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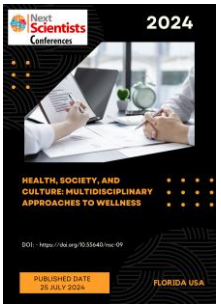

SELECTION OF A SOFTWARE RATIONAL STRUCTURE OF CONTROL COMPUTING FACILITIES OF DATA TRANSMISSION SYSTEMS

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ABSTRACT

The article provides the software structure of data transmission systems (DTS) and a decoding of its composition and individual components. It is noted that the correct choice of computer time distribution algorithms and the study of the functioning of computing facilities (CF) using a set of modeling programs (MP), conducted at the early stages of DTS design, makes it possible to ensure compliance of the designed system and its CF with the specified characteristics and, in the first place, with the main requirement for the operation of CF of DTS - to execute programs in compliance with the specified time constraints on the delay of routines and subroutines.

KEYWORDS: In-house software, external software, dispatch programs.

INTRODUCTION

The software of control computing facilities (CCF) of DTS has several features. These features are reflected both in the structure of the CCF software and in the list of facilities that make up the software components.

The development of CCF software is characterized by labor intensity, complexity, and high costs of its preparation and debugging, which exceed the costs of developing the CCF. Currently, issues of software development for communication networks are widely covered in the literature /1, 2/. However, the structure and elements of the CCF software of DTS have significant specifics, which do not allow full use of the experience accumulated by software and computing facilities developers.

The correct choice of the CCF software structure of DTS allows us to reduce the costs of software development and significantly influences the timing characteristics of the CCF functioning. The main function of the software is to perform information-processing tasks in the CCF of DTS and implement control logic for data management and processing. Along with performing the main function of the software, it must provide automated development, adjustment, and debugging of programs for CCF, and check the performance of the CCF and programs during commissioning of the DTS and its elements /3/.

When designing software structure, the following general requirements must be taken into consideration:

- unification and standardization of similar programs and software;
- model construction of programs;
- maximum possible use of existing general-purpose software for the communication network;
- unity in the presentation of documentation forms.

The structure of the CCF software of DTS is determined by the nature of the tasks solved in the DTS, the purpose and features of the CCF of DTS operating mode, and the types and classes of computing facilities used.

However, regardless of the specifics of individual requirements for the designed DTS and the classes of CCF used, the CCF software of DTS includes components of the following main types /4/:

- facilities that provide direct implementation of the main operating algorithms (a set of programs for functional tasks);
- facilities that ensure the organization of the process of functioning of the control system facilities (basic and specialized operating systems, dispatch programs);
- facilities for monitoring the process of the CCF functioning (a set of functional control programs);
- program development facilities (programming automation system /2/, consisting of programming languages of various levels and translators from these languages);
- facilities for correcting and debugging programs (system for automating program debugging / 2.5 /, consisting of various debugging tools, complexes of service, and debugging programs);
- facilities ensuring testing of the CCF operability when putting the DTS into operation (a set of test programs);
- facilities that provide modeling of the process of CCF functioning (a set of modeling programs).

The division of software into general (system-wide) and special software /2/ for CCF software of DTS is unacceptable due to the significant specificity of software components. Features of CCF of DTS functioning specify the predetermining influence of the control logic and data processing in CCF of DTS on all the above components. Complexes of programs for functional tasks (main operating programs), control programs, test programs, modeling programs, and several programs of operating systems (especially dispatch programs) are completely specific to DTS and its CCF. Developing facilities and tools for correcting and debugging programs also have several features compared to the corresponding components of general communication network software.

It is more justified to divide the CCF software of DTS into internal and external software. These two groups of facilities differ sharply in their purpose and methods of implementation. The internal software creates programs and tools that implement all the functions assigned to CCF. External software consists of tools (languages and translators) for recording internal software programs, and programs and tools designed to automate the process of compiling and debugging internal software programs, putting them into operation and checking the compliance of the operating characteristics of CCF with the specified characteristics at the system development stage.

The structure of CCF software of DTS is influenced largely by the fact that all the components listed above include facilities of three different types:

- basic software supplied together with computer equipment selected for use in DTS;
- general application software developed for CCF and communication networks for various purposes;
- software facilities developed specifically for CCF of DTS.

The most specific components of the CCF software of DTS are complexes of basic working programs (BWP), most of the facilities of the complex of functional control programs (FCP), complexes of test programs (TP), and modeling programs (MP).

The construction of operating systems for DTS software is influenced by the fact that a large number of programs must be simultaneously executed in CCF under conditions of strict restraints on the delays in the execution of the entire program and its parts, and the fact that programs are executed on demand, their pattern, intensity, and time of response are strictly determined for each program by the external and internal operating conditions of CCF. Thus, operating systems for DTS should be built based on a set of basic software, general-purpose software, and specially developed facilities that ensure the implementation of exchange with a given set of CCF of DTS and the execution of specific algorithms of program dispatching.

The least specific software components are program development facilities, correction and debugging tools. The specificity of program development facilities comes down to the inclusion in the programming automation system of specially developed algorithmic languages, focused on the tasks of managing the processes of switching channels and messages, and the tasks of automated control of DTS facilities and channels. Such a “switching” language, focused on the problems of automation of communication processes, should enable DTS software developers to quickly and efficiently describe DTS functioning algorithms without using the machine language of a specific CCF.

The specificity of the facilities for correcting and debugging programs comes down to the inclusion in the automation system of program debugging of a number of special facilities for debugging simulation programs, allowing for complex debugging with a truncated set of CCF, and special interpreting programs.

In accordance with the DTS software, the following groups of facilities can be distinguished:

- functional software;
- facilities on program preparation;
- a set of test programs;
- a set of modeling programs.

The structure of the system software is shown in Fig.1.

The internal software that implements the DTS functions includes functional software consisting of complexes of basic operating programs, complexes of operating systems (OS) and complexes of control programs. External software includes software for preparing programs, consisting of tools for developing and debugging programs, and complexes of test programs and simulation programs.

Of the facilities presented in the diagram in Fig.1, the complexes of basic working programs, test programs, and simulation programs are specially developed for DTS. These groups of facilities consist of facilities of general use and facilities specially developed for DTS.

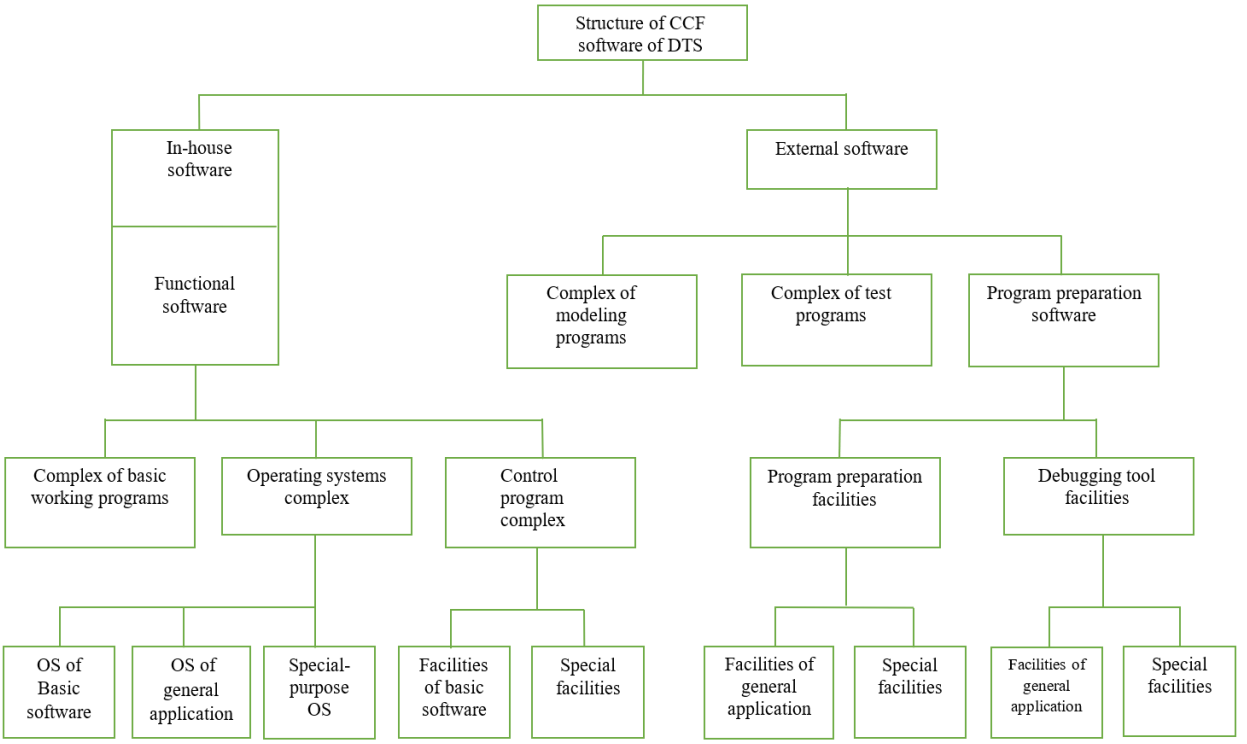

Fig.1. Structure of the CCF software

Thus, when choosing a rational structure for CCF software of DTS, we must be guided by the following basic principles:

1. Regardless of the purpose, function, and type of CCF of DTS, the structure of the software must include complexes of BWP, FCP, operating system programs, TP, MP, and preparation program facilities, consisting of automation facilities for program development and automation facilities.
2. When constructing a BWP complex, methods of functional-block construction of programs and a general program, contained in one place in memory, should be used.
3. Operating system programs (dispatcher programs for specialized CCF and microprogram machines) must ensure the implementation of specific algorithms for dispatching routines and subroutines (distributing computer time).
4. Automated programming facilities should include languages (and, accordingly, translators) that ensure the effective development of BWP and FCP complexes and are focused on the class of tasks performed by CCF of DTS.
5. The FCP complex must include a set of emergency, diagnostic, test programs and control task programs that together ensure proper operation of CCF during long periods of DTS operation.
6. The program debugging facilities should include special interpretive modeling programs that allow simulating the process of CCF functioning of the designed DTS on the general-purpose CCF and checking, even at the stage of DTS development, the degree to which the timing characteristics of CCF meet the specified requirements.
7. For autonomous and complex debugging and docking of software, programs of the TP complex must be used, which ensures a full performance check at the stage of commissioning of the computing facilities of DTS or when upgrading DTS and expanding its capacity and functionality.

The fundamentally important provisions formulated above are related to the construction of the operating system and the program debugging system. The correct choice of computer time distribution algorithms and the study of the CF operation using the MP complex, conducted in the early stages of DTS design, allow us to ensure compliance of the designed system and its computing facility with the specified characteristics and, first of all, with the main requirement for the operation of the computing facility of DTS - execution of programs in compliance with the specified time restraints on the delay of routines and subroutines.

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