# Policy negotiation in 6G Dynamic Frequency Sharing System

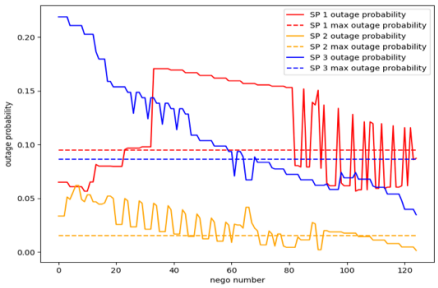
Minji Phi
*Yonsei University*
*School of Electrical and Electronic Engineering*
Seoul, Korea
phiminji@yonsei.ac.kr

Kwang Soon Kim
*Yonsei University*
*School of Electrical and Electronic Engineering*
Seoul, Korea
ks.kim@yonsei.ac.kr

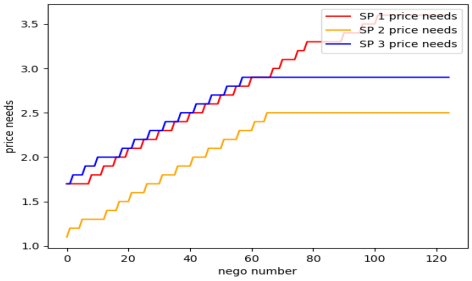
**Abstract**— This paper describes the negotiation process of a dynamic frequency sharing system that ensures deterministic QoS (Quality of Service) for 6G communication services, which require significantly more resources than conventional systems. The system enables multiple communication operators to efficiently share limited frequency resources through an SAS (Spectrum Access System). It introduces an efficient policy negotiation outcome where communication operators secure their desired outage probability, while the SAS minimizes total bandwidth, resulting in optimal resource allocation. Through this approach, communication operators achieve optimized results in terms of resource quantities and costs to guarantee deterministic QoS. Meanwhile, the SAS can provide sufficient frequency resources while using them efficiently, showcasing high frequency efficiency.

*Keywords—SAS, dynamic spectrum sharing system, outage probability.*

The proposed dynamic frequency sharing system consists of two phases: the licensing phase and the action phase. During the licensing phase, negotiations take place between service providers and the SAS to share frequency resources. Subsequently, in the action phase, real-time frequency resource allocation occurs, where base stations are assigned the necessary frequency resources. Service providers assess the total required frequency resource amount for their base stations over the long term. Based on this, they determine the price needs to propose during negotiations. They also establish a maximum outage probability to ensure service performance and decide on the acceptance of negotiations. Service providers present their required resource amounts, price needs, and max outage probability to the SAS. The SAS prioritizes allocations by considering lower contract prices relative to the necessary frequency resource amounts. It communicates the average outage probability for base stations to service providers. Service providers accept negotiations if they are allocated an outage probability lower than the maximum allowed. If they receive a higher outage probability, they continue negotiations by increasing their price needs.The SAS engages in negotiations until the desired outage probability of service providers is met. Through this process, the system minimizes the utilized frequency resources while providing service providers with a sufficient amount of resources as per their requirements.




<Figure 1. The negotiation outage probability>




<Figure 2. Service providers' price needs>

Figure 1 illustrates the negotiation outage probability provided by the SAS in response to the required frequency resource amounts and price needs presented by the service provider. Through a total of 120 negotiations, it becomes evident that all service providers achieved an outage probability lower than their desired max outage probability. Figure 2 represents the price needs proposed by the service providers during the 120 negotiation rounds. To conclude negotiations successfully, all service providers must obtain an outage probability lower than their specified max outage probability. Throughout this negotiation process, service providers propose prices corresponding to their required frequency resource amounts, while the SAS aims to minimize total bandwidth.

In summary, the negotiation process ensures that service providers obtain outage probabilities below their specified limits, and it allows service providers to offer prices aligned with their needed frequency resource amounts, while enabling the SAS to optimize resource allocation.

[1] Samsung, 6G The Next Hyper-Connected Experience for All, Available at http://research.samsung.com/next-generation-communication#6gPop, December 2020.

**Acknowledge**. This work was supported by Institute of Information & communications Technology Planning & Evaluation (IITP) grant funded by the Korea government(MSIT) (No.2021-0-00347, 6G Post-MAC (POsitioning- & Spectrum-aware intelligenT MAC for Computing & Communication Convergence)) and the National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIT) in 2023 (No.2022R1A5A1027646)