

Shapley Value-Based Satellite Communication Bandwidth Allocation Strategy

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Satellite technology is essential in the field of communications and is popularly called SATCOM, short for Satellite Communication. Bandwidth and connectivity needs are the two main expensive resources in SATCOM that are constantly changing and therefore need to be efficiently managed. An expensive resource that we manage every day is money. Needs and priorities where this money can be spent are constantly changing in most of our lives. Budgeting and money management are very essential to achieve financial peace and freedom. Likewise, in SATCOM we use resource managers (like financial advisors) to adaptively adjust the bandwidth based on needs and priorities. The available research is very low on a combination of demand-driven resource allocation and satellite communication based on control theory concepts. Our goal is to support SATCOM network operation centers by proposing a very systematic framework that integrates the available controller design architectures (Linear Quadratic Regulator LQR) with a fair and adaptive resource allocation algorithm (Shapley Value-based Algorithm).

This is achieved by following the rules of co-operative game theory where the competitors work in the direction of winning by forming coalitions or groups. Figure 1 shows a satellite network with Remote Terminals (RT), who are the players. When the sum of requested data rates of some of the RTs passes the threshold of the majority level, the formation of a winning coalition is enabled and this will help to evaluate the resource to be allocated to each player. The Shapley Value-based resource allocation establishes socially fair and high standard bandwidth allocation for each remote terminal and the average fairness of the complete system is high. The Satellite System Controller (SSC) is like the Money manager who decides what proportion of the available budget gets assigned based on need and priority while making sure that the quality of communication is not compromised, in any way. Mathematical modeling and simulation of the entire SATCOM network along with Shapley Value-based resource allocation are carried out using MATLAB.

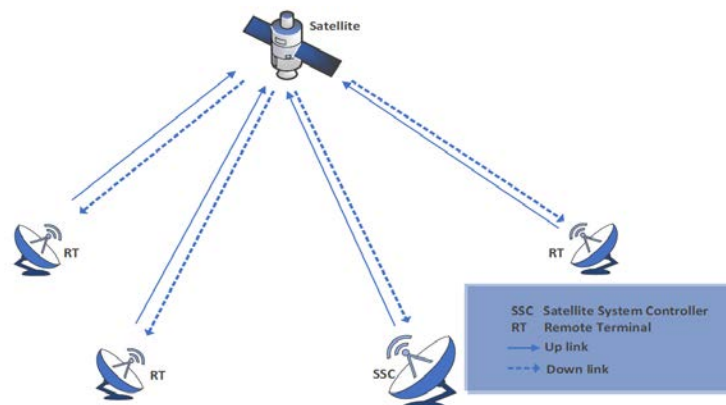


Figure 1. Satellite Communication Design