A Fair Channel Access Using Reinforcement Learning: Poster

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ABSTRACT

A novel reinforcement learning based is applied to slotted ALOHA in order to approach fair transmissions. Active Nodes learn to transmit following the policies with the highest weights to minimize packet collisions. This results converge to fair transmission schedules within a short window of time. our ALOHA version is shown to be better than conventional slotted ALOHA with respect to fairness and throughput in most cases.

1 INTRODUCTION

Simplicity is the key feature of the ALOHA protocol where a node with a packet to send simply transmits. This simplicity makes ALOHA candidate for underwater acoustic networks, space networks, and wireless networks. However, the tradeoff of simplicity of ALOHA comes at the price of poor performance (maximum throughput of only 18%). The first considerable improvement of ALOHA is slotted ALOHA with maximum throughput of only 36%). There are different variations of slotted Aloha introduced over the course of the years [3, 4].

In the recent years, research community has started applying Q-learning to slotted Aloha for wireless sensor [1] and wireless networks [5] [6]. This paper introduces a new approach to the use of Reinforcement Learning (RL) for fair channel in slotted ALOHA. The key feature of the proposed approach is to organize the known policies into a policy queue. Without any prior knowledge, nodes learn which policies results to higher throughput by learning policy weights for each time-slot.

2 METHODOLOGY

This section briefly describes the methodology. Each active node selects a subset policies to follow in the time slot t, based on the assigned weights of the policies. If the node has a packet to send and it has the highest policy weight for the corresponding slot, it will transmit its packet otherwise, it waits.

Updating policy weight. depends on the channel state either the transmission was successful or resulted in collision. The node updates the weights of all policies based on such information.

3 PRELIMINARY EVALUATION AND RESULTS

As shown in Table 1, our proposed approach learns how to maximize the network utilization by learning how to avoid collisions and utilize empty slots. As we can see, the network utilization on average (the simulation is repeated for 20 times and the values are averaged) is improved by 80% for 50 nodes (almost doubled compared to Slotted ALOHA).

Table 1: Average Bandwidth utilization

Number of Nodes	Slotted ALOHA	Proposed ALOHA
5	36%	52%
20	36%	67%
50	36%	80%

To measure the fairness we use the famous Jain index [2] for evaluation. As shown in Table 2, our proposed approach improves the fairness from 0.5 to about 0.8.

Table 2: Fairness (Jain Index)

Number of Nodes	Slotted ALOHA	Proposed ALOHA
5	0.5	0.75
20	0.6	0.80
50	0.55	0.82

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