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Classification of objective control functions of fanet communication nodes

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The purpose of the report is to determine the target functions of managing FANET communication nodes of land-air networks, to determine directions, approaches and methods of their use in the conditions of conducting modern hostilities and performing other special tasks of monitoring and ensuring information exchange.

In the general case, the following management tasks exist for the FANET-class spacecraft (Fig. 1):

- are implemented at the planning stage (clarification of tasks - aerial reconnaissance, use of spacecraft as mobile sensor nodes, repeaters), study of application conditions, selection of UAV type; deployment (identification of areas/routes, provision of tethering, determination of flight tasks); operational management (support of flight tasks, support of communication tasks by a group of spacecraft or autonomously), i.e. at various stages of LAN management;

- provide various functions: changing the trajectory, speed, acceleration of a single UAV or as part of groups, mobile nodes of the land network; determination of target coordinates, UAV energy resource management, etc.); coverage of the monitoring or communication zone (definition of the "responsibility zones" of the CAP, the priority group of subscribers of the land component, the sequence of work, etc.); ensuring the quality of data transmission (routing management, topology management, load management, etc.);

- applied to various objects (the entire LAN, a separate area of the land component, the spacecraft network, the direction of information transmission, the route, the radio

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channel of the spacecraft-land component node), which requires coordination and coordination of target functions; definition of target functions that may contradict each other; statements of target functions (mathematical apparatus of clear or fuzzy logic, representation of processes as mass service tasks, methods of describing different types of routing, etc.);

- implementation in conditions of high dimensionality of the network and the dynamic nature of its topology change;

- formation of a complete interrelated group of indicators for assessing the effectiveness of LAN functioning;

- collection of control information about the state of LAN nodes and its elements.

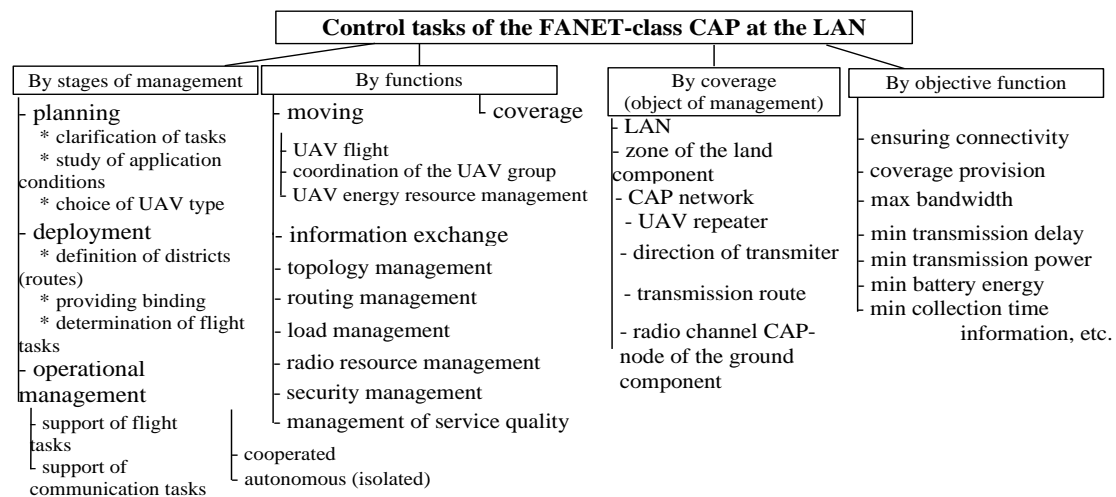


Figure 1

Classification of FANET management tasks with CAP as part of LAN

In modern LANs, management functions are partially performed centrally (by control centers), regardless of the trend of decentralization and self-organization networks (that is, part of the functions are performed by LAN nodes). Therefore, conditionally, management functions can be divided into groups: network (zone) and user goals. Thus, for the first group, it is necessary to achieve optimization of efficiency indicators, for the second, the appropriate quality of information exchange between LAN nodes.

Network (zonal) management goals include the following optimal parameters: productivity of the entire LAN or its zone; transmission power of network nodes or its zone; degree

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of coverage of the monitoring and communication zone by communication aerial platforms (mobile or stationary nodes of the land component); structural reliability (connectivity) of LAN and its zones; the number of resources (stationary and mobile nodes, aerial platforms, etc.) that must be used to achieve a certain goal; time of operation of the air network on the spacecraft; the volume of service traffic, which is generated to collect information about the state of the nodes of the land component; time of planning, deployment, restoration of the network on the spacecraft; security settings. The main limitations are the resources and parameters of the spacecraft: power batteries, bandwidth of radio channels, range of radio communication, memory volumes, speed of information processing by processors, class of used antenna devices (directed/non-directed), etc.

The second group of management goals includes:

1. optimization of the bandwidth of the LAN node;
2. message transmission delay time depending on the type

of information – $\xi = \overline{1,3}$ where 1 – video, 2 – voice, 3 – data;

3. transmission power;
4. specific energy consumption per bit of information;
5. management of the area of the monitoring/communication

area;

6. network topology adaptation time when reducing the number of CAPs, etc.

Thus, the classification of the target functions of managing tactical radio networks with telecommunication aerial platforms has been carried out. A new approach to the formation of management objective functions in these radio networks is proposed: each node determines the current objective function in time depending on the type of traffic, the situation on the network and the available network resources. The task of making a decision regarding the choice of the target function of radio network management is reduced to a hierarchical target evaluation of alternatives.

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