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Modelling Spectrum Assignment in a Two-Service Flexi-Grid Optical Link with Imprecise Continuous-Time Markov Chains

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Poster Abstract

Flexi-grid optical networks (Gerstel et al., 2012) are a novel paradigm for managing the capacity of optical fibers more efficiently. The idea is to divide the spectrum in small frequency slices, and to consider an allocation policy that adaptively assigns one or multiple contiguous slices to incoming bandwidth requests, depending on their size. However, as new requests arrive and old requests are served and return resources to the free pool, the spectrum might become fragmented, leading to inefficiency and unfairness. It is therefore necessary to quantify the performance of a given spectrum allocation policy, for example by determining the probability that a bandwidth request is blocked, in the sense that it cannot be allocated because there are not enough contiguous free slices.

To determine blocking probabilities for an optical link with traffic requests of two different sizes and a random allocation policy, Kim et al. (2015) use a Markov chain. Unfortunately, the number of states of this Markov chain grows exponentially with the number of available frequency slices, making it infeasible to determine blocking probabilities for large systems. Therefore, Kim et al. (2015) also consider a second Markov chain, with a highly reduced state space and approximate transition rates, to obtain approximations of these blocking probabilities. In this contribution, we first show how to construct such full and reduced-state Markov chains for two other allocation policies, and compare these with the random policy. Next, we introduce a so-called imprecise Markov chain, which has the same reduced state space but imprecise (interval-valued) transition rates, and explain how it can be used to determine guaranteed upper and lower bounds for — instead of approximations of — blocking probabilities, for different families of allocation policies.

References

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