AN INTERWORKING IMPLEMENTATION AND PERFORMANCE EVALUATION IN IEEE 802.11S BASED CAMPUS MESH NETWORKS

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Abstract

To address deployment schemes over large dispersed geographical area a paradigm shift in the technology was needed. Wireless Mesh Networks (WMN) has emerged as a promising technology to such challenging tasks. As wireless network grows it puts an increased demands in infrastructure based networks.802.11s based WMN is a concrete step that address this paradox to make infrastructure itself wireless. As there is a high demand of internet usage and revolution in computer technology in university campuses, we have done a survey among the students on usage of WiFi based communications and henceforth modeled and implemented an interworking Campus Mesh Wi-Fi Network and have evaluated the networks performance.

***Keywords*: WMN; Campus Mesh; Interworking.**

1. Introduction

IEEE 802.11s wireless mesh networks (WMNs) [1] have generated extensive research and commercial interest in recent years. Unlike ad hoc networks and sensor networks, which are primarily motivated by military, crisis, or environmental applications, WMNs show potential for commercial applications such as last-mile wireless access or home wireless networking.WMN includes Mesh Access Point (MAP), Mesh Point (MP) and Mesh Portal Point (MPP) which has the routing capabilities and forms the backbone. The clients access through these access points. Today university campuses are implementing WMN for seamless connectivity and also for its cost effectiveness. The standard Wireless LAN can be replaced very easily by the mesh backbone architecture, where the access points are connected wireless. Along with wireless local area network (WLAN) and the wireless product's maturity, has introduced massively WLAN the campus net. Interworking other wireless networks with WMN will be an inevitable technology in these modern days.

2. IEEE 802.11s WLAN Mesh

The IEEE 802.11s WLAN mesh covers a range of about 10km practically and 100kms theoretically. A mesh can be deployed with ease in hard terrains. It also creates enough redundancy in the system to make less prone to failures and uniform coverage. In traditional WLAN the Access Points (AP) create a radio coverage area around them called as Basic Service Set (BSS).Several such BSS logically connected creates an Extended Service Set (ESS).This BSS is responsible for providing services to stations, to get associated to AP and use LAN services.

In WMN the distribution system that was traditionally wired has been replaced with Wireless Distribution System .AP's acting as wireless forwarding nodes with atleast one AP requires a wired connection to communicate with outside world. The range of wireless network has been expanded and does not depend only on a single AP.To overcome the limitations of single hop communication, data packets need to traverse over multiple wireless hops and wireless mesh networks called for[2]. The greatest benefit of this architecture is that, if the nearest AP has congestion due to heavy network traffic, data can be automatically re-routed to a neighboring node of smaller communication traffic for transmission [3].

3. Wi-Fi in University Campuses

Wi-Fi, an acronym for "Wireless Fidelity", is a set of product compatibility standards for Wireless Local Area Networks (WLAN) based on the IEEE 802.11 specifications. Wi-Fi was intended to be used for mobile devices and LANs, but is now often used for Internet access. It enables a person with a wireless-enabled computer or personal digital assistant (PDA) to connect to the Internet when in proximity of an access point. Wireless Fidelity is the wireless way to handle networking. It is also known as 802.11 networking and wireless networking. Using this technology we can connect computers anywhere in a home or office without the need of any wires. The computers connect to the network using radio signals, and they can be up to 100 feet or so apart. Wi-Fi allows to connect to the internet from virtually anywhere at speeds of up to 54Mbps.The computers and handsets enabled with this technology use radio technologies based on the IEEE 802.11 standard to send and receive data anywhere within the range of a base station. Wi-Fi goes beyond wirelessly connecting computers, it also connects people.

3.1. *Survey among the student community*

Nearly 75% of the students who took part in a recent poll in our University said Wi-Fi access on their college campuses helps them get better grades. In fact, college students like Wi-Fi so much that 48% said academic performance would degrade if Wi-Fi is removed from the campus.

The survey appears to confirm that Incoming freshmen seek out schools with Wi-Fi capability. Nearly 60% of the students surveyed said they wouldn't attend a college that didn't offer free Wi-Fi. And 79% said that without Wi-Fi access, college would be a lot harder. .

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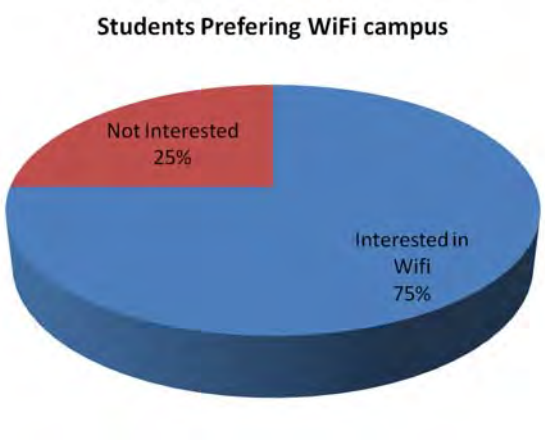

Fig.1 Wi-Fi survey chart.

Wi-Fi has become a universal expectation among college students, we noted that students respond to the quick access to information that Wi-Fi makes possible, including access to academic information, university schedules and events or the ability to connect with friends via Facebook.The survey also found that students use Wi-Fi during classes can be decided by the professors in the universities. Fully 90% believe Wi-Fi access is as essential to an education as a classroom or a computer. Wi-Fi has become so prevalent on college campuses that ABI Research said Wi-Fi penetration should reach 99% of all campuses by 2013[4].

4. IEEE 802.11s interworking with IEEE 802.11g in University campuses

The WMN implements a single broadcast domain and thus integrates seamlessly with other 802 networks [2].IEEE 802.11s based mesh supports transparent delivery of uni, multi and broadcast frames to the destination in and outside of Mesh BSS.

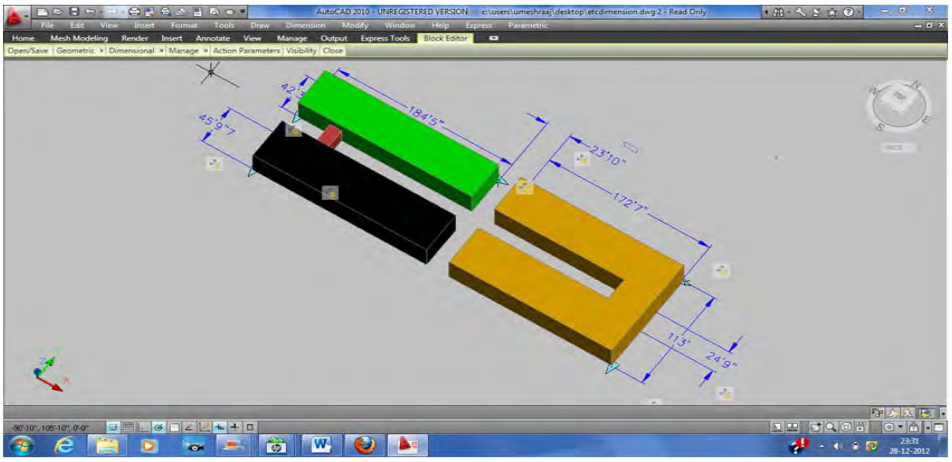

Fig. 2. Computer Aided Design of Campus Department

4.1. *Modeling of Campus Terrain*

We have implemented the idea of interworking in Department of Electronics and Telecommunication in Sathyabama University. Experimental surveys for indoor and outdoor, Department building and street segment measurements were collected. We have analyzed the performance of the integrated network using the Qualnet software 5.2.[5].The terrain details collected were first designed using autocad as shown in Fig. 2 and then written as xml coding using the xml style sheet. Using the Qualnet terrain format the xml code is read and implemented in the software.

The position of the building was decided first in the workspace grid of the software and then using the building

```
<?xml version="1.0" ?>
- <Site xsi:noNamespaceSchemaLocation="file:qualnet-road.xsd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  totalParts="01" part="1" CoordinateType="cartesian" ReferencePoint="0.0 0.0 0.0" id="Site1" Name="Downtown-West">
  -
  - <Region CoordinateType="cartesian" id="Region0">
      <position>0.000000 0.000000 0.000000</position>
    </Region>
    <!-- GRID: A1 TO A3 :: BUILDINGS: 1 TO 3 -->
  -
  - <Building id="A1" Name="Buld1">
    -
    - <face id="A1W" Name="Wwall">
        <position>400.0 400.0 0.0</position>
        <position>400.0 445.9 0.0</position>
        <position>400.0 445.9 44.7</position>
        <position>400.0 400.0 44.7</position>
      </face>
      -
    - <face id="A1N" Name="Nwall">
        <position>584.5 445.9 0.0</position>
        <position>400.0 445.9 0.0</position>
        <position>400.0 445.9 44.7</position>
        <position>584.5 445.9 44.7</position>
      </face>
      -
    - <face id="A1E" Name="Ewall">
        <position>584.5 400.0 0.0</position>
```

Fig. 3 Xml Coding for the implementation of Department Qualnet Terrain File

heights the four directions wall heights were fixed and written using xml as shown in Fig 3.

5. Simulation Results

The mesh backbone based on IEEE 802.11s network was designed using four MAPs and one Mesh Root Point (MRP).The 802.11g network is integrated through MRP and the WiFi users get connected to the mesh cloud users positioned in the department indoor and outdoor as shown in Fig 4. Constant Bit Rate (CBR) traffic is analyzed between the WiFi network customers who are getting connected with WMN network. The mesh connected user Nos. 8, 9, 12, 13 send packets to the integrated user No.16.A packet delivery rate of about 80% is achieved. Remaining 20% of packets are dropped. Fig. 5 and 6 shows the output graphs in qualnet analyzer. As the mesh connected users are positioned indoor as well as outdoor of the campus building; there may be some fading of signals due to the multi path effects.

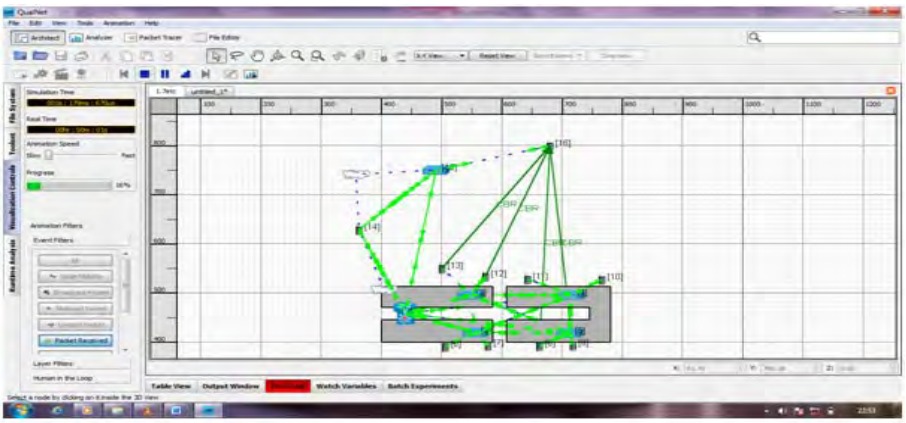

Fig. 4.Qualnet View of Campus integrated Network Deployment

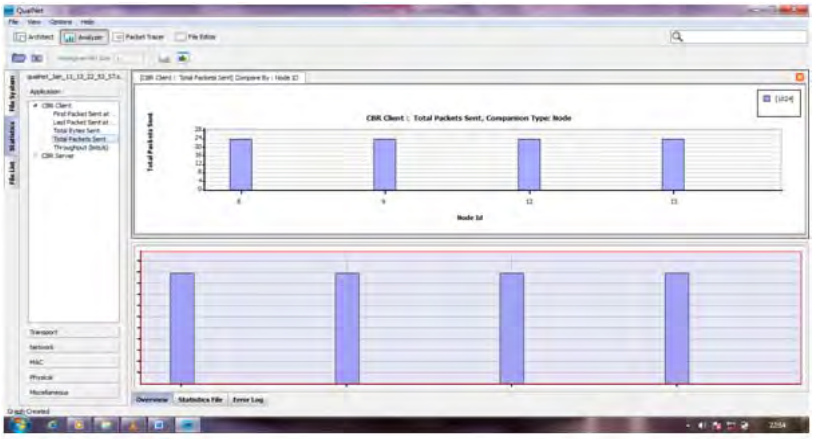

Fig. 5.No of Packets Sent from Mesh

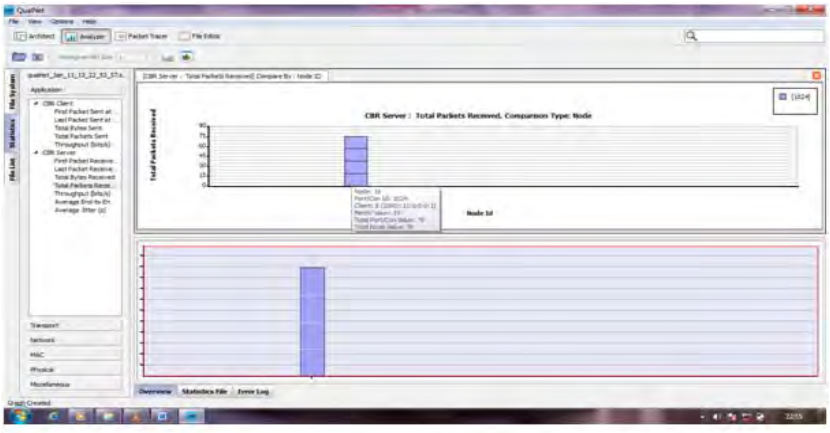

Fig. 6 No. of Packets Received to WiFi user

Even if there may be some percent of losses due to some factors such as fading we have justified that the real time needed for simulation with mesh integration is less than without mesh. Increasing the no. of users we have compared the real time required for sending 100 packets by designing the network by integrating with mesh and

without mesh. The time required for mesh based WiFi integrated network is about only 5 to 10 seconds comparatively for a standalone WiFi network which ranges from 25 to 40 seconds which is shown below Fig 7.

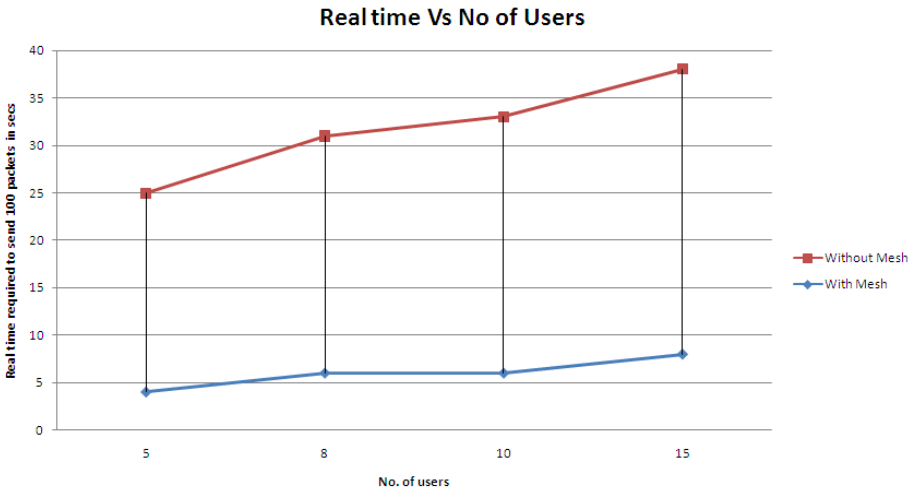

Fig. 7 Real time required for simulation

6. Conclusions

The emergence of wireless mode of teaching gradually will bring WMN as effective technology in campuses. With the help of Wireless Mesh Network, students can download the teacher's courses anytime, do online discussion with teachers or classmates, watch and participate in video conferences and reports of academic. The teachers can guide students conveniently through wireless network. Because the network is self-forming and self-healing, administration and maintenance costs are lower. In addition, a wireless mesh overcomes the line-of-sight issues that may occur when a space is crowded with buildings or industrial equipment.

Based on the results of simulation level implementation of an integrated Campus WiFi Mesh network even if the packet delivery rate is about 80% level, we can claim that it is a wise design because as we increase the no of users the real time required to send packets by integrating with mesh is less than the network which is not using mesh.

References

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