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METHODS, MEANS OF CONTROLLING AND DIAGNOSTICS OF NETWORK STRUCTURES OF DATA TRANSFER

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Ever-increasing problem of control accuracy on aircraft generated a row of specific tasks, which decisions significantly connected to network technologies that demanded transition to digital implementation of all component networks of information processing. An example of such networks is Flight Navigation system and Flight Control system, where information sources of control components of a digital network are Вычислительная Система Управления Полётом (Electronic Flight Control Computer), Вычислительная система самолётовождения (Flight Management and Guidance Computer), Вычислительная Система Управления Тягой (Thrust Management Computer) and Вычислительная Система Устойчивости и Управляемости (Stability and Controllability Computer). The server of these components is Бортовая Цифровая Вычислительная Машина (Onboard Electronic Computer).

Onboard Electronic Computer is the high-performance computer of general purpose with the external and random-access memory for performing different computational processes. Three Onboard Electronic Computers are used on the aircraft for reliability of operation of data transmission systems. Every BSVM solves the same problem on each channel onboard the aircraft. It receives all information, exchanges with information source, processes and gives the processed signal to the client.

In this regard official documents were accepted, which regulated data communication networks onboard, that led to the creation of the common interface on which information exchange is centralized. Nowadays, the most widespread interface for the transfer of digital data between avionics systems on commercial aircraft is the serial link of information exchange in accordance with *ГОСТ 18977-79 (ARINC-429)*.

ARINC429 defines both the hardware and data formats required for bus transmission. Hardware consists of a single transmitter – or source – connected to from 1-20 receivers – or sinks – on one twisted wire pair. Data can be transmitted in one direction only – simplex communication – with bi-directional transmission requiring two channels or buses. The devices, line replaceable units or LRUs, are most commonly configured in a star or bus-drop topology. Each LRU may contain multiple transmitters and receivers communicating on different buses. This simple architecture, almost point-to-point wiring, provides a highly reliable transfer of data.

A transmitter may ‘talk only’ to a number of receivers on the bus, up to 20 on one wire pair, with each receiver continually monitoring for its applicable data, but does not acknowledge receipt of the data. A transmitter may require acknowledgement from a receiver when large amounts of data have been transferred. This handshaking is performed using a particular word style, as opposed to a hard-wired handshake. When this two-way communication format is required, two twisted pairs constituting two channels are necessary to carry information back and forth, one for each direction.

Transmission from the source LRU is comprised of 32-bit words containing a 24-bit data portion containing the actual information, and an 8-bit label describing the data itself. LRUs have no address assigned through ARINC429, but rather have Equipment ID numbers, which allow grouping equipment into systems, which facilitates system management and file transfers.

Sequential words are separated by at least 4-bit times of null or zero voltage. By utilizing this null gap between words, a separate clock signal is unnecessary. Transmission rates may be at either a low speed – 12.5 kHz – or a high speed – 100 kHz.

The existing means of maintenance of aircraft provide complex monitoring, diagnostics and prognosis of the status of all parameters of a network and its components, switching elements, connectors, actuation mechanisms and other elements of automatic equipment, but they do not estimate the transmission quality of digital data and diagnosing of a status of digital networks. The built-in monitoring of all electronic units of avionics states the condition (good or bad) of these components, but doesn't provide an assessment of transmission quality of digital data and diagnostics of a status of digital networks on the period of production and maintenance of the aircraft. An objective of this research is to enhance the methods of monitoring aids and diagnostics of network structures of digital data circuits.

The model of a digital network of the modern aircraft represents the twisted and screened pair cable of wires on which the encoded digital signal is transmitted. Screens of the twisted pair cable of wires are connected to the ground close to the connector. The transmitter transmits the differential output signal of U_{ab}, balanced relatively to the ground, on two wires "a" and "b". The receiver provides reception of information in this given range.

There is a number of control and diagnostic methods of network structures that transfer data on the aircraft, such as technique of console monitoring, technique of console monitoring using computer aids, technique of monitoring, and diagnostics of the Electrical Power system and Flight Navigation system based on the modern hardware and software, e.t.c. All listed methods carry out the task of monitoring but do not perform the estimations of transmission quality of digital data and their diagnosing.

The purpose of this research is creation of methods and means, which will allow not only to monitor and make diagnostics of a status of digital networks, but also to estimate the transmission quality of the information. For achievement of this purpose, the following problems are being solved:

− Carrying out analysis of methods, monitoring aids and diagnostics of the electrical wiring system of aircraft.

− Carrying out analysis of methods, diagnostic aids and estimation of quality of the digital communication networks.

− based on the carried-out analyses on the basis of the modern electronic instruments, creation of structural and basic diagrams of an equipment for an assessment of quality of digital lines on aircraft.

References

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