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Performance Analysis of New 802.11KT MAC Protocol And IEEE 802.11 MAC Protocol for Random Topology in MANET Using NS-2

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Abstract :- Newly designed 802.11KT MAC protocol for a mobile ad-hoc network (MANET) communication system aims to provide low cost, small end to end delay and more throughputs. The main method for evaluating the performance of protocol is simulation. This paper is subjected to comparison of performance of existing IEEE802.11 Mac protocol and new 802.11KT Mac protocol for random topology in MANET. Adhoc on Demand Distance Vector (AODV) is used as routing protocol with NS-2 simulator. Simulation results observed that new 802.11KT Mac protocol is better in performance than existing IEEE 802.11 Mac protocol.

Keywords: - MANET, AODV, IEEE 802.11, NS-2.

I. INTRODUCTION

MANET represents a system of wireless mobile nodes that can freely and dynamically self-organize in to arbitrary and temporary network topologies, allowing people and devices to seamlessly communicate without any pre-existing communication architecture. Each node in the network also acts as a router, forwarding data packets for other nodes. A main challenge in the design of ad hoc networks is the development of new Mac protocol that can enhance the performance of communicating nodes in MANET. Our goal is to carry out a systematic performance study of a new 802.11 KT Mac protocol and existing IEEE802.11 Mac protocol for ad hoc networks. Moreover our performance analysis is based on varying number of nodes in the Mobile Ad Hoc Network in random topology. The rest of the paper is organized as follows: The work contributed in this area is provided in section II. The AODV, 802.11 MAC protocol & 802.11KT MAC protocol description is summarized in section III. The simulation environment and performance metrics are described in SectionIV. The simulation results and observation are described in section V and the conclusion is presented in section VI.

II. RELATED WORK

A Several researchers have done the qualitative and quantitative analysis of Ad Hoc Routing Protocols by means of different performance metrics. They have used different simulators for this purpose. Rafi U Zamam et.al [1] studied & compared the performance of DSDV, AODV and DSR routing protocols for ad hoc networks using NS-2 simulations. In this paper, author observed that the competitive reactive routing protocols, AODV and DSR, both show better performance than the other in terms of certain metrics. It is still difficult to determine which of them has overall better performance in MANET. Vahid Garousi et.al [2] studied an analysis of network traffic in ad-hoc networks based on the DSDV protocol with an emphasis on mobility and communication patterns of the nodes. In this paper, he observed that simulations measured the ability of DSDV routing protocol to react to multi-hop ad-hoc network topology changes in terms of scene size, mobile nodes movement, number of connections among nodes, and also the amount of data each mobile node transmits. Das,S.R., Perkins,C.E. et.al [4] studied & compared the performance of DSDV, AODV and DSR routing protocols for ad hoc networks using NS-2 simulations. In this paper, they observed that DSDV uses the proactive table-driven routing strategy while both AODV and DSR use the reactive on-demand routing strategy. Both AODV and DSR perform better under high mobility simulations than DSDV. High mobility results in frequent link failures and the overhead involved in updating all the nodes with the new routing information as in DSDV is much more than that involved AODV and DSR, where the routes are created as and when required.

Chao,C-M. et.al [5] studied the performance comparison based on packet delivery fraction and normalized routing load. In the future, extensive complex simulations could be carried out in gain a more in-depth performance analysis of the ad hoc routing protocols. This would include delay of data packet delivery and performance comparison on location-based ad hoc routing protocols.

III. DESCRIPTION OF PROTOCOLS

This section briefly describe the key features of 802.11 protocol, AODV protocol & modified 802.11KT MAC protocol that being studied in this paper..

A) IEEE 802.11 Mac Protocol

The basic access method in the IEEE 802.11 MAC protocol is DCF, which is based on carrier sense multiple access with collision avoidance (CSMA/CA). Before starting a transmission, each node performs a back off procedure, with the back off timer uniformly chosen from [0, CW − 1] in terms of time slots, where CW is the current contention window. When the back off timer reaches zero, the node transmits a DATA packet. If the receiver successfully receives the packet, it acknowledges the packet by sending an acknowledgment (ACK). If no ACK is received within a specified period, the packet is considered lost; so the transmitter will double the size of CW, choose a new back off timer, and start the above process again. When the transmission of a packet fails for a maximum number of times, the packet is dropped. To avoid collisions of long packets, the short request to send/clear to send (RTS/CTS) frames can be employed. Note that the IEEE 802.11 MAC also incorporates an optional access method called PCF, which is only usable in infrastructure network configurations and is not supported in most current wireless cards. In addition, it may result in poor performance as shown in [10] and [12].

B) Ad Hoc On-Demand Distance Vector (AODV)

i)Route Discovery Process

During a route discovery process, the source node broadcasts a route query packet to its neighbours. If any of the neighbours has a route to the destination, it replies to the query with a route reply packet; otherwise, the neighbours rebroadcast the route query packet. Finally, some query packets reach to the destination.

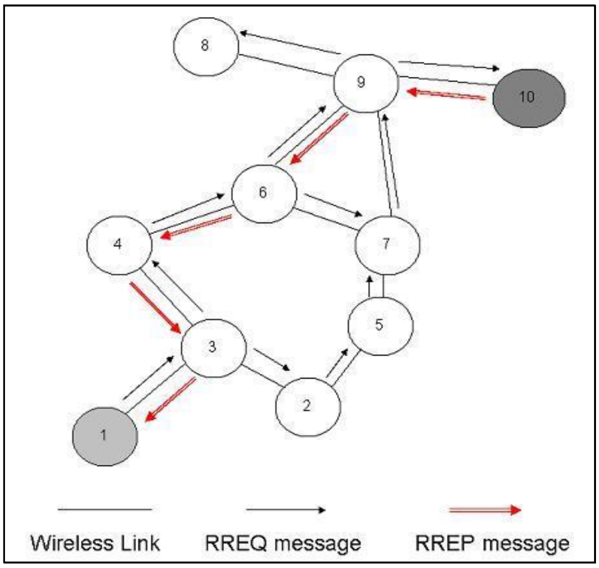

Fig 1. AODV Route Discovery Process

"Fig. 1" shows the route discovery process from source node1 to destination node 10. At that time, a reply packet is produced and transmitted tracing back the route traversed by the query packet as shown in "Fig. 1".

ii)AODV Route Message Generation

The route maintenance process in AODV is very simple. When the link in the path between node 1 and node 10 breaks the upstream node that is affected by the break, in this case node 4 generates and broadcasts a RERR message. The RERR message eventually ends up in source node 1.After receiving the RERR message, node 1 will generate a new RREQ.

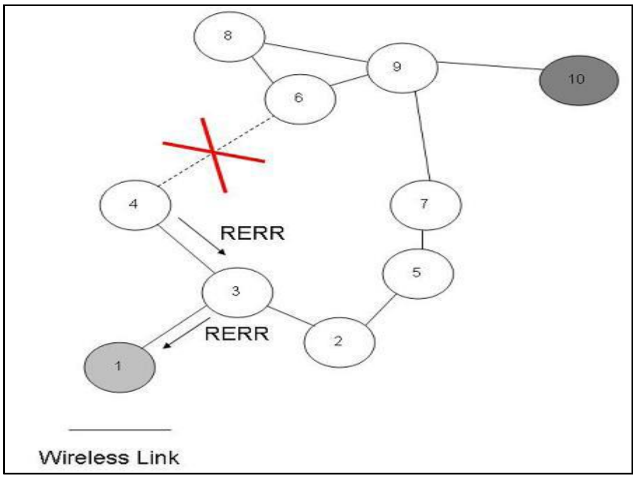

Fig 2. AODV Route Error message generation

iii)AODV Route Maintenance Process

Finally, if node 2 already has a route to node 10, it will generate a RREP message, as indicated in Figure 3.Otherwise, it will re-broadcast the RREQ from source no1 to destination node 10 as shown in "Fig. 3".

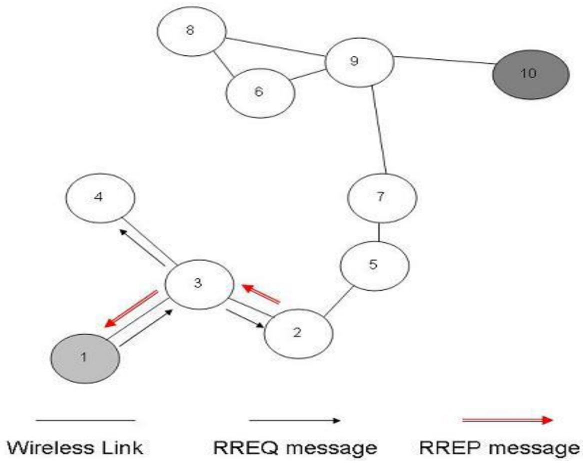

Fig 3. AODV Route Maintenance Process

C) *MAC 802.11KT PROTOCOL*

The MAC 802.11KT protocol is designed for better RTS/CTS handshake on transmitter (RTS) and receiver (CTS), respectively. This protocol is designed by considering better parameters for various inter frame space, contention window for minimum and maximum size to obtain high system throughput and small end to end delay. This protocol have better security mechanism, power management mechanism, synchronization mechanism, association and reassociation mechanism of nodes with access point. It also have better management information base required for network management purpose for external entities. Our goals is to obtain the maximum throughput, less numbers of data packets dropped, high packet delivery ratio and small end to end delay by the 802.11KT protocol as compared to that of the conventional 802.11 system. Simulation evaluation of the proposed analysis framework indicates that the 802.11KT protocol system can provide a significant increase in throughput and decrease in end to end delay for any type of topology in MANET.

IV. SIMULATION ENVIRONMENT

A) Simulation Model

This section have given the emphasis for the simulation of performance of IEEE 802.11 MAC protocol and 802.11KT MAC protocol with AODV as routing protocol varying the mobility of mobile nodes. The simulations have been performed using network simulator NS-2 [12]. The network simulator ns-2 is discrete event simulation software for network simulations which means it simulates events such as sending, receiving, forwarding and dropping packets. The latest version, ns-allinone-2.34, supports simulation for routing protocols for ad hoc wireless networks such as AODV, TORA, DSDV, and DSR. Ns-2 is written in C++ programming language and Object Tool Common Language (OTCL). Although ns-2.34 can be built on various platforms, we chose a Linux platform [FEDORA 7] for this paper, as Linux offers a number of programming development tools that can be used along with the simulation process. To run a simulation with ns-2.34, we have written the simulation script in OTCL, got the simulation results in an output trace file. The performance metrics are calculated using AWK file and the result graphically visualized. Ns-2 also offers a visual representation of the simulated network by tracing nodes movements and events and writing them in a network animator (NAM) file.

B) Simulation Parameters

We consider a network of nodes placing within a 2200m X 500m area. The performances of IEEE 802.11 MAC and 802.11KT MAC are evaluated by keeping the network payload constant and varying the mobility of mobile nodes. Table 1 shows the simulation parameters used in this valuation.

TABLE 1
PARAMETERS VALUES FOR SIMULATION

Simulation Parameters	
Simulator	ns-2.34
MAC Protocols	802.11,802.11KT
Simulation duration	150 seconds
Simulation area	2200 m x 500 m
Number of nodes	50
Transmission range	250 m
Movement model	Random topology
Routing Protocol	AODV
Maximum speed	5,10,15,20,25,30m/s
Packet rate	4 packets/sec
Traffic type	CBR (UDP)
Data payload	512 bytes/packet

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C) Performance Metrics

While analysing IEEE 802.11 MAC protocol and 802.11KT MAC with random topology, we focused on performance metrics such as Generated Packets vs. No. of nodes, Received Packets Vs. no. of nodes, Packet delivery ratio Vs. no. of nodes, Total dropped packets Vs. no. of nodes, Average end to end delay Vs. No. of nodes.

V. SIMULATION RESULTS & OBESRVATION

The simulation results are shown in the following section in the form of line graphs. The performance of IEEE 802.11 MAC and 802.11KT MAC protocol are done based on the mobility of the node. The perform matrix consists of parameters like Total packets generated, Packets dropped, Packets Delivery ratio & Average End to End delay,. "Fig. 4" shows the creation of 50 numbers of mobile nodes in random topology. "Fig.5" highlights the movement of nodes in the with the mobility of 5 m/s. It is observed that the nodes are communicating with each other. There is best synchronisation between nodes.

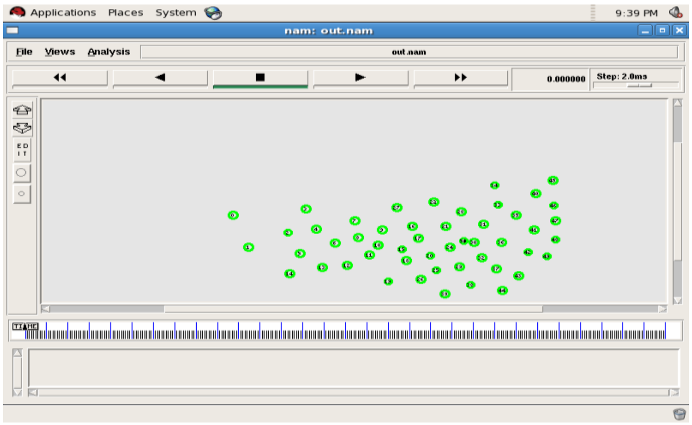

Fig 4. 50 numbers of nodes in rural village in random Topology

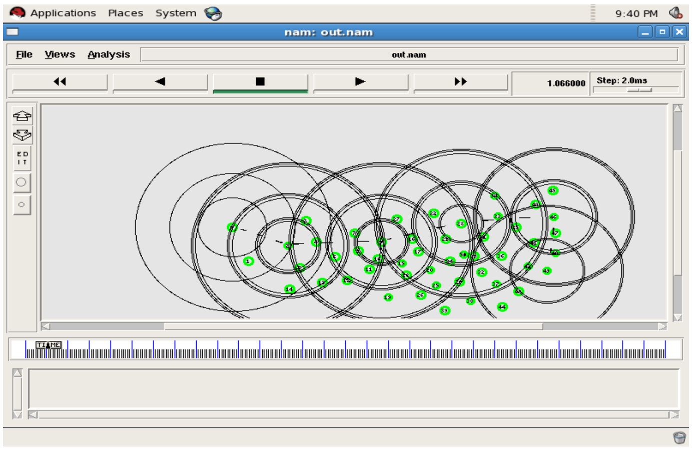

Fig 5. Mobility of nodes with 5 m/s

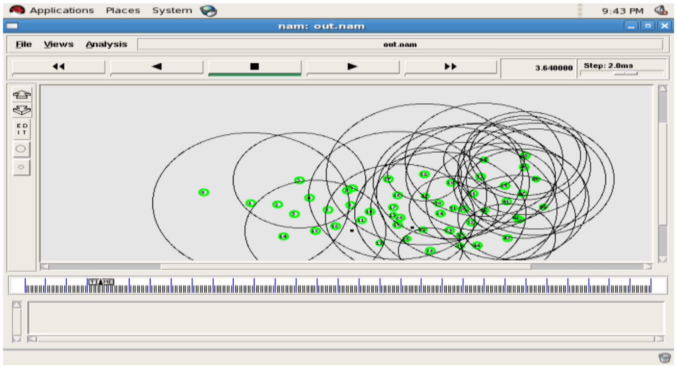

Fig 6. Mobility of nodes with 10 m/s

"Fig. 6" highlights movement of nodes with mobility of 10 m/s..Nodes are aligning at new position with better communication between them.

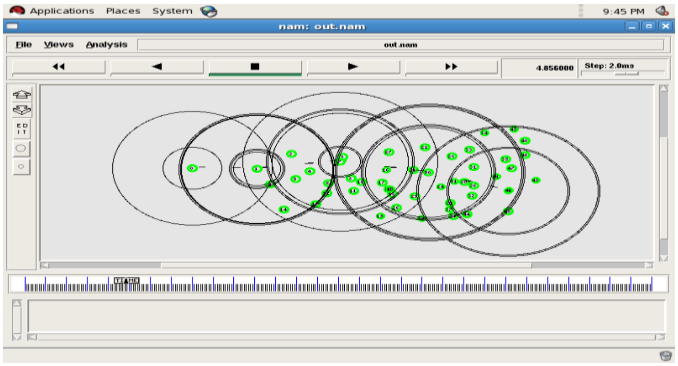

Fig 7. Mobility of nodes with 15 m/s

"Fig 7" illustrate data packet communication between nodes at mobility at 15 m/s.. It represent that at this mobility, nodes are maintaining synchronisation between them. "Fig 8" highlights movement of mobile nodes with mobility of 20 m/s. It illustrate that at high mobility, nodes are changing their position with proper coordination between them. There is a perfect synchronisation and communication between them. "Fig. 9" illustrate the position of various node reached with a mobility of 25 m/s. It highlights those nodes able to communicate with each other with minimum data packets dropped.

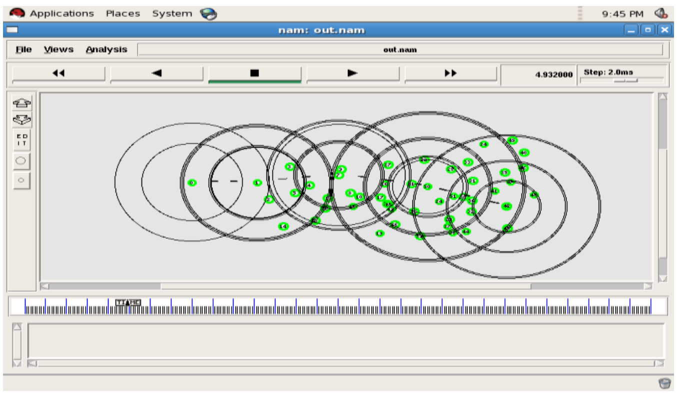

Fig 8. Mobility of nodes with 20 m/s

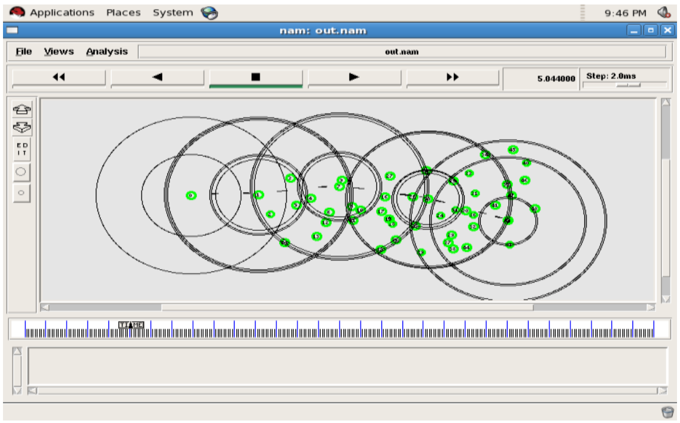

Fig. 9. Mobility of nodes with 25 m/s

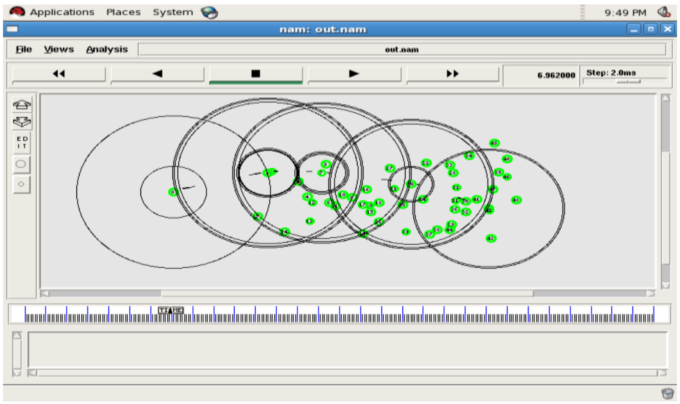

Fig. 10. Mobility of nodes with 30 m/s

"Fig.10" illustrates the final position of location of 50 nodes with a mobility movement of 30 m/s. At such high mobility (approximately 90 Km/hr.),mobile nodes are maintaining proper synchronisation with minimum numbers of data packet dropped, minimum end to end delay and high packet delivery ratio i.e. high throughput.

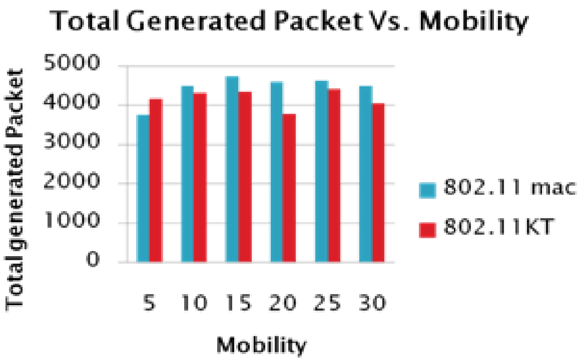

Fig 11.Total Generated Packets vs. Mobility

"Fig. 11" highlights the relative performances of IEEE 802.11 MAC protocol and 802.11KT MAC protocol for Generated Packets with varying mobility of nodes. From figure it is observed that data packet required to transfer information from source to destination is small for 802.11KT MAC protocol than IEEE 802.11 MAC protocol. This saves considerable amount of power of transmitter.

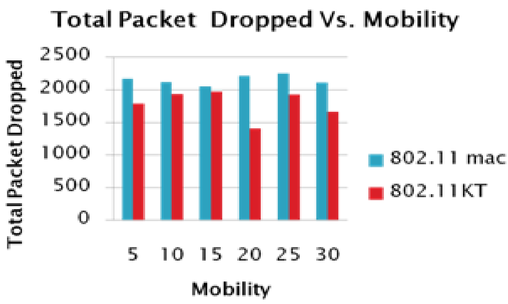

Fig 12. Total Dropped Packets Vs. Mobility

Fig.12 highlights the relative performance of IEEE 802.11 MAC protocols and 802.11KT MAC protocol for Total Dropped Packet with mobility of nodes. From figure it is observed that 802.11KT MAC protocol provides better synchronisation between nodes than IEEE 802.11 MAC. Therefore, there is less numbers of data packet loss for 802.11KT MAC protocol. This helps in providing better redundancy of information transmission between nodes of rural village area and complete information is communicated between them. Fig.13 highlights the relative performance of IEEE 802.11 MAC protocol and 802.11KT MAC protocol for Packet Delivery Ratio with mobility of nodes. From figure it is observed that 802.11KT protocol have better performance over IEEE 802.11 MAC protocols in term of Packet Delivery Ratio. 802.11KT MAC protocol have better synchronisation between nodes, dropped less number of data packets and delivered more data packets to the destination than IEEE 802.11 MAC protocols.Hence,802.11KT protocol have more throughput of system network than IEEE 802.11 MAC protocol.

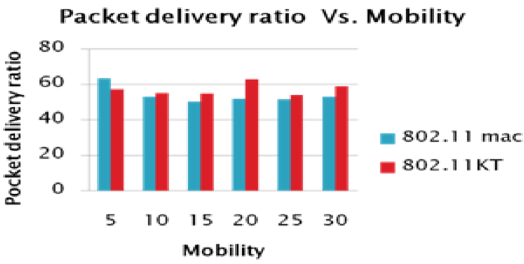

Fig.13. Packet Delivery Ratio Vs. numbers of nodes

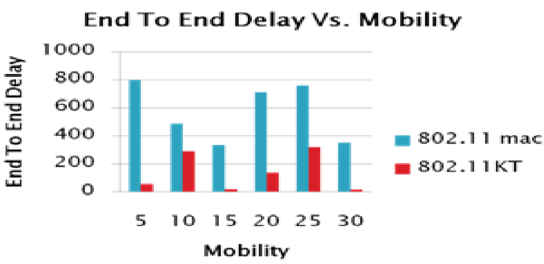

Fig.14. End to End delay Vs. Mobility

Fig.14 highlights the relative performance of 802.11KT protocol and IEEE 802.11 MAC protocol for Average End To End delay with mobility of nodes. From figure it is observed that 802.11KT MAC protocol have better performance over IEEE 802.11 MAC protocol in terms of Average End To End delay. Beacon frame of 802.11KT MAC protocol provides efficient synchronization than IEEE 802.11 MAC between nodes. This result in better data transfer with minimum time required and improves the end to end delay.

VI. CONCLUSION

The work presented in this paper gave an overview of relative performance comparison of available IEEE 802.11 MAC protocol and 802.11KT MAC protocol in random topology. Simulation performance analysis indicate that 802.11KT MAC protocol have better performance than IEEE 802.11 MAC in terms of Total Data Packets generated, Total Packet Dropped, Packet Delivery Ratio and End to End delay parameters with mobility of node. It is also indicate that 802.11KT MAC protocol have better synchronization mechanism, efficient link layer recovery mechanism, less numbers of collision and less inter link interference than IEEE 802.11 MAC

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