Electrical, Electronics and communications, and Computer Engineering

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.

تصميم وتحليل شبكة WIMAX بناءً على تخطيط التغطية

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الخلاصة

في هذه الورقة ، تم تخطيط الشبكة اللاسلكية ؛تعتمد الشبكة على معيارIEEE802.16e بواسطة WIMAX . تتمثل أهداف هذه الورقة في زيادة التغطية والخدمات ورسوم التشغيل المنخفضة. تخطط   من خلال ثلاثة أساليب. في نهج واحد ؛ تعد تغطية شبكة أساسية لتوسيع التغطية الخلوية، وأفضل المواقع (مع عرض النطاق البالغ 5 ميجا هرتز و 20 ميجا هرتز لكل قطاع وأربعة أقسام لكل خلية). في النهج الثاني ، تحليل التدخل في وضع CINR   في النهج الثالث من التخطيط ، يتم اختبار جودة الخدمات(QoS)وتقيمها. برنامجATDI ICS   (نظام إلغاء التداخل) الذي يستخدم لأداء التصميم. تظهر

النتائج في منطقة التخطيط التي تغطي 90.49 ٪ من مدينة بغداد وتستخدم 1000 مشترك للهاتف المحمول والنسبة المئوية للتواصل مع المحطة الأساسية 84.3 ٪ على متطلبات إنشاء جودة الخدمة.

الكلمات الرئيسية : ـ تخطيط شبكةWIMAX ICS Telecom التغطية ، مدينة بغداد.

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.

Figure 1. Base station location in the city of Baghdad.

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 for 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):The propagation path loss in this model is given by (Andrews, Ghosh et al. 2011):-

$$L(dB) = 46.3 + 33.9 \log fMHZ - 13.82 \log hb - a(hm) + (44.9 - 6.55 \log hb) \log dKM - Q \qquad (1)$$

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^{Rx} 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.**

Table2. WIMAX Base stations have the following parameters.

Parameters	Value
Signal	WimaxP35MTDD
Type	TX/Rx
Coverage	COST-231 Hata
Nominal power BS (W)	12

Dynamic(dB)	2
Tx antenna gain(dBi)	14.20
Rx antenna gain(dBi)	14.20
SS antenna gain (dBd)	7
TX Losses (dB) RX Losses (dB)	1 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**

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

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**
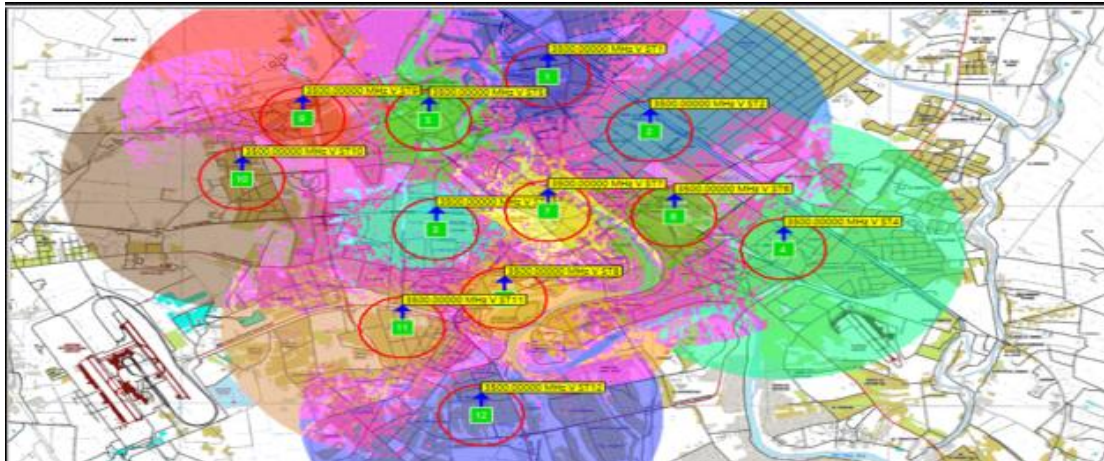

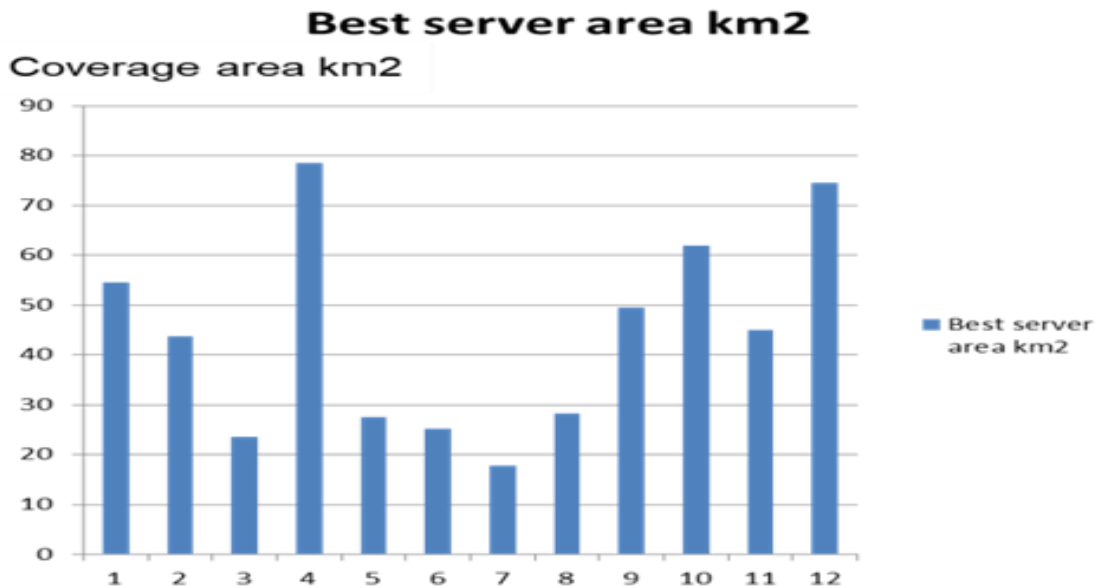**Figure 2.** Coverage for twelve base station in Baghdad city.

Best server area km2

Coverage area km2

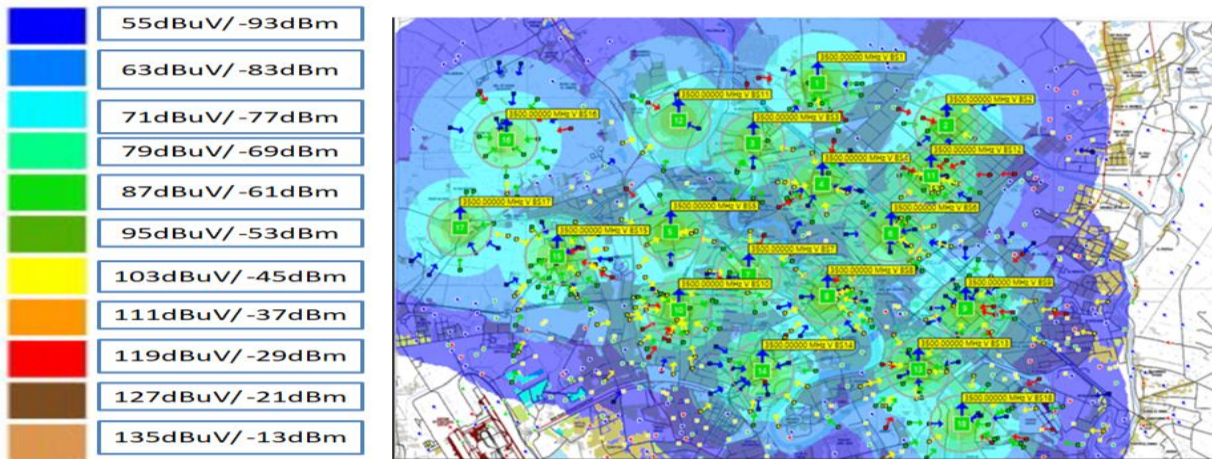**Figure 3.** Best server 12 base stations in coverage area km2.

	55dBuV/-93dBm
	63dBuV/-83dBm
	71dBuV/-77dBm
	79dBuV/-69dBm
	87dBuV/-61dBm
	95dBuV/-53dBm
	103dBuV/-45dBm
	111dBuV/-37dBm
	119dBuV/-29dBm
	127dBuV/-21dBm
	135dBuV/-13dBm

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.
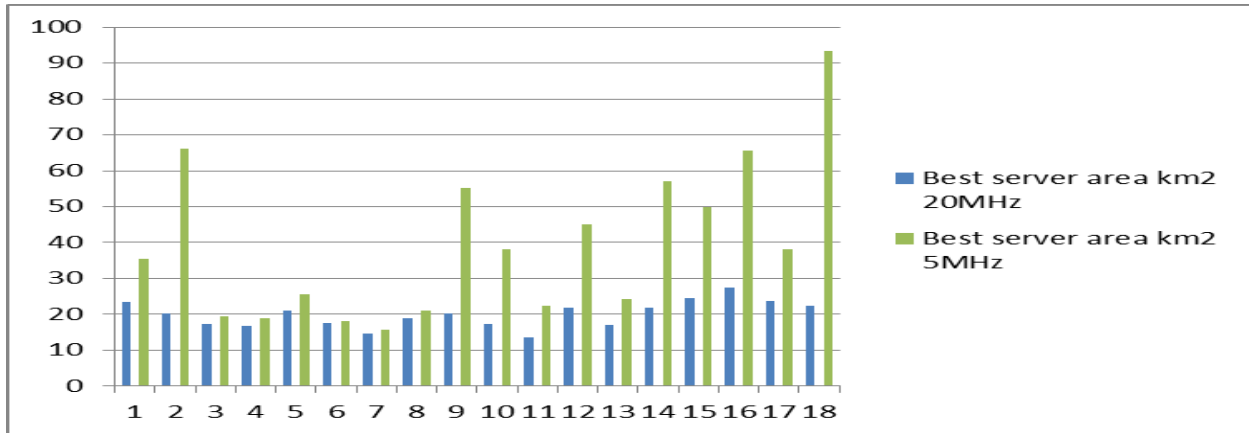
Figure 5. comparing best server for 18 base stations in coverage area km2 with different bandwidth 5MHz& 20MHz.

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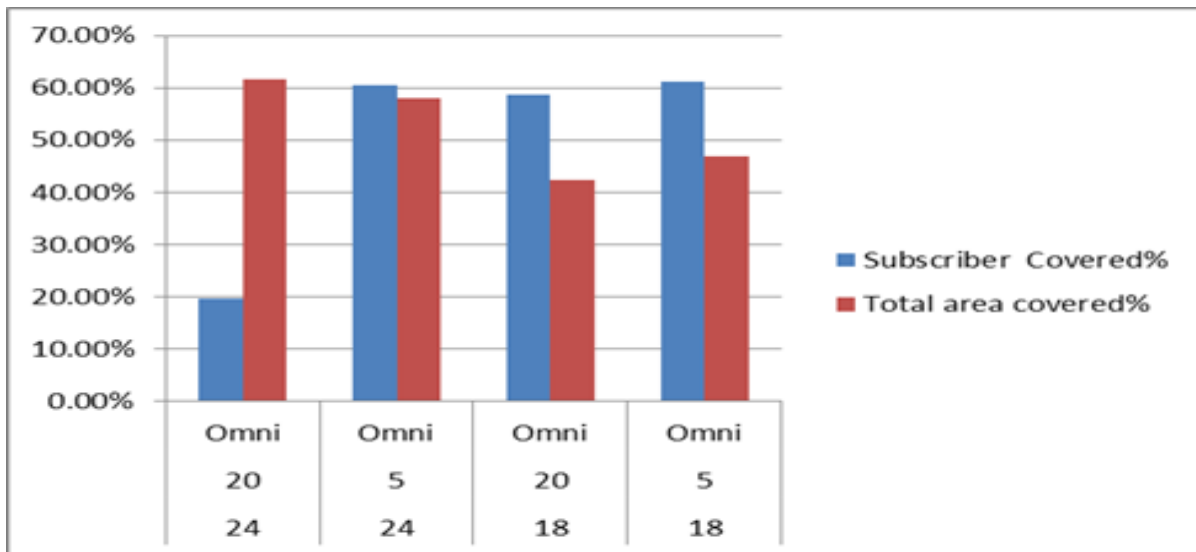

Figure 6. Omni antenna with 20MHZ and 5MHZ at 18&24 base stations.

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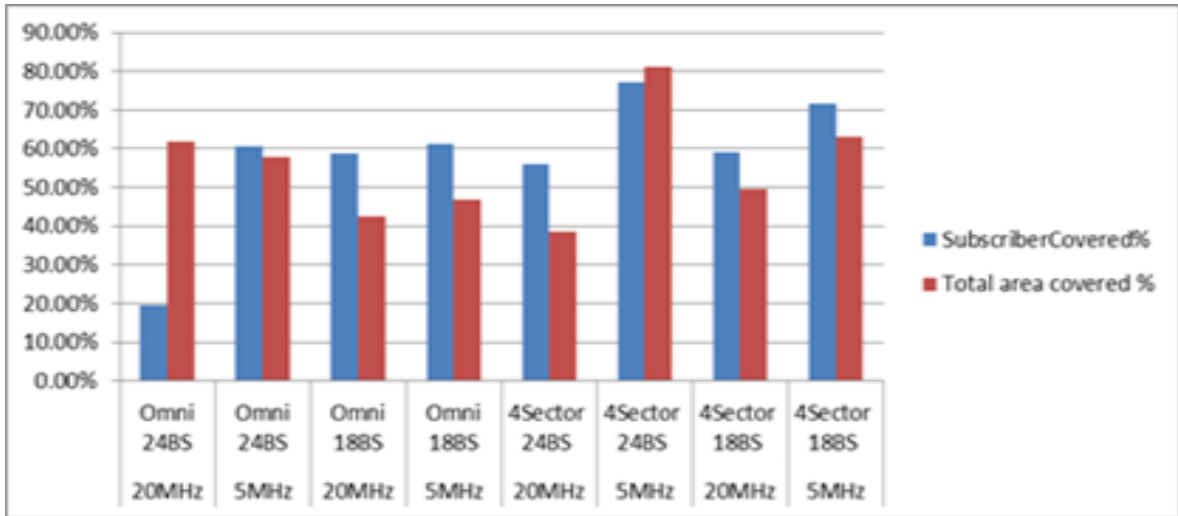
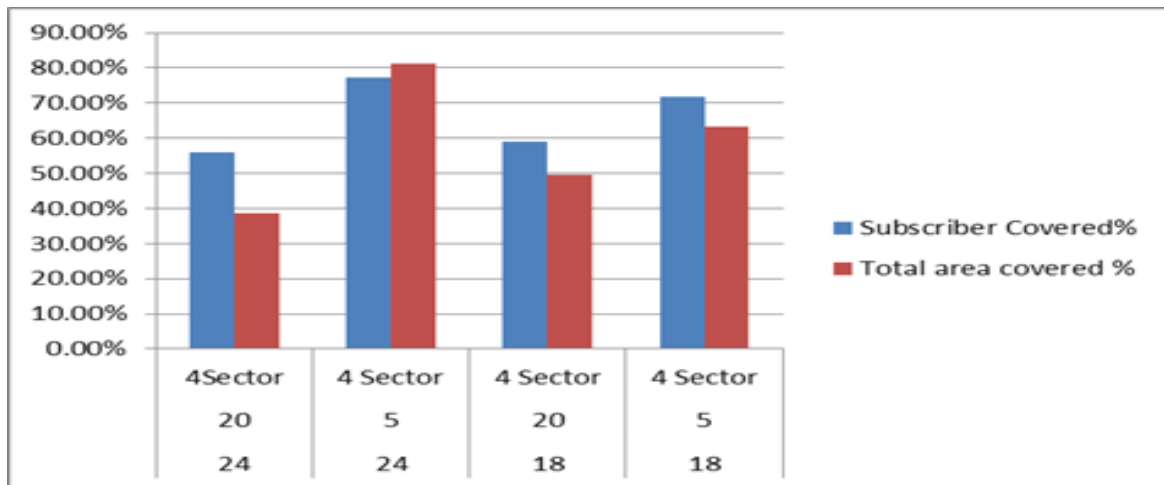**Figure 7.** Four directional antenna with 20MHZ and 5MHZ at eighteen stations & Twenty-four stations.

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 interferenece ,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).

Tabel.2 show type of interference according value of C/I and IRF mask in (dB).

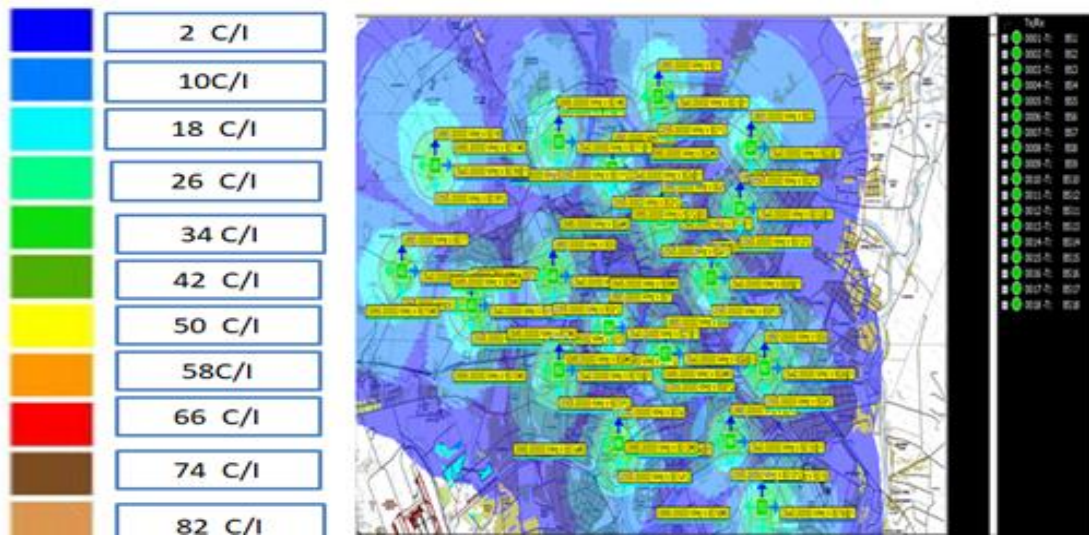|	C/I required (dB)	IRF mask (dB)
Co-Channel	22	0
Adjacent Channels	-3	25
N+/-2 Channels	-21	43

Figure9. 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**.
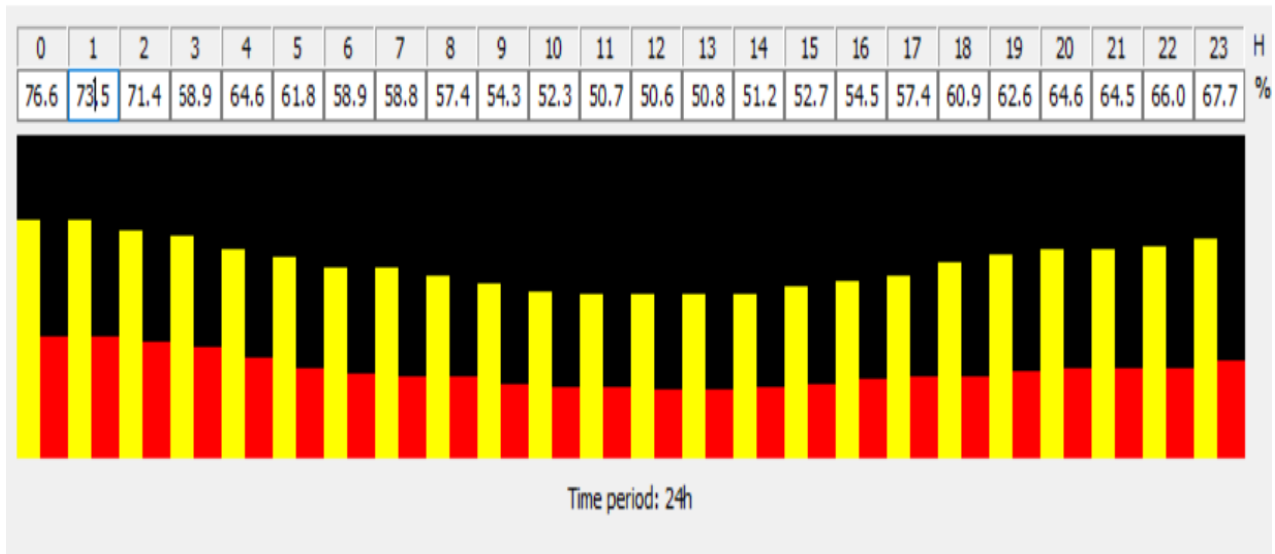
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0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	H
76.6	73.5	71.4	58.9	64.6	61.8	58.9	58.8	57.4	54.3	52.3	50.7	50.6	50.8	51.2	52.7	54.5	57.4	60.9	62.6	64.6	64.5	66.0	67.7	%

Time period: 24h

Figure10. Traffic 24h-Qos% covered.

In **Fig.11** the result show quality of service for uplik and downlink with activity and mobile subscriber connect according to Service flows.
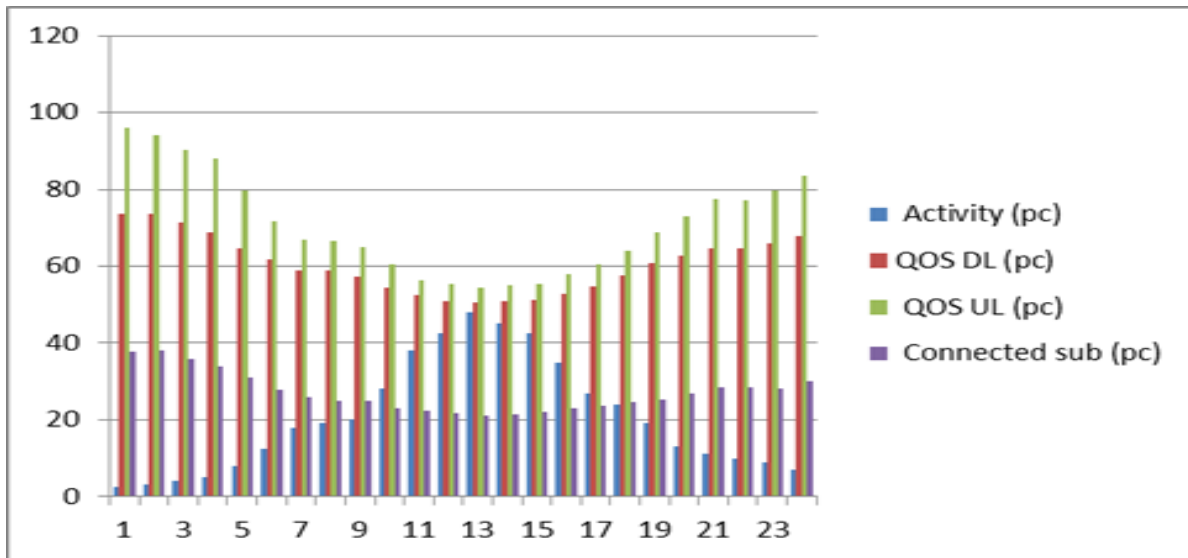

Figure.11 Network response to QoS Service flows.

4. CONCLUSION

In this paper, The WIMAX network planning used 24 and18 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 to10km 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 can be 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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