Design and Analysis WIMAX Network Based on Coverage Planning

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ABSTRACT

In this paper, wireless network is planned; the network is predicated on the IEEE 802.16e standardization by WIMAX. The targets of this paper are coverage maximizing, service and low operational fees. WIMAX is planning through three approaches. In approach one; the WIMAX network coverage is major for extension of cell coverage, the best sites (with Band Width (BW) of 5MHz, 20MHz per sector and four sectors per each cell). In approach two, Interference analysis in CNIR mode. In approach three of the planning, Quality of Services (QoS) is tested and evaluated. ATDI ICS software (Interference Cancellation System) using to perform styling. It shows results in planning area covered 90.49% of the Baghdad City and used 1000 mobile subscribers and percentage connect with base station 84.3% on the establish QoS requirements.

Keywords:- WIMAX Network planning, ICS Telecom, coverage, Baghdad city.
1. INTRODUCTION
A wireless technology (Al-Rubaye, Kadhum et al. 2018) WIMAX is connected for both mobile and fixed, reach for long-range wireless networking (2018). WIMAX technology has become wireless broadband communications field. WIMAX technology development leads to the convergence of mobile broadband. IEEE 802.16e standard has been introduced with the prop of mobility and enhanced Capabilities in terms of bandwidth and coverage space, it’s a part of WIMAX forum. WIMAX has developed IEEE802.16 to enable a mobile subscriber to realize atop of data rate and link to the web with a top Qos. The WIMAX technology is assigned NLOS and LOS communications frequency bands of 2–11 GHz and 10–66 GHz, severally (Pahal, Singh et al. 2014). In our design, broadband wireless connectivity is provided to Participants in a very Wireless Metropolitan Area Network (WMAN) environment in like a road the operation is built on a single-hop relocate between a single Base Station (BS) and multiple mobile Subscriber Stations (SSs) (Hameed 2015). WIMAX supports rural and city broadband coverage with less cost, the WIMAX technology depends on IEEE 802.16e (Al-Hilfi, Salih et al. 2018). In our planning, we chose the city of Baghdad for fixed outdoor coverage, simulator for radio planning and coverage utilized by ATDI ICS telecom. (ATDI -Advanced Topographic Development & Images, 2011). Radio planning is supported from 10 KHz to 450 GHz frequency by ICS telecom. The both fixed and mobile-WIMAX is been a tool by an ideal radios planning, various methods of process FDD and TDD, for the whole frequency bands and various bandwidths. the distance to which the signal is traveled in a geographical area with a block by Coverage through specified by means of two keys; path loss and received signal power (Zaiab .T Alisa. 2013) The results establish COST 231 Hata model is the best model for WIMAX coverage at a 3.5GHz frequency to get better coverage. The rest of the paper is structured as follows. Section 2 discusses the WIMAX network planning model. Section 3 discusses Simulation Model include Coverage, Interference analysis, and QoS analysis according to Service flows results are discussed. Section 4 concludes the paper.

2. WIMAX NETWORK PLANNING MODEL
An arrangement of a network that is able to maximize the execution is being found additionally satisfying all objectives by the WIMAX network planning, enclose on the first chosen probably position locations for base station (BS) spread, determination from the wanted number from sectors while suitable tools from every active location, i.e. antennas, into the saving from effective covering and appeasement from transit request of subscribers in the wrapped region (Teterin and Hurley 2014). In next sections are explaining the components of the Simulation modeled network:-

2.1 Potential site locations
In the paper, the WiMAX network built on the IEEE 802.16e technology and has been Scheme for constant outside coverage for the city of Baghdad see figure1. A group of possible locations for base station positioning.
2.2 Choose the frequency range

The wireless network has been a significant impacted on the dimension and layout by Frequency range. Actual idea is displayed using the frequency range around the world by the following representation. 3.5 GHz range by us planning is chosen because it is greatly applied around the scholar. Furthermore, that range is allowed thus overlap is beneath a rule and permits utilizing higher sending force. However, the NLOS status is supported and best range and coverage than 2.5 GHz and 5.8 GHz.

Table1. Different Frequency ranges allocated into WIMAX Network (RAMASANKAR 2012)

| Geographical regions     | Frequency range allowed | Frequency range not allowed |
|--------------------------|--------------------------|----------------------------|
| North America            | 2.3&2.5GHz               | 5.8GHz                     |
| Central&South America    | 2.5&3.5GHz               | 5.8GHz                     |
| Eurpa                    | 3.5GHz                   | 5.8GHz                     |
| Aisa                     | 3.5GHz                   | 5.8GHz                     |
| Africa                   | 3.5GHz                   | 5.8GHz                     |
2.3. Publishing model for WIMAX at 3.5 GHz

The Hata model is submitted accordingly an arithmetical term for relieve the most effective match from diagrammatic the most effective match through vintage Okumura model (Katev 2012) (Katev, P.D.,2012). Hata model is applied into the frequency range of 150 MHz to 1500 MHz for presage the medium route loss for the distance d of a sender into receiver antenna up to 20 km; To prediction the rout loss in the frequency range 1500 MHz to 2000 MHz COST 231 Hata model is started such the associate expansion of Hata model. It is accustomed for calculating rout loss in three totally various environments such as an urban, residential area and rural. The fundamental rout loss equation for this COST-231 Hata Model is expressed as (1):

\[ L(dB) = 46.3 + 33.9 \log \text{f MHz} - 13.82 \log h_b - a(h_m) + (44.9 - 6.55 \log h_b) \log d KM - Q \]  

(1)

Where: f MHz is the center frequency in MHz, (hb) is the effective height of the base station antenna, (hm) is the height of the mobile station antenna, d is the distance between the base station and mobile station and Q= 0 or 3 dB depending on the environment, it is 0dB in the suburban and rural areas and 3 dB in the urban environment.

3. SIMULATION MODEL

Simulation Model contains three sections Details of coverage planning, Interference analysis in CNIR mode, QoS analysis according to Service flows.

3.1 Coverage planning

Next the Base station is mounted and organized (e.g. power, azimuth and tilt set) a coverage space of Baghdad city is known. A real time transfer protocol (RTP) is taken into account for becoming coated by a sector if the received signal force is robust sufficient, i.e. on top of the sensitivity threshold (Zhang, Y. and H.-H. Chen, 2007). The sensitivity level \( R_{i,tx} \) defined at the RTP limited the minimum received power level needed for the subscriber instrumentality to spot the signal with an appropriate level of errors among the noise and interference. The receiver should be able to decode data bits with a BER less than \( 10^{-6} \) this might vary with completely different equipment and user service requirements, as the threshold value has been selected to have an uplink and downlink system gain balanced (Zainab Ibrahim Abood ,2017). These nominal values are given in Table 2.

| Parameters        | Value         |
|-------------------|---------------|
| Signal            | WimaxP35MTDD  |
| Type              | TX/Rx         |
| Coverage          | COST-231 Hata |
| Nominal power BS (W) | 12           |
| Parameter                          | Value  |
|-----------------------------------|--------|
| Dynamic (dB)                      | 2      |
| Tx antenna gain (dBi)             | 14.20  |
| Rx antenna gain (dBi)             | 14.20  |
| SS antenna gain (dBd)             | 7      |
| TX Losses (dB)                    | 1      |
| RX Losses (dB)                    | 1      |
| Central frequencies BS (MHz)      | 3500   |
| E. R. P.I (W)                     | 239.4315 |
| BS height (m)                     | 35     |
| SS height (m)                     | 9      |
| TX bandwidth (MHz)                | 5-20   |
| Rx bandwidth (MHz)                | 5-20   |
| SS Nominal power (w)              | 0.4    |
| SS Central frequencies (MHz)      | 9.00   |
| Aperture (degree)                 | 0.10   |
| Carrier (dBm)                     | -90    |
| Path budget threshold 10^-6 (dBm) | -83.00 |
| Path budget threshold             | -88.00 |
| Sensitivity                       | -109   |
| Coverage threshold (dBuV/m)       | 35     |
| Rx threshold (dBuV/m)             | 30     |
| FFT                               | 128    |
| Distance (Km)                     | 20Km   |
| SS Rx Threshold (dBuV/m)          | 51     |
| Noise                             | -107   |
| kTBF                              | -107   |
| TIL (dBW)                         | -137   |
| Modulation                        | QPSK1/2(Kadhum) |
We chose Twelve location coverage in Baghdad city permission is going to be complete to define that bases station site is best coated to be adopted, and therefore best coverage cell is Not taking into consideration as shown in Fig.3, to realize most coverage with as littlest range to avoid overlapping, that is diagrammatic by the rose area in Fig.2

|                           | and Haitham 2018) |
|---------------------------|-------------------|
| UL/DL Activity (%)        | 100               |
| UL/DL Bit Rate (Kbit/s)   | 256.00            |
| Slot/cx                  | 1                 |
| Permutation Scheme        | PUSC              |
| Segmentation              | 6                 |

**Figure 2.** Coverage for twelve base station in Baghdad city.
**Figure 3.** Best server 12 base stations in coverage area km2.

**Figure 4.** Show coverage for 18 base station per sector for each cell with bandwidth 5MHz.

In Figure 5 Comparing different best server area KM2 for 18 base station with different bandwidth 5MHz and 20MHz in terms of percentage coverage area to find Less coverage of base stations to prevent interference between stations.
**Figure 5.** Comparing best server for 18 base stations in coverage area km2 with different bandwidth 5MHz & 20MHz.

In planning, we used 18 and 24 base stations to cover the city of Baghdad using Omni Antennas shown in Figure 6. The difference between stations by percentage for total covered and linked subscriber covered and gives their best.

**Figure 6.** Omni antenna with 20MHZ and 5MHZ at 18 & 24 base stations.

In Fig. 7, results are shown in percentages for 18 & 24 base stations type of antenna used four directional antenna (4 sectoe for each cell) with different bandwidth 5, 20MHz.
Figure 7. Four directional antenna with 20MHZ and 5MHZ at eighteen stations & Twenty-four stations.

Figure 8. Omni antenna with 20MHZ and 5MHZ at eighteen stations.

3.2 Interference analysis in CNIR mode

This CNIR analysis will allow checking which modulation (bit rate) will be lost according to the interference. for that a C/(N+SumI) planning must be calculated. this covered planning will be calculated based upon a noise floor N and the interference rejection factors (IRF) of the equipment. A noise floor 107 dBm. There is two type of interference ,when a subscriber in a neighboring cell employ the same channel frequency is occurred by the first type is called co-channel interference(CCI).when a subscriber in the same region uses a neighboring channel frequency is occurred by Secondtype Adjacent Channels Interference(ACI). A table showing the amount of each C/I in(dB) and IRF mask (dB).
**Table 2** show type of interference according value of C/I and IRF mask in (dB).

|                      | C/I required (dB) | IRF mask (dB) |
|----------------------|------------------|---------------|
| Co-Channel           | 22               | 0             |
| Adjacent Channels    | -3               | 25            |
| N+/-2 Channels       | -21              | 43            |

**Figure 9.** shows the interference results C/I for 18 base stations with 4sector according IRF mask using IRF mode.

### 3.3 QoS analysis according to Service flows

The QoS of the network also varies according to the contention ratio of the connections along the day. A 24h QoS analysis can therefore be calculated. Mobile subscribers will be used to simulates traffic during 24h and number of covered mobile subscribers is 1000/1000 show in **Fig.10.**
In Fig. 10, the result shows the quality of service for uplink and downlink with activity and mobile subscriber connection according to service flows.

**Figure 10.** Traffic 24h-Qos% covered.

In Fig. 11 the result shows the quality of service for uplink and downlink with activity and mobile subscriber connection according to service flows.

**Figure 11.** Network response to QoS Service flows.

4. CONCLUSION

In this paper, the WIMAX network planning used 24 and 18 base stations (BS) in different profile bandwidth 5MHz, 20MHz with 3.5GHz frequency range and the middle distance covered by a base station was improved to 10km in WIMAX for high solid modulation technique QPSK1/2 using ATDI ICS Telecom. In planning, managed to cover an area of Baghdad city 467.34 $KM^2$. The ability of base station is backing active subscribers. As the number of
subscriber connected either base station in percentage 84.3% of 1000 SS. the network profile with B.W=5MHz and four sectors was nominated because the results of the simulation of this network offered maximum percentage coverage equals to 80% of the total area of Baghdad, and connected SSs equals to 79.8% of the 1000 SSs.

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