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APPROACHES TO SOLVING THE PROBLEM OF SWITCHING OVER OF THE INTERSATELLITE LINKS OF A SPACECRAFT IN A PACKET SWITCHING SATELLITE NETWORK

Abstract

A perspective approach is satellite packet switching networks with inter-satellite communication lines. This includes networks with constellations of different heights. A spacecraft of such network has permanent attitude and is permanently incorporated in the network structure, creating controllably directed links with satellites in the same constellation (ahead and behind in the same orbital plane and on the left and right in the side planes) and in higher and lower constellations.

It is preferable that the network topology be stable. Links between satellites in the same orbital plane and in different planes of the same height can be kept unchanged. However, near the intersection points of the trajectories of a linked pair (that we call switching nodes) there is "a window of lateral link breaking". If before a switching node a satellite was connected to another one on the left, and the left side device was used for connection, it will be on the right side after the node, and the device on the right side should be used. This communication break effect is enhanced by the fact that near the switching node there is an area, where usage of the side communication device is impossible. This "slows down" the load flow.

To solve this problem, it was proposed, in the routing by the lowest-cost path, to increase the value of the corresponding elementary path segment, when the spacecraft approaches the point of the orbit, at which the lateral break occur. This causes the load to "bypass" the switching zone. Additional "smoothing" of the effect of switching nodes can be achieved by placing connecting pairs of spacecraft in orbits in such a way that their passage of neighboring switching nodes would occur at different time. One can use different orbital inclinations of the planes in the same constellation of a network (it will spread passage of the switching nodes in space and time, however, will lead to different precessions of orbital planes). Another option is to use orbits of slightly different altitudes in the same network segment (in this case, connections are analogues of inter-segment ones, but the orbital periods will differ).

Dynamic changes in the costs of communication lines can also be used when approaching the moment of switching inter-segment communications.

The described variants of optimization of the load flows in the network and their combinations were studied with the use of specially developed simplified simulation models of satellite networks.