

ENSC 427: COMMUNICATION NETWORKS
Simulation and Analysis of Wi-Fi Performance in
campus network

Group No. 1

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1. Abstract

Wi-Fi is based on the IEEE 802.11 standard. It is one of the wireless mobile network products which widely used in this decade. It allows different electronics devices to exchange data over a computer network. In this project, we analyze the performance of Wi-Fi in a small area network, and simulation Wi-Fi transmission speed for different numbers of router and user. The results of our simulation are based on riverbed modeler's simulation.

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2. Introduction

2.1 Overview of Wi-Fi

Wi-Fi is short for “Wireless Fidelity”. It is one of the wireless technologies, and it was introduced by Wi-Fi Alliance. Wi-Fi becomes the most common used wireless communication systems in today’s society. People can not only use Wi-Fi in personal areas, such as home or office, but also in public areas, such as university campus, airport, or coffee shops. Wi-Fi is based on the IEEE 802.11 communication standard for WLAN (Wireless Local Area Networks). There are several types of IEEE 802.11 protocol, such as IEEE 802.11a, IEEE 802.11b, IEEE 802.11g and IEEE 802.11n [1]. The most common used in today’s society is IEEE 802.11g and IEEE 802.11n standard, because these two protocols have better transmission. In this project, we use IEEE 802.11b standard to analysis and simulate each case.

2.1 Describe of Overview Design

The overall design of the project will focus on compare the transmission speed in a small size of network area within different numbers of user and router. Because of the limitations in resource and time, our simulations only involve a maximum of 50 users or 2 routers within a campus sized network. We use riverbed modeler in our project simulation. The following table summarizes the number of routers and users in each case. All other settings are the same [2].

| | Subnet 1 | Subnet 2 | Subnet 3 |
|---------------|----------|----------|----------|
| User Number | 50 | 50 | 5 |
| Router Number | 1 | 2 | 1 |

Table 1: Summarize of Each Case

Also, we choose some different workstations (users) in each case; each workstation has the different distances to the routers, and simulates the transmission speed for each workstation.

3. Main Sections

3.1 Overall Topology

Our top net topology includes a subnet and a FTP server, which shows in Figure 1. This set up applied to our scenario and all of our cases.



| | | |
|-----------|---|---|
| |  |  |
| Icon type | FTP | Subnet |
| OPNET | Ethernet | Subnet |

Figure 1: Top Net [3]

The following Figure shows the icon types we used in our analyzing in each case.






| | | | | | |
|-----------|---|---|---|--|---|
| |  |  |  |  |  |
| Icon type | Application | Profile | Workstation | Switch | Router |
| OPNET | Application Config | Profile Config | Wlan_wkn_adv | Ethernet4_slip8_gtwy | Wlan_ethernet_slip4 |

Figure 2: Inside the Subnet [3]

Our goal for this project is to find the data receive and throughput changes within different Number of Users, Number of Access Points, and Distances. We tested for three different subnets: 50 users with 1 APs, 50 users with 2 Access Points, and 5 users with 1 Access Point. The network overview and topologies of each case shows in below. Workstations inside red circles in Figure 4, 5, 6 are the users we choose to compare how the data and throughput changes with respect to the distance.

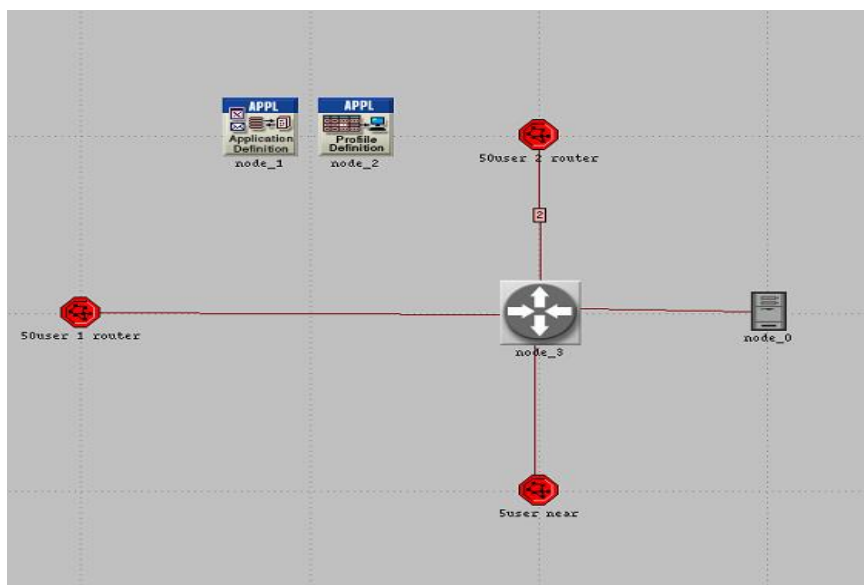


Figure 3: Network Overview

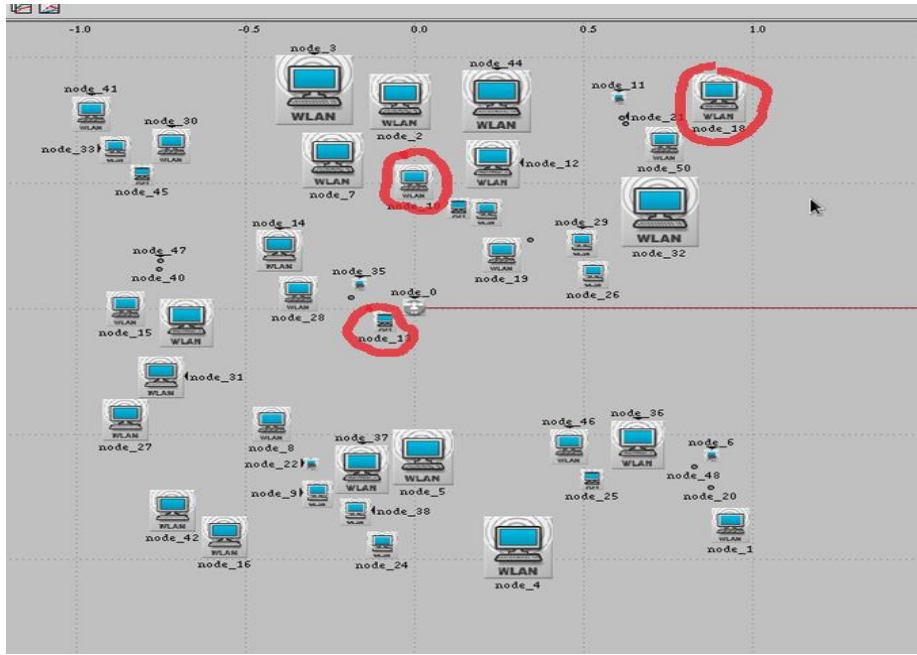


Figure 4: Topology for Subnet 1

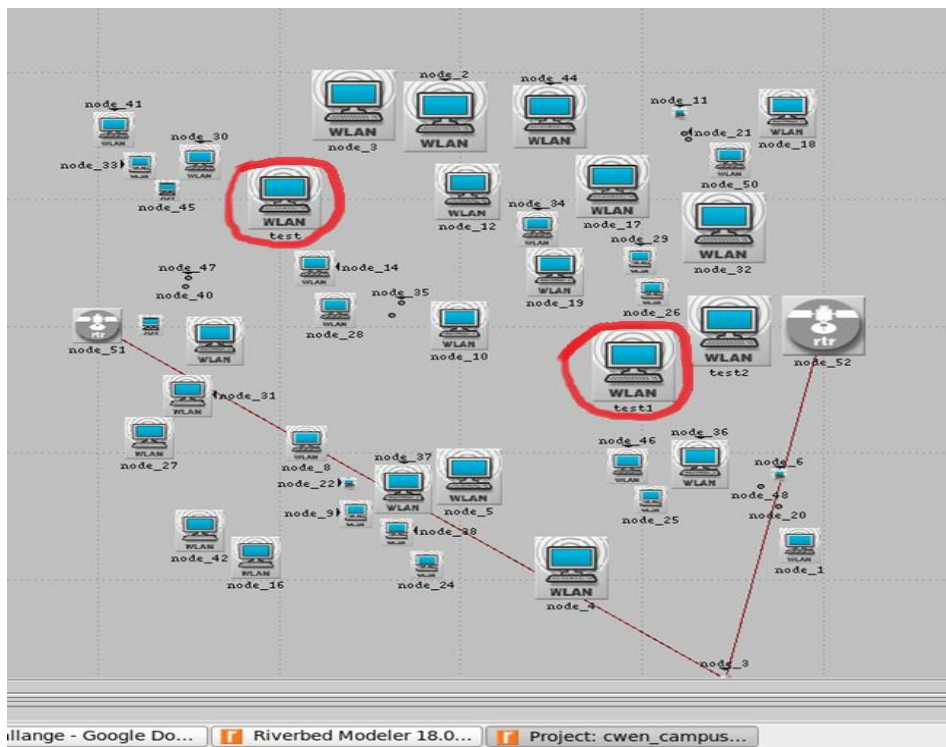


Figure 5: Topology for Subnet 2

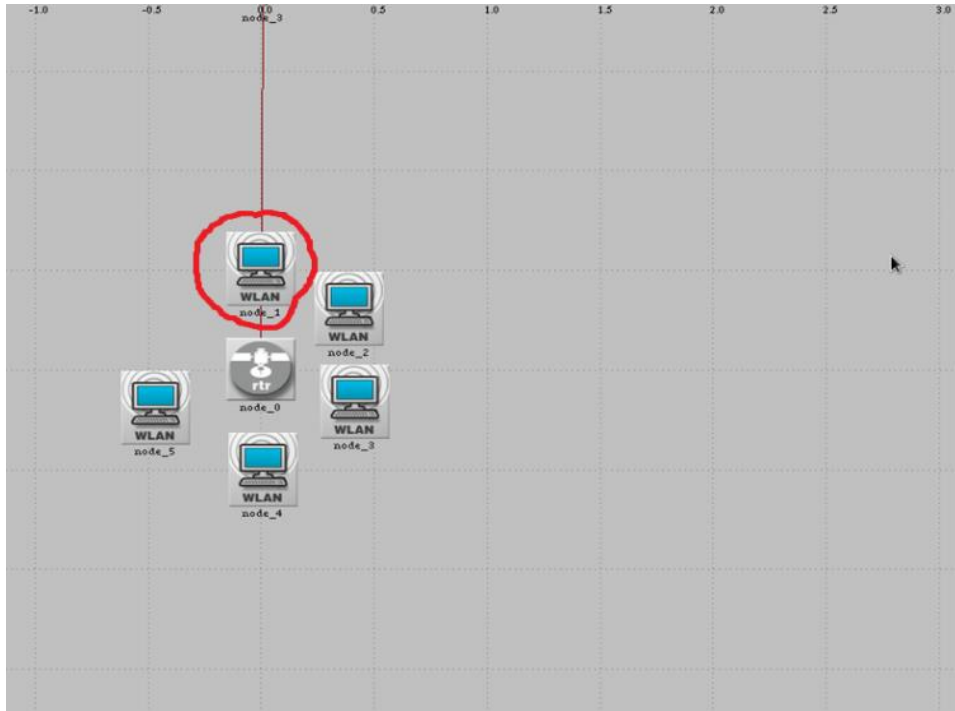


Figure 6: Topology for Subnet 3

3.2 Case 1: Different Number of users

In this case, we are going to explore the relationship between different number of users and network quality. We picked subnet 1 and 3 that each has one access point and same application. There are 50 workstations in subnet 1 and 5 users in subnet 3. To ensure they have the same distance, we observe station 10 in subnet 1 and station 1 in subnet 3. Both of them are 500 meters away from their access points.

Applications: Video Conference (high load)

Simulation Duration: 5 min

Simulation Running Time: ~10 min

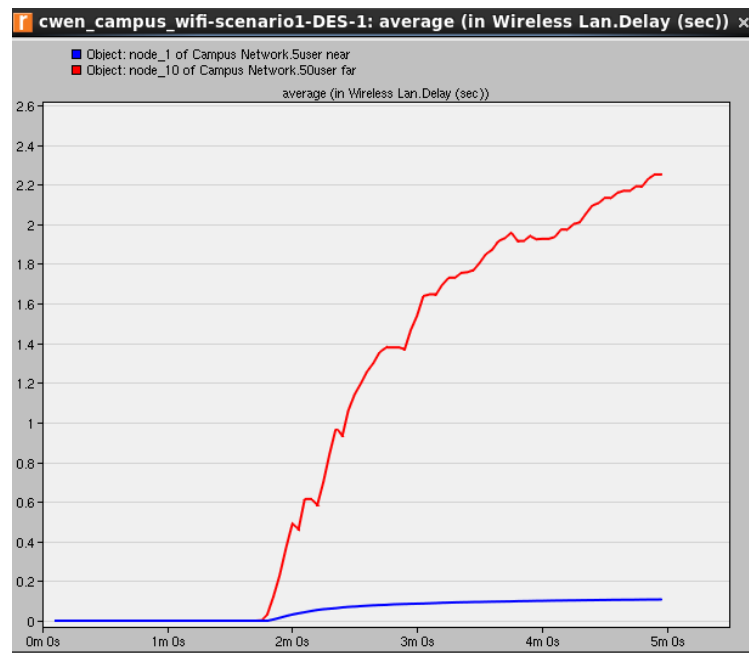


Figure 7: Delay Comparison for different workstations

As expected, the more workstations the more delay there is. As data arrive at AP increase, when AP is fully occupied, the delay will start to grow. That is why we can see a steady increase of delay for the 50 workstation case.

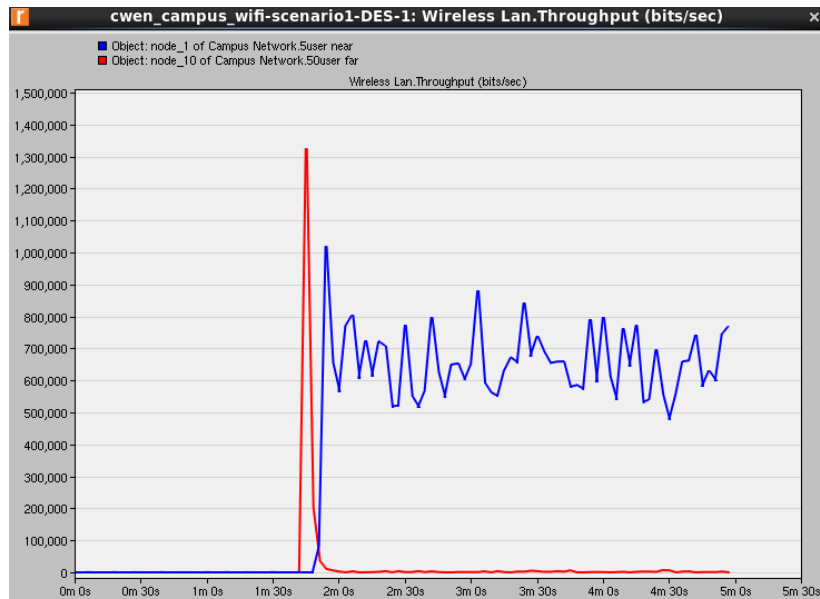


Figure 8: Throughput comparison for different workstations

As we can see, for 5 workstations, there are more successful data transfers to next level of layer. Both plots have a high peak at the beginning, which is the signal to establish the connection between the workstation and AP.

3.3 Case 2: Different distances between workstation and AP

We are going to find out the difference of the distance from workstations to AP regarding the network quality. We picked three nodes in subnet 1 which has the same access point and same application. Node 13 is 100 meters away from AP; node 10 is 500 meters away; and node 18 is 2 1200 meters away.

Applications: Video Conference (high load)

Simulation Duration: 5 min

Simulation Running Time: ~10 min

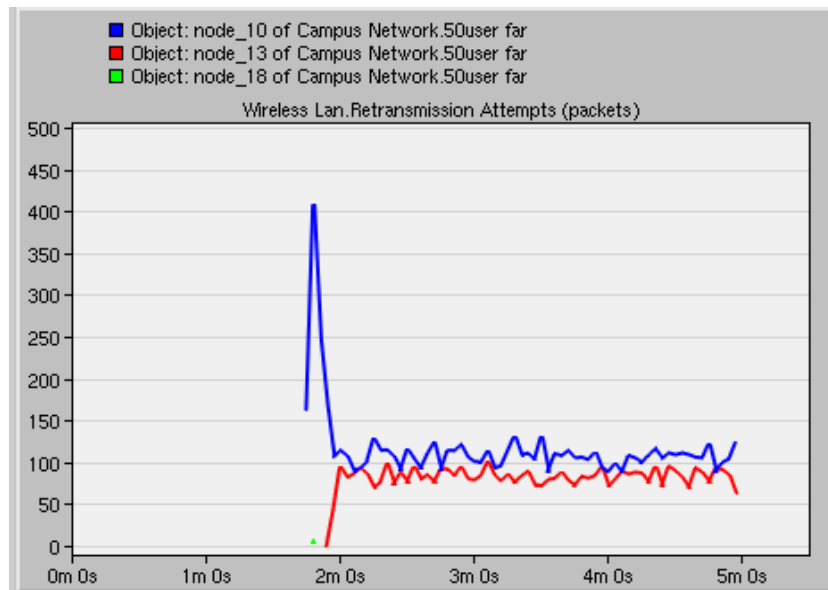


Figure 9: Retransmission comparison for different distance

There is more retransmission for node 10 than node 13 because it is further away and takes more data transfers to stabilize the connection. Node 18 is not shown in this graph because its too far away and signal cannot reach that distance. The high peak before 2 minute is the data transmission to establish the connection.

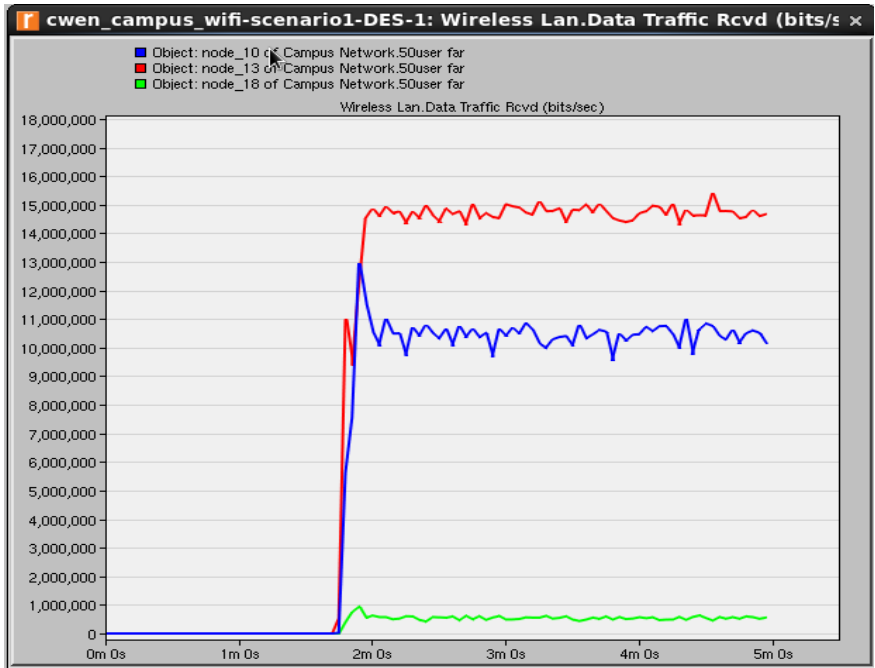


Figure 10: Data Received comparison for different distance

As we expected, the closer to the AP, the more data can be received by the workstation. Node 18 again is too far for the signal to reach.

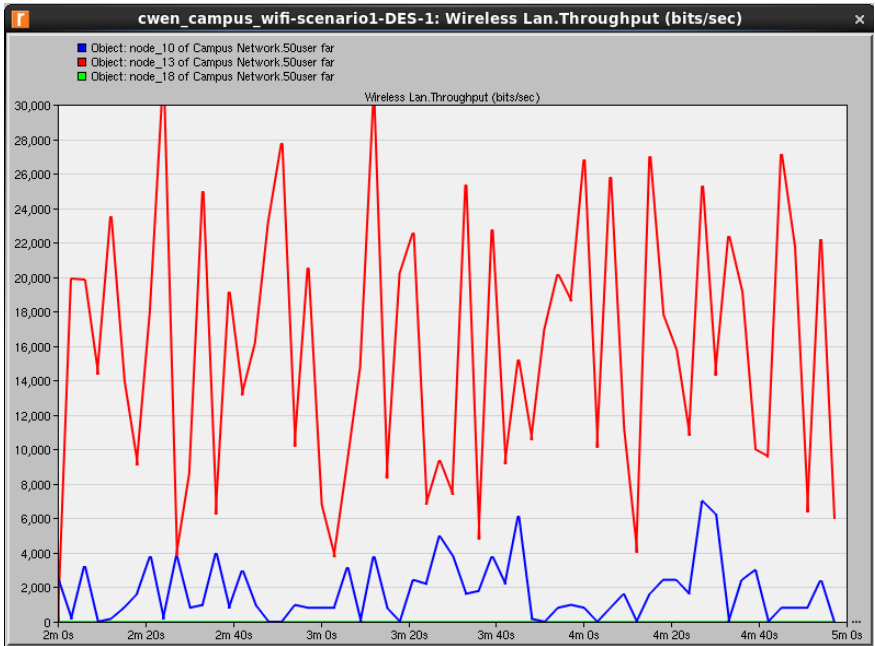


Figure 11: Throughput comparison for different distance

Data throughput as well, as the workstation is closer to the AP, more successful data transfers can be completed.

3.4 Case 3: Different number of Access Points

This time we want to analysis the effect of increasing the number of access points. We compare subnet 1 and subnet 2 both with the same application and same number of workstations. Subnet 2 has one more access point in its network. We picked node 10 and node 13 in subnet 1; node “test” and node “test1” for subnet 2. Node 10 and node “test” is further away than node 13 and node “test1” respectively. From that we can see if AP coverage can have any effect on network quality.

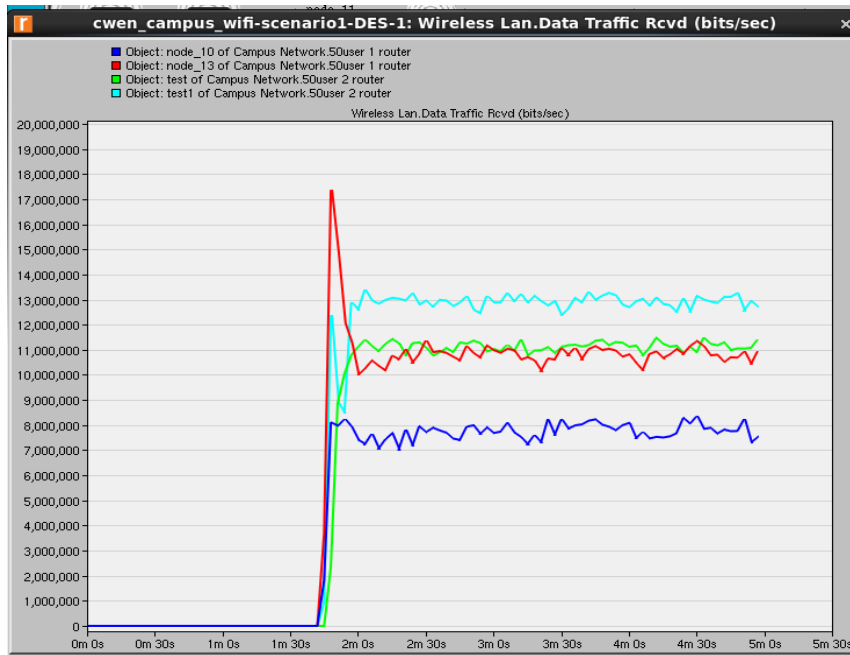


Figure 12: Data Receive comparison for different number of AP

The graph shows that when the number of AP increases, there is generally more data received for the workstations. This is because more AP provides more signal coverage, which also increases network communication effectiveness.

4. Discussions and Conclusions

In this project, we simulated three different scenarios to discuss the performance of Wifi IEEE 802.11b under different conditions. The factor we applied are distance of transmission, numbers of access points and numbers of workstations. The data we measured are throughput, traffic received and retransmission data.

The plot diagrams of throughput indicate the performance of throughput when the distance of workstation and number of workstation are varying. The traffic received plot diagrams show the number received data are varying when the scenarios have different access point and workstation distance. The retransmission plots diagram illustrates the changing of retransmission rate. As the comparison result we get from the diagrams, we can say that the distance, access point and users are three important factors of Wi-Fi performance. The increasing quality of Wi-Fi is proportional to the decreasing of workstation distance or users number. Also, the increasing quality of Wi-Fi is proportional to increasing number of access points.

5. References

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