Comparing the Link Scheduling Policies in 5G Integrated Access and Backhaul Systems *

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Link scheduling in communication networks is a dynamic control mechanism that aims to schedule transmission over conflicting links in the network. Modeling a communication network as a constrained multi-class queueing network with discrete time allows to develop link scheduling policies and analyze system performance such as delay and stability. Due to the fact that conflicting links mainly occur in wireless communication, a number of link scheduling policies have been developed over the past thirty years.

The recent emergence of Integrated Access and Backhaul (IAB) technology, which utilizes multi-hop wireless transmission, has encountered challenges due to half-duplex limitations. These challenges could be overcome by implementing link scheduling. To address this, we investigate appropriate link scheduling policies developed for wireless multi-hop networks and compare their performance in terms of stability region, implementation complexity, and packet delay. The stability region of a policy is defined as the set of arrival rates that keep the system stable when controlled by that policy. We emphasize that using the Foster-Lyapunov criterion or fluid limits approach, it can be proven that some policies have the largest possible stability region and are throughput optimal. For policies that are not provably throughput optimal, we evaluate stability region through simulation. The complexity of policy implementation includes both the number of operations required for obtaining control actions and the signaling overhead caused by transmitting data to and from a central controller, if it is used. We note that the computational complexity of a policy can vary from non-polynomial to constant time, and therefore, the preferred policy largely depends on the size of the network and the capabilities of the equipment. The delay performance of the policy is measured by the end-to-end delay of packets travelling through the network. Due to poor analytical delay analysis in the literature, we construct a model of a basic IAB network and investigate its average and 99th percentile of delays using simulation with realistic parameters.

By evaluating the trade-offs between these three performance indicators, we can outline the advantages and disadvantages of all the policies under consideration. A comprehensive comparison of these policies allows us to recommend the most effective one for an IAB network, as well as providing insight into current practices and future developments.

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