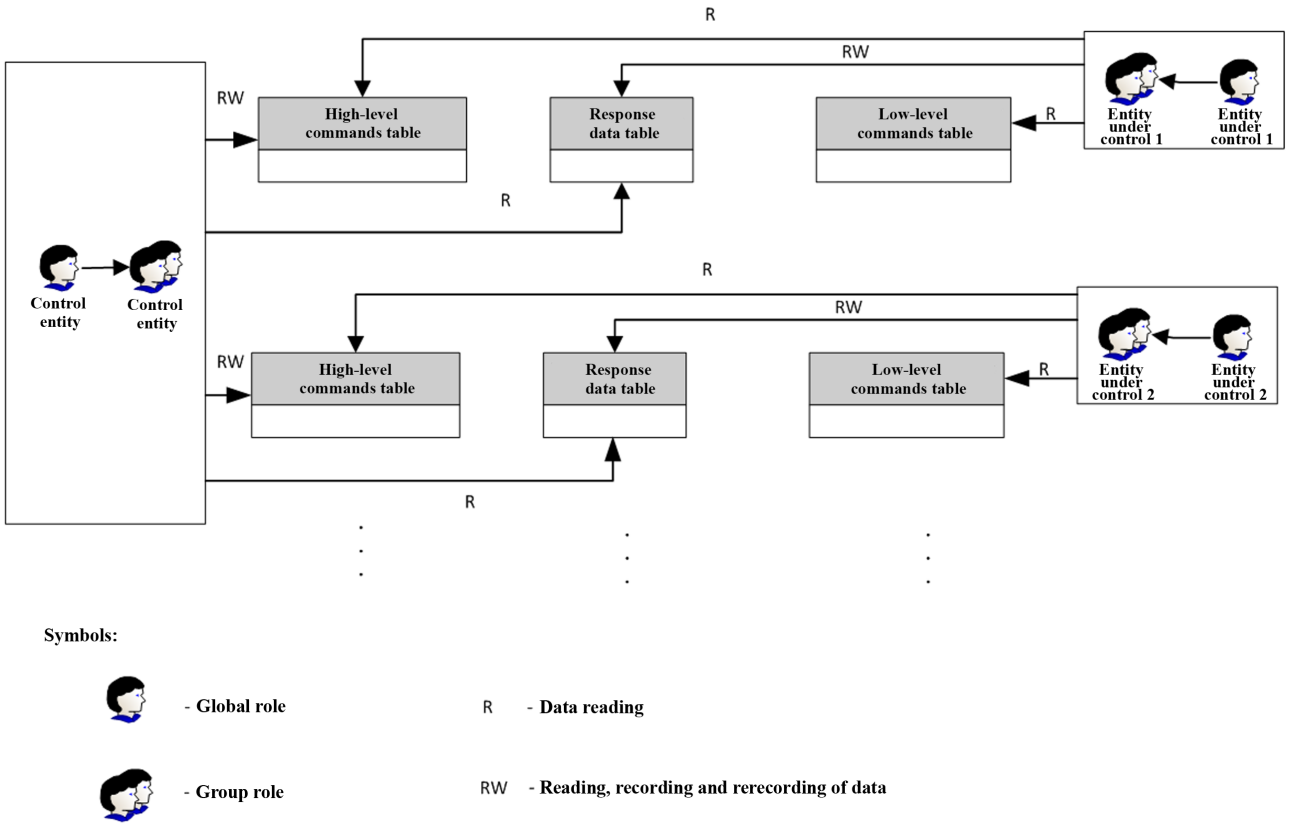

Fig. 2. Rights differentiation of the control server database of the equipment

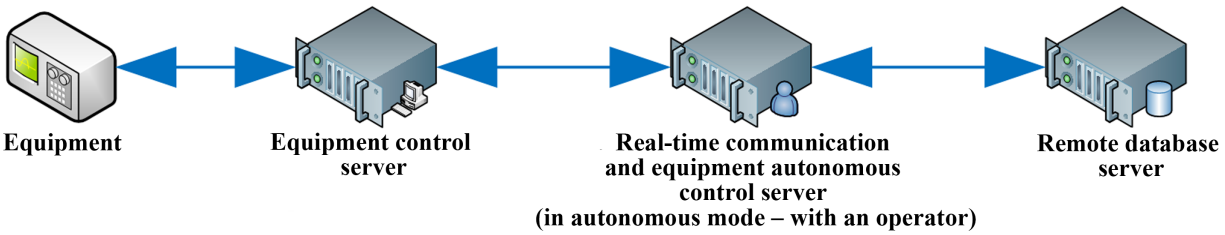

Fig. 3. The path of each command

Disadvantages:

- the path of each command is in four stages: Equipment – Server of equipment control – Server of autonomous equipment control – Server of the remote database (Fig. 3).
- it is quite probable that such quantity of stages reduces system reliability from failures. However, the problem is not very essential, as methods and control algorithms of control load very little modern computer means on which the system of automated control is built.

5. Conclusion

This architecture of automated control systems for the radio engineering equipment (and difficult radio engineering complexes) is universal, as has no strict binding to certain types of the equipment and a variety of the tasks facing a complex. In fact, the system is a system of finite-state automatic control machines and can be easily finished to the level of valve matrixes (instead of the whole PC) that minimizes the system dimensions and will also increase their reliability.

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