International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 05 | May - 2022 Impact Factor: 7.185 ISSN: 2582-3930

Design of CSI Based ALOHA Protocol using Cooperative Sensing for IoT Applications

Dhunav Dhuray[1], Prof.Priyanshu Dhameniya[2]
M.Tech Scholar[1], Assistant Professor and Head of the Department[2]
Department of Computer Science & Engineering, AITR, Indore (India)[1,2]

Abstract— Aloha systems have drawn much attention for satellite-based mobile and personal communications because of the capability of simultaneous access and low peak power in the transmitter. Many investigations have been performed so far in order to improve the system performance in terms of throughput. This paper proposes a channel sensing technique for Slotted ALOHA so that the channel is sensed and colliding or collision conditions are investigated. The performance of the system has been evaluated based on the arrival rate and throughput of the proposed system. It has been shown that the throughput with colliding packets is lesser compared to that of non-colliding packets.

Keywords— ALOHA, Slotted ALOHA, Throughput, Arrival Rate, Cooperative Sensing.

I. INTRODUCTION

The use of slotted ALOHA has remained as one of the most simple to implement yet effective techniques for packet data communication. A technique called channel load sensing protocol CLSP, a hub station senses the channel load, which is the number of ongoing transmissions. If the channel load is less than a certain threshold, then packet accesses are allowed. Otherwise, packet accesses are rejected until the ongoing transmissions fall below the threshold. Without the access timing delay, which means the time difference between channel load sensing and timing of packet access, the throughput of a spread unslotted Aloha system with CLSP is satisfactory. When the access timing delay is no longer negligible, a wrong channel load information may be given as the channel load changes moment by moment. The packet access control based on this wrong information results in degradation of the system performance. Therefore, a spread unslotted Aloha system with CLSP is not practical with the access timing delay. There has been no mention of the effect of the access timing delay in any of the papers. The object of this paper is to propose a novel spread slotted Aloha system with CLSP and show a significant improvement of the throughput performance even in the presence of access timing delay. The channel is to be continuously sensed or monitored for the collision or colliding conditions prior to packet data transmission.

II. CHANNEL SENSING FOR ALOHA

There are several techniques for the sensing purpose of the cognitive channel which are being discussed here. Only the frontlines are being discussed here which show the maximum promise in the accurate spectrum sensing. This technique is used for the energy detection mechanism and senses the energy of the channel at any given point of time. The hypothesis that governs this technique is the following:

$$h(t) = k(t); \textit{ideal no packet collision} \quad (1)$$

$$h(t) = k(t) + j(t); \textit{ collision present} \quad (2)$$

The chances for a false alarm occur when there is collision present but the CSI suggest that collision is absent or vice versa. The chances of false alarm increase when there is actual addition of noise in the desired spectrum. It is noteworthy that such noise effects may lead to a false interpretation that there is collision noise being injected in the signal spectrum and it is the act of eavesdropping by the adversary. This however is not true and leads to misleading and inaccurate results. The effect can be summarized as follows:

Let the threshold for collision to be present by 'T'

$$\text{If } h(t) > T; \textit{Collision presnet} \quad (3)$$

However,

If $h(t) + n(t) > T$ holds true; **(4)**

Then there is a clear chance of false alarm often computed as the probability of false alarm of security threat.

III. MATHEMATICAL MODELLING OF CHANNEL SENSING AND THROUGHPUT

The channel is to be sensed based on the collision activity and can be done using energy sensing. The proposed technique can be explained using the following algorithm:

- **Step1.** Generate a random serial data set that is to be transmitted in the form of 0s and 1s.

  Let it be given by:

  x(n)=random (n); where n is the number of bits are completely random

- **Step2.** Design a typical channel response of an ALOHA system.

  Let the channel response in time domain h(t) in the frequency domain, let the channel response be H(f)

  H(f)=F.T. {h(n)}

  F.T. denotes the Fourier Transform

- **Step3.** Design frequency dependent collision or collision mechanism.

  Let the collision or collision power be:

  Pjam=f(frequency or subcarrier)

  Here,
  different frequencies are used for different users in the network, which are also called sub-carriers

- **Step4.** Design and add spectral noise

  Design a time domain noise signal n(t)

  Add it to the signal in the channel to get

  X=S+N

- **Step5.** Detect low, moderate and high collision action

  The decision is to be based on:

  Low Channel Collision Activity: if sub-carrier gain<1.5*Ideal Subcarrier Gain

  Moderate Channel Collision Activity: if sub-carrier gain>1.5*Ideal Subcarrier Gain>2*Ideal Subcarrier

  High Channel Collision Activity: if sub-carrier gain>2*Ideal Subcarrier Gain

- **Step6.** Generate signaling points for the system and obtain the scatter plot for:
- No Collision Action
- Low Collision Action
- Moderate Collision Action
- High Collision Action

  The scatter plots can be plotted for

  Re{x(n)}

  Img{x(n)}

- **Step7.** Compute Throughput for 2 cases:

  1) Throughput w.r.t. arrival rate

  2) System throughput w.r.t. SNR

  3) Also compute signal fading with and without colliding packets

IV RESULTS

The results obtained are depicted in the form of graphs below. The parameters evaluated are:

1) Arrival rate at receiving end w.r.t. throughput

2) Fading analysis w.r.t. distance considering collision

3) ALOHA throughput w.r.t. SNR

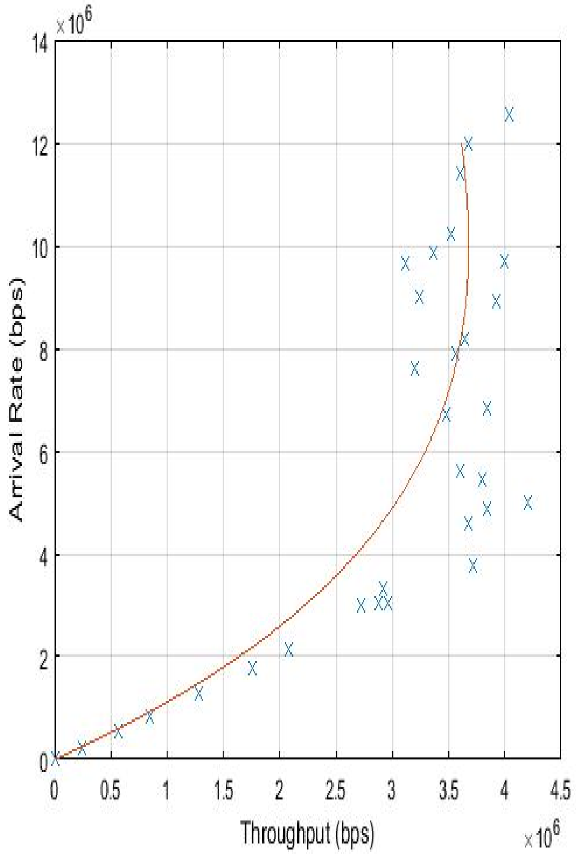

Fig.1 Throughput versus Packet arrival rate at receiving station

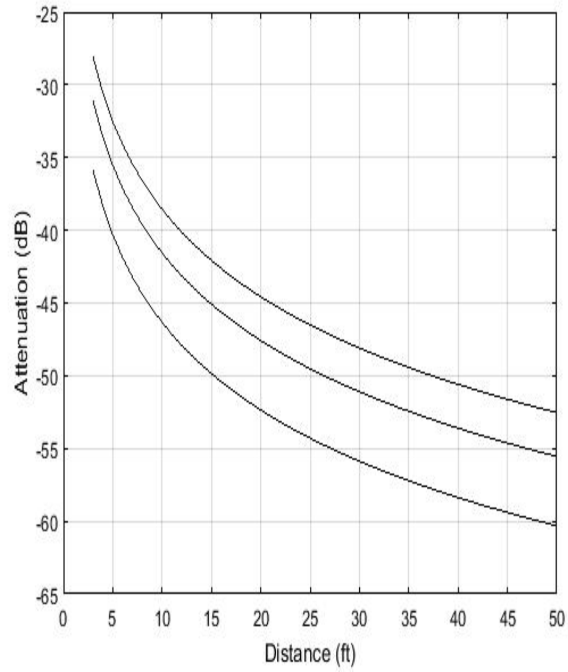

Fig.2 Fading in signal strength with respect to distance without colliding packets

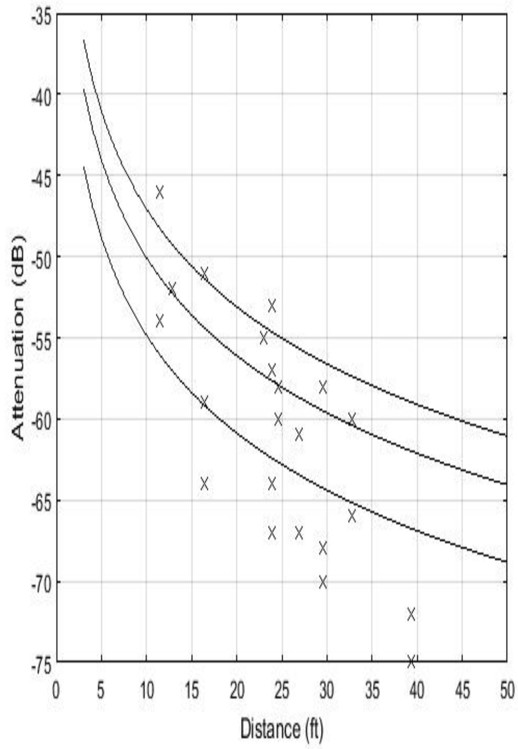

Fig.3 Fading in signal strength with respect to distance with colliding packets

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 05 | May - 2022 Impact Factor: 7.185 ISSN: 2582-3930

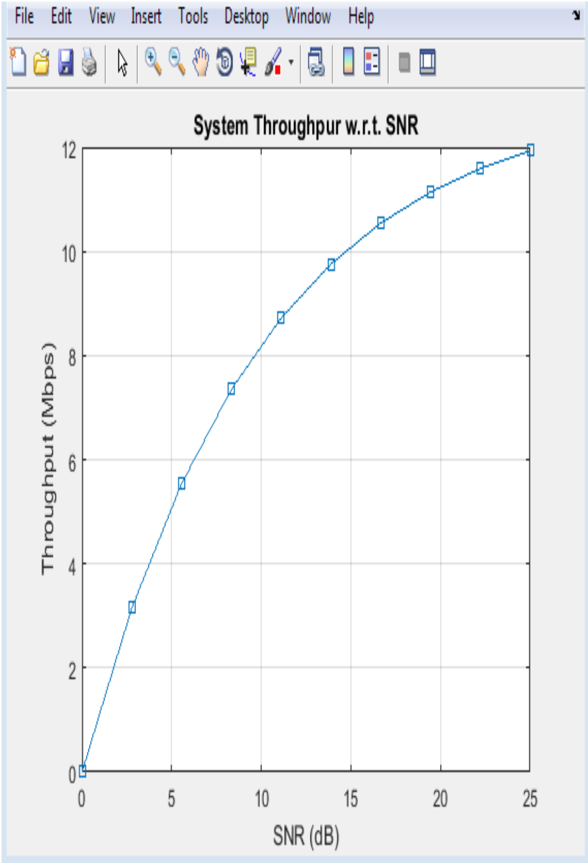

Figure.4 System Throughput w.r.t. SNR

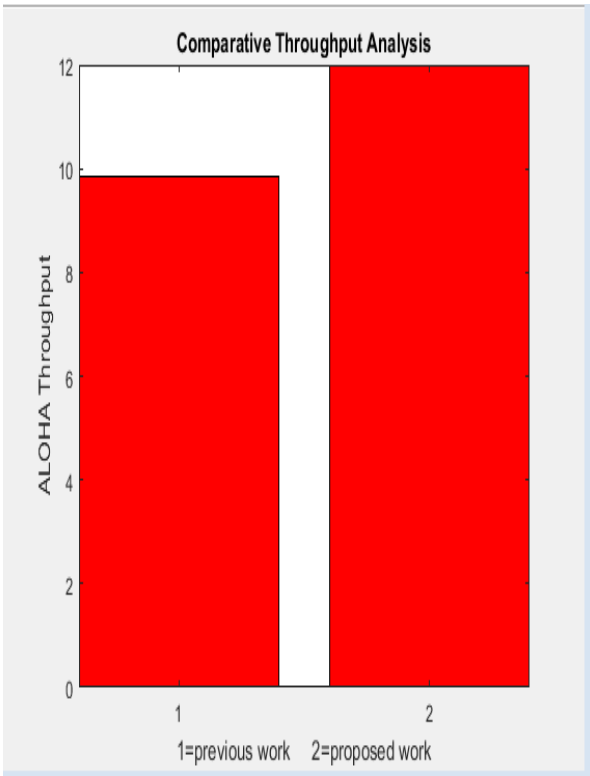

Figure.5 Comparative Throughput Analysis

It has been shown that the proposed system attains batter ALOHA throughput compared to previous work i.e. Ana Paula Teles Ribeiro da Silva, José Marcos Câmara Brito "Analysis of Adaptive Modulation Performance in Networks with Multiple Access Slotted Aloha", IEEE 2017, [1].

V CONCLUSION

It can be concluded from the previous discussions that the proposed system uses channel sensing for ALOHA throughput enhancement. The proposed system senses the channel for high, low or moderate collision (colliding packet) activity based on energy detection. The sensed channel is then used for data packet transmission. The resulting aspect is the enhanced throughput of the proposed system. It has been shown that the proposed system attains better throughput compared to previous work.

REFRENCES

[1] Ana Paula Teles Ribeiro da Silva, José Marcos Câmara Brito "Analysis of Adaptive Modulation Performance in Networks with Multiple Access Slotted Aloha", IEEE 2021

[2] Claire Goursaud and Yuqi Mo, "Random Unslotted Time-Frequency ALOHA: Theory and Application to IoT UNB Networks", 2020 23rd International Conference on Telecommunications (ICT).

[3] Enrico Plaini, Gianluigi Liva Marco Chiani "Slotted Aloha:A Graph Based Method for UnCoordinated Multiple Access", IEEE Transactions On Information Theory, Vol. 61, No. 12, December 2019

[4] F. V´azquez-Gallego et al., "Performance Evaluation of Frame Slotted-ALOHA with Successive Interfrence Cancellation in Machine-to-Machine Networks", European Wireless 2018

[5] Cˇ edomir Stefanovic´, Peter Popovski, "A Random Access that Opertates as a Rateless

Code IEEE Transactions On Communications, Vol. 61, No. 11, November 2017.

[6] Cedomir Stefanovi´c, et al., Frameless ALOHA Protocol for Wireless Networks", IEEE Communications Letters, Vol. 16, No. 12, December 2016.

[7] Gianluigi Liva, "Graph Based Analysis and Optimization of Contention Resolution Diversity Slotted ALOHA", IEEE Transactions On Communications, Vol. 59, No. 2, February 2015.

[8] Jun-Bong Eom et al., "Accurate Tag Estimation for Dynamic Framed-Slotted ALOHA in RFID Systems, IEEE Communications Letters, Vol. 14, No. 1, January 2014.

[9] Radha Krishna Ganti et al., "Spatial and Temporal Correlation of the Interference in ALOHA Ad Hoc Networks", IEEE Communications Letters, Vol. 13, No. 9, September 2013.

[10] M. Sarper Gokturk, Ozgur Ercetin, Ozgur Gurbuz, "Throughput Analysis of ALOHA with Cooperative Diversity", IEEE Communications Letters, Vol. 12, No. 6, June 2013.

[11] Mariam Kaynia and Nihar Jindal, "Performance of ALOHA and CSMA in Spatially Distributed Wireless Networks", in: IEEE 2012.

[12] N. Abramson "The Throughput of Packet Broadcasting Channels", IEEE Transactions on Communications, Vol 25 No 1, pp117–128, January 2011.

[13] R. Binder, ALOHAnet Protocols, ALOHA System Technical Report, College of Engineering, The University of Hawaii, September, 1974.

[14] R. Binder, W.S. Lai and M. Wilson, The ALOHAnet Menehune – Version II, ALOHA System Technical Report, College of Engineering, The University of Hawaii, September, 1974.

[15] R. Metcalfe, Xerox PARC memo, from Bob Metcalfe to Alto Aloha Distribution on Ether Acquisition, May 22, 1973.