Article Review

No Reservations Required: Achieving Fairness between Wi-Fi and NR-U with Self-Deferral Only

Summary

The paper suggests selecting an appropriate size of contention window for the backoff counter to address fairness in wireless channel access between random-based and scheduled-based nodes. The authors use Wi-Fi and NR-U as examples of random and scheduled access technologies and focus on self-deferral schedule access. They develop an analytical model of the backoff process, where NR-U's gap period is served as another type of backoff. The authors conduct Monte Carlo simulations to verify the analytical model and conclude that an optimal contention window size achieves fairness in airtime between the two technologies. This size can be obtained using the analytical model or predicted through a regression model trained with simulation data.

Strength and Weakness

Strength:

1. The innovative approach of incorporating the gap period into the analytical model as a type of backoff is noteworthy. Additionally, the conclusion that proper contention window sizes can result in fairness is both simple and valuable.
2. The proof-of-concept that a regression model can accurately predict the appropriate window size is significant for future development of an online adjusting mechanism.

Weakness:

1. The analytical model is complex and requires further elucidation of the equation's meaning. Additionally, some notations require clarification, such as the symbol σ in equation (11).
2. The description of metrics is challenging to read and comprehend, such as "per-technology average per-node normalized airtime." It would be easier to understand if expressed in formula format.
3. The contention window adjustment approach can only be applied offline with a fixed number of devices. However, in practice, the number of devices varies over time, making it uncertain whether the optimal size of contention windows can be calculated and updated dynamically. Even if the regression model can predict the size on the fly, it is still unclear if overall fairness can be achieved by setting the optimal size for each moment.

Questions

1. What is the reason behind designing the joint airtime-fairness metric (F) as the product of the aggregate normalized airtime of all nodes and fairness? Are there any alternative metrics that can effectively measure both channel utilization and fairness?
2. What is the rationale behind the specific form of the optimization rule presented in equation (12)? Furthermore, what is the significance of setting "I" to 64?

Conclusion

This is the first time I have learned about multiple access for wireless technologies. Two novel concepts I have discovered are that the backoff process can be represented as a random process, and that the gap period can be regarded as a uniformly distributed random variable.