Analysis of Wireless Mac 802.11 and 802.11Ext in NS-2

Ankita Singh, Nar Singh

Abstract - The major issues with increasing of wireless networks are throughput, packet delivery ratio, average delay and MAC specifications. IEEE 802.11 standard is a set of media access control (MAC) and physical layer (PHY) for implementing wireless MAC. New modeling of IEEE 802.11 have been developed in NS-2, which introduces two new modules: Mac802_11Ext and Wireles Phy Ext for aiming at a significantly higher level of simulation accuracy. In this paper, we analysis the throughput, packet delivery ratio and average delay for Mac802_11 and 802_11Ext. Simulation results are evaluated by NS-2 using different no. of nodes for both Mac 802_11 and 802_11Ext based networks. After analysis of results from NS-2 the Mac 802_11Ext is better perform to compare Mac802_11 of IEEE 802.11in wireless network.

Index Terms: IEEE802.11, Mac802_11, Mac802_11Ext, NS2.

I. INTRODUCTION

Wireless Technology is an essential part of our life. In a very short duration wireless technology has impacted the world in many important ways. Its success has made our life easy and free. Wireless technology users are so much addicted to its devices such as laptops, mobile phones, etc. This world of wireless network can exchange information easily. There are different types of networks based on size and scale of operation. They are classified as Local Area Network (LAN), Metropolitan Area Network (MAN), Wide Area Network (WAN) and further Wireless Local Area Network (WLAN), etc. Local Area Network (LAN) connects two or more devices like laptop, mobile phones within a short and limited range. It uses wireless distribution method (often spread-spectrum or OFDM radio) within a short area such as school, computer laboratory, office, home, etc. Users can move around within that local coverage of the network which is connected to the Internet. WLAN are very easy to setup with low cost[1]. In the next generation of wireless system, we can see a large number of independent mobile users. There networking devices such as computers, laptop, mobile phones and 802.11/wifi [MANETs] have made this an compelling topic for research.

The key task of a MAC protocol is to coordinate the process of sharing the same medium among multiple users with the aim of achieving certain goals as throughput and QoS, e.g., average delay and packet delivery ratio, etc.[6]. The 802.11 MAC standard specifies two access mechanisms, the Distributed Co-ordination Function (DCF) and Point Co-ordination Function (PCF)[1].

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IEEE 802.11: IEEE 802.11[3] protocol is a standard for Wireless Local Area Networks (WLANs). IEEE 802.11 standard is a set of media access control (MAC) and physical layer (PHY) specifications for implementing wireless local area network (WLAN). It operates within the ISM (Industrial, Scientific and Medical) frequency bands.

To evaluate the performance of wired and wireless network, NS-2 simulator is very widely used. For formal information, please check NS-2 official website[7]. NS-2.31 version introduced the extended version and the modules through which the existing 802.11PHY and MAC layer are implemented[2].

802.11Ext.: According to the book of "ns manual" [4], a team from Mercedes-Benz Research and Development North America and from University of Karlsruhe have collaborated to develop a completely new 802.11 Mac and Phy model, called Mac802_11Ext and WirelessPhyExt, respectively. These extensions are based on Mac 802_11 and WirelessPhy, but they performed a very major modification to the original code for higher level of simulation accuracy. Mac 802_11Ext and WirelessPhyExt are implemented and tested under NS-2.31, but it can also be installed under NS-2.32[5].

The new model contains the following features:

- Structured design of MAC functionality modules: transmission, reception, transmission coordination, reception
- coordination, backoff manager, and channel state monitor
- Cumulative SINR computation
- MAC frame capture capabilities
- Multiple modulation scheme support
- Packet drop tracing at the PHY layer
- Nakagami fading model

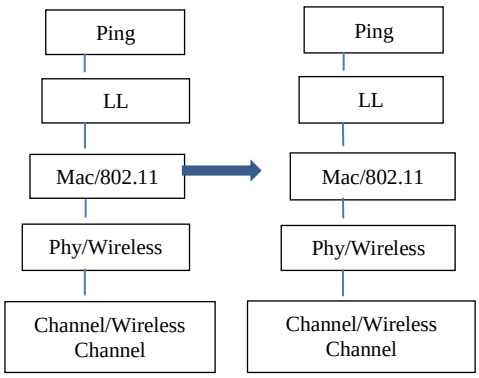

Fig 1.1. Node Construction in TCL Script

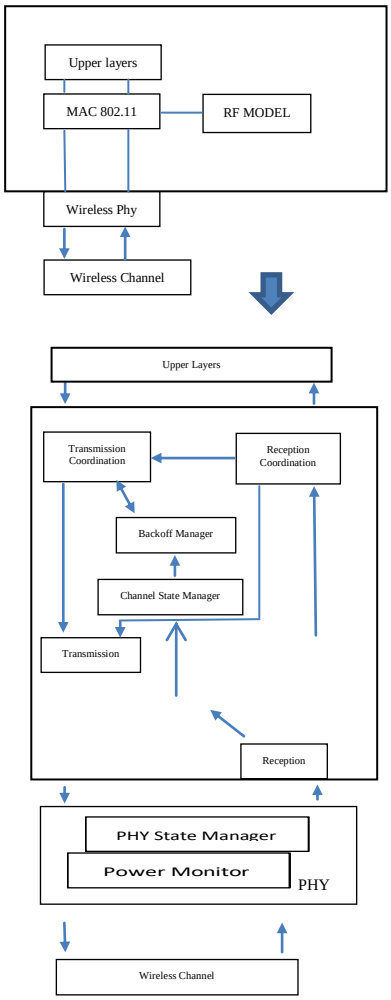

Fig 1.2. Extension of MAC and PHY Module

Fig 1.1. shows the protocol stack of an NS mobile node in a NS2 simulation. It needs to be pointed out that Mac-802_11Ext and WirelessPhyExt have to be used together[4].

Due to the differences in functionalities of PHY and MAC, the Mac 802_11Ext and Wireless PhyExt have undergone major modifications in the design and coding. WirelessPhyExt take care of monitoring and received radio power. MAC frames are processed by Mac 802.11Ext. It also maintains the logic view of channel states and manages the backoff procedures[4]. The another major change is a structured design for the internal function modules which is described in fig 1.2. The 802.11Ext is an approved amendment to the IEEE 802.11 standard that defines a set of QoS enhancement for WLAN applications through modification to the MAC layer[4].

In this manuscript, Mac802.11 and 802.11Ext based networks are analyzed by simulating the throughput, packet delievery ratio and average delay parameters using the Network simulator version 2. This paper provide details of the analyzed 802.11Ext which increases the level of simulation accuracy. This extension is best to provide accurate results in parameters. Section II, presents the configuration parameters. Section III, presents result analysis of Mac 802.11 and Mac 802.11Ext. Conclusions & Future Scope of the paper are described in Section IV and V respectively.

II. RELATED WORK

Many researchers evaluate protocols and introduced new ones efficiently. Different parameters are taken for different protocols such as the packet drop rate, normalized overhead, end-to-end packet delays, network throughput, etc.

Performance analysis for the IEEE 802.11 MAC protocol can help to discover the solutions to many problems. Many papers on this topic have been published [6,10-12]. Cali, conti and Gregori [10],[11] derived the protocol capacity of the IEEE 802.11 MAC protocol and presented an adaptive backoff mechanism to replace exponential back off mechanism. In [12], to evaluate the performance of IEEE 802.11 MAC protocol in wireless LANs, the queuing models discussed in this paper can accurately estimate various performance metrices of WLAN in the non-saturated state which is desired state for some application with a ceratin QoS requirement because there is no excessive queuing delay as that in saturated state.

III. SIMULATION PARAMETERS

The baseline NS-2 implementation chosen for our testbed is all-in-one version of ns-2.33 from sourceforge[9] and ns-allinone[8]. The NS-2 configuration parameters set for the simulations are given in Table 2.1.

Table 2.1. Configuration Parameters

NS-2 version	ns-allinone-2.34
Routing Protocol	AODV
No. of Nodes	25, 50, 75
Wireless MAC	Mac802_11 & Mac802_11Ext.
Physical layer	Phy/WirelessPhy & Phy/WirelessPhyExt
Simulation time	300 sec.
Traffic	CBR

Following the default parameter of two modules: Mac802_11Ext and WirelessPhyExt are taken in NS-2 to higher level of simulation accuracy.

```
Phy/WirelessPhyExt set CSThresh_6.31e-12
Phy/WirelessPhyExt set Pt_ 0.001
Phy/WirelessPhyExt set freq_ 5.18e+9
Phy/WirelessPhyExt set noise_floor_ 2.512e-13
Phy/WirelessPhyExt set L_ 1.0
Phy/WirelessPhyExt set PowerMonitorThresh_ 1.259e-13
Phy/WirelessPhyExt set HeaderDuration_ 0.000020
Phy/WirelessPhyExt set BasicModulationScheme_ 0
Phy/WirelessPhyExt set PreambleCaptureSwitch_ 1
Phy/WirelessPhyExt set DataCaptureSwitch_ 0
Phy/WirelessPhyExt set SINR_PreambleCapture_ 2.5118
Phy/WirelessPhyExt set SINR_DataCapture_ 100.0
Phy/WirelessPhyExt set trace_dist_ 1e6
Phy/WirelessPhyExt set PHY_DBG_ 0

Mac/802_11Ext set CWMin_ 15
Mac/802_11Ext set CWMax_ 1023
Mac/802_11Ext set SlotTime_
0.000009
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Mac/802_11Ext set SIFS_                 0.000016
Mac/802_11Ext set ShortRetryLimit_      7

Mac/802_11Ext set LongRetryLimit_       4
Mac/802_11Ext set HeaderDuration_       0.000020
Mac/802_11Ext set SymbolDuration_       0.000004
Mac/802_11Ext set BasicModulationScheme_  0
Mac/802_11Ext set use_802_11a_flag_     true
Mac/802_11Ext set RTSThreshold_         2346
Mac/802_11Ext set MAC_DBG               0
```

IV. RESULTS AND DISCUSSIONS

To enhance the performance of Mac 802.11 in 802.11Ext, appropriate simulations were conducted using NS-2 simulator. This simulator is modified by the extension protocol to support the capabilities of coding and related computations.

In this section, we first present the simulated results of nodes 25, 50 and 75 with respect to packet delivery ratio, throughput and average delay for Mac802.11 and 802.11Ext. In the later part of section, we present analysis of results obtained with NS-2 simulations. After filtering the data from generated trace file for Mac802.11 and 802.11Ext are shown in Table 3.1 and Table 3.2 respectively.

Table.3.1. Simulated Results for MAC802.11

No. of Nodes	PDR	Throughput	Avg. Delay
25	71.7831	189575	0.0129448
50	54.9091	145170	0.0137919
75	67.3638	178375	0.0134997

Table 3.2. Simulated Results for MAC802.11Ext

No. of Nodes	PDR	Throughput	Avg. Delay
25	99.4223	263511	0.0115815
50	99.0914	262152	0.0112861
75	99.6466	262282	0.0101135

We have perform various simulations by varying no. of nodes for analyzing behavior of Mac802.11 and 802.11Ext. Fig 3.1. shows the packet delivery ratio variations between Mac802.11 and 802.11Ext. for nodes 25, 50 and 75. As we can observe in results by varying no. of nodes, packet delivery ratio for the Mac802.11Ext. is better than Mac802.11.

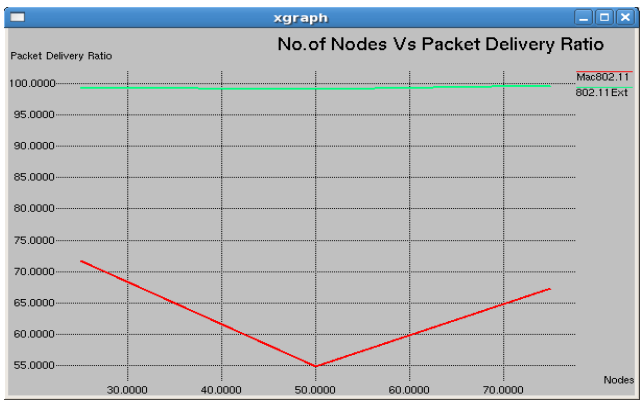

Fig. 3.1. No. of Nodes Vs Packet Delivery Ratio for Mac802.11 & 802.11Ext

Fig 3.2. shows the throughput variations between Mac802.11 and 802.11Ext. for nodes 25, 50 and 75. As we can observe in results for varying no. of nodes, throughput for the Mac802.11Ext. is improved than Mac802.11

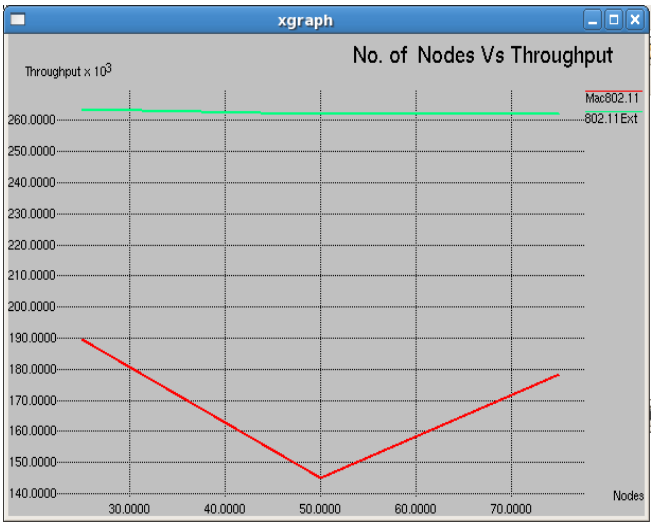

Fig. 3.2. No. of Nodes Vs Throughput for Mac802.11 & 802.11Ext

Fig 3.3. shows the average delay variations between Mac802.11 and 802.11Ext. for nodes 25, 50 and 75. As we can observe in results for varying no. of nodes, average delay for the Mac802.11Ext. is decreased than Mac802.11.

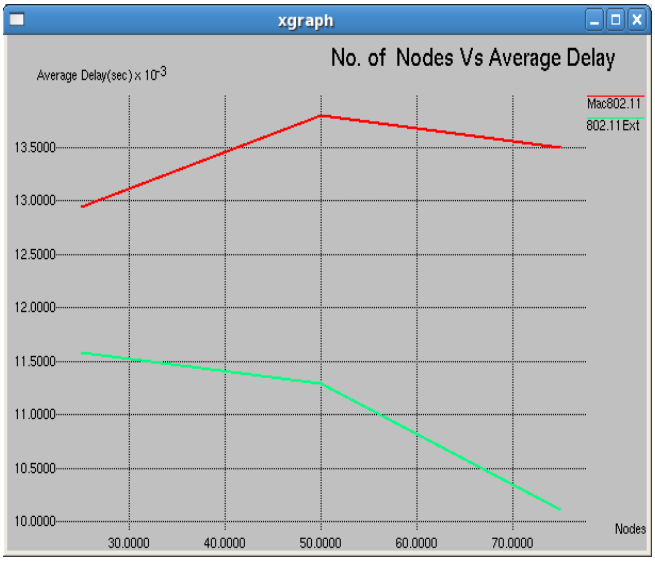

Fig 3.3 No. of Nodes Vs Average Delay for Mac802.11 & 802.11Ext

V. CONCLUSIONS

Wireless Local Area Networks is an emerging technology. Throughput, packet delivery ratio and the average delay of wireless network is always a big challenge. In this paper, we explain new modules: Mac802.11Ext and Wireless PhyExt for IEEE 802.11. The aim to develop new modeling Mac802.11Ext in NS-2 was high level of simulation accuracy. The performance of Mac 802.11Ext is better than Mac 802.11 in terms of throughput, packet delivery ratio and average delay due to change in the parameter of Mac802.11.

SCOPE FOR FUTURE WORK

Though it is observed from simulation results 802.11Ext works better than Mac 802.11 of IEEE 802.11 wireless network. Now the Mac 802.11Ext must be used for simulation as it increases the throughput, packet delivery ratio, average delay and it provides the higher level of accurate results.

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