Reconfigurable and Traffic Aware MAC Design for Virtualized Wireless Network via Reinforcement Learning

Priyanka Sanjay Giri

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In this paper, they present a reconfigurable MAC scheme where they showed advantages of reinforcement learning for handling traffic issues in the network by doing partitions. Device traffic statistics is used for partitioning algorithms. In the absence of such knowledge, they develop a learning algorithm using Thompson sampling to get packet arrival probabilities of devices.

1 Introduction

To improve the channel usage, the traffic statistics information could be provided to efficiently select and configure a MAC protocol adapting to the outer environment. There might not be any prior knowledge of traffic statistics. Hence, learning algorithms is difficult to use the traffic statistics such that the expected total performance is improved.

2 Motivation

To solve issues from traditional to modern machine to machine they have focused on two things: resource allocation and isolation. In this paper, they consider a virtualized wireless network and the MAC protocol aims to preserve isolation by maintaining slice reservations.

3 Scope of the Paper and Contributions

The main contributions of this paper are described in four parts:

1. Aiming to improve the network efficiency, they design a reconfigurable MAC with optimal contention-free and contention-based partition based on the device packet arrival statistics.
2. They produced an optimal output for a complex network with considerably less computational complexity as compared to the proposed CGP-based scheduling.
3. Without prior knowledge of the situation where unknown devices come, they develop a Thompson sampling-based algorithm to learn packet arrival probabilities.
4. Thompson sampling algorithm for thresholding multi-armed bandits is used for analysis.

4 Structure of the Paper

This paper is divided into following parts:

1. **System Model**
   a) They have explained Network Model and Frame Structure for reconfigurable MAC for a virtualized wireless network
   b) The operations in DA and RA regime according to times lot and issues

c) Analytical Model for p-persistent CSMA protocol in unsaturated mode and formulation for total access airtime in RA regime.

2. **Formulation of the Problem** Formulation of RAand DA in time frame 't' and also formulation for getting optimal solution.

3. **Scheduling with Traffic Knowledge** For scheduling problems they set it as CGP and for complex networks they used different algorithms which is based approximation and two-step decomposition: Algorithm 1 : Reconfigurable MAC scheduling via CGP Algorithm 2: Scalable Reconfigurable MAC for denser network

4. **Reconfigurable MAC using Thompson Sampling** They proposed algorithm for situation of transmission without prior knowledge Algorithm of Thompson Sampling for Reconfigurable MAC i.e Algorithm 3 Development of a thresholding algorithm for the scheduling, model it as a thresholding multi-armed bandit, and apply Thompson Sampling for learning i.e Algorithm 4

5. **Regret analysis** The regret bound in the DA regime of thresholding reconfigurable MAC when the network consists of one slice or number of optimal arms and Proof of TS-TMAB algorithm for binary rewards achieves an optimal regret bound is given.

5 Finding Results

1. **Simulation in MATLAB and GP problems are solved using CVX**

2. **Results are compared using following schemes:**

   a) p-persistent CSMA: All devices compete with each other by performing p-persistent CSMA.

   b) Random Hybrid DA-RA: 'Tmax' slots are assigned to the devices randomly, while the rest of devices compete in the CSMA regime with p = 0.05.

   c) Distributed queuing (DQ): The frame structure is divided into three parts: i) C sub-slots for collision resolution ii) one slot for data transmission iii) one sub-slot for transmission of feedback information from AP to devices

3. **Explanation for reconfigurable MAC for known and unknown statistics**

6 Conclusion

This paper presents a reconfigurable MAC, where DA and RA are used for devices with different packet transmission probabilitiesand using simulation results, the effectiveness of the algorithms for both known and unknown packet arrival statistics are proven.

7 References

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