Controllable Resource Queuing System and MDP for Analyzing Resource Reallocation in 5G NR Network Slicing

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The increasing demand for various services among users, which in turn requires a certain amount of network traffic, has led to the emergence of a resource management problem. To address this issue, 5G NR networks have developed a network slicing technology that allows operators to create virtual segments tailored to specific usage scenarios. The allocation of resources among these segments can be adjusted over time based on the number of users and usage patterns.

In the paper, we analyze network slicing using a framework based on a controllable queueing system and Markov decision processes (MDP). An MDP consists of four components: a state space, a set of actions, a matrix of transition rates, and a reward function. We propose a model for network slicing that considers the isolation of two segments. The flow of data requests is assumed to follow a Poisson process, and the amount of transmitted data is exponentially distributed during service provision. Additionally, the flow of control signals is also Poisson.

The reallocation algorithm's reward function takes into account several factors. First, it tries to match the original allocation of resources. Second, it guarantees that reallocations are available after receiving a controller signal. Finally, it considers the availability of free resources at one operator when another operator may be blocked.

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