International Journal of Computer Applications (0975 – 8887)
Volume 50– No.17, July 2012

Nominal and Detailed LTE Radio Network Planning considering Future Deployment in Dhaka City

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ABSTRACT
Long Term Evolution (LTE) is the next major step in mobile radio communications and is introduced in 3rd Generation Partnership Project (3GPP) Release 8. It is the last step toward the 4th generation (4G) of radio technologies designed to increase the capacity and speed of mobile telephone networks. With industrial attachment very few radio planning works of LTE are going on. But because of certain commercial issues those works aren't widely available. Radio network planning is a very vital step for wireless communication technology. As standardization work of LTE is approaching the end line, it is high time to go for efficient radio network planning guideline for LTE. In LTE just like other cellular technologies, initial planning is normally guided by various industries and vendors at their own discretion. They aren't likely to disclose their advancements and findings. That makes the job even more challenging. As a result, going on with LTE radio network planning perspective is a well-chosen challenge and a certain hot topic in the current research arena. In this work, a detailed LTE radio network planning procedure has been elaborated which concentrates on nominal and detailed planning considering possible network implementation in the densely populated South-Asian city-Dhaka.

General Terms
Telecommunications, Wireless Networks.

Keywords
Radio Network Planning, Planning Tool, Coverage Prediction, Traffic Map, LTE Simulation

1. INTRODUCTION
Whenever new cellular technology is considered for mass deployment hundreds of its RF parameters go through tuning process with a view to find out optimum value. But this phase is time consuming and very costly. So, before commercial deployment if extensive simulation can be run this tuning phase can be facilitated in numerous ways. Cost can also be greatly minimized. That is the benefit of running simulation before mass commercial deployment. In this sub-continent LTE is expected to be commercially launched in Q4 of 2012. All these aim at proper radio network planning of LTE. So, looking for optimization of the vital parameters in the least possible time is a very challenging issue which will obviously help network operators in a greater extent.

The main advantages with LTE are high throughput, low latency, plug and play, frequency division duplexing (FDD) and time division duplexing (TDD) in the same platform, an improved end-user experience and a simple architecture resulting in low operating costs. LTE downlink transmission scheme is based on Orthogonal Frequency Division Multiple Access (OFDMA) - which converts the wide-band frequency selective channel into a set of many at fading subchannels. The LTE specification provides downlink peak rates of at least 100 Mbps and an uplink of at least 50 Mbps. LTE supports scalable carrier bandwidths, from 1.4 MHz to 20 MHz and supports both FDD and TDD [1] [2] [3]. LTE will also support seamless passing to cell towers with older network technology such as GSM, CDMA-One, W-CDMA (UMTS), and CDMA2000 [1, 2] [4, 5].
Radio network planning being quite a vital step for a wireless communication technology and as its standardization work is approaching the end line; it is high time to go for efficient radio network planning guideline. For the same reason, along with the fact that in LTE radio network planning just like other cellular technologies, initial stage planning is normally guided by various industries and vendors at their own discretion; they aren't likely to disclose their advancements and findings. That makes the job even more challenging.
The ultimate objective of this work is to come up with the detailed radio network planning guideline with respect to Dhaka city. With this mission ahead, in this paper a step by step method has been followed using radio planning tool Atoll. The idea was to cover the nominal and detailed planning stage in detail with respect to Dhaka city. Performance analysis of the planned network has also been included here. Prior to that, a brief description of the nominal and detailed radio planning has been given.

2. RELATED WORKS
In [6] coverage and capacity estimation is carried out in radio network dimensioning. Radio link budget is investigated for coverage planning. Theoretical work is later put into the development of an Excel based dimensioning tool which is designed to keep the interface simple and to set the functional parts clearly distinguishable. The final product gives the number of sites (cells) needed in order to support a certain subscriber population with a given capacity. In [7] an attempt to provide analysis of LTE system performance from radio network planning aspects has been made. Determination of the number of resources to be allocated to the PDCCH and how UEs should be efficiently signaled over the PDCCH is addressed in [8]. Resource allocation in LTE downlink and LTE PHY layer simulation aspects have been featured respectively in [8] and [9]. [10-16] are the 3GPP Technical Specifications related to this work. Link and system level simulation results have been obtained using [17] and [18] respectively. Effect of change in number of transmitting antennas has been shown in [19]. An attempt to facilitate a planned decision making stage for the mobile broadband solution specifically focusing in the South Asian region has been done in [20]. In [21] a detailed LTE radio network

dimensioning procedure i.e. capacity and coverage analysis-link budget preparation, link and system level simulation; has been performed in order to prepare a radio planning guideline considering possible network implementation in Dhaka city.

3. RADIO NETWORK PLANNING PROCESS

Radio Network Planning contains number of phases:

- Initial phase-which includes collection of pre-planning information and starting network dimensioning i.e. Link Budget preparation, coverage and capacity calculation by running simulations.
- Nominal and detailed planning- which includes selection and use of radio planning tool. This step involves propagation model tuning, defining thresholds from Link budget, creating detailed radio plan based on the thresholds, checking network capacity against more detailed traffic estimates, Configuration planning, Site surveys, Site pre-validation and validation, eNodeB parameter planning.
- Defining KPIs and Parameter Planning- using eNodeB system parameters and counters, defining performance KPIs and its target values based on vendor's promise, verification of the KPIs and target values using planning and dimensioning tools nominally along with pre and post-launch optimization.

But defining KPI and parameter planning has been considered out of the scope of this paper.

4. RADIO PLANNING FOR DHAKA CITY

Dhaka is the capital of Bangladesh and it is an overpopulated city in the South-Asian region. Efficient radio network planning is obviously a big challenge here with the optimal utilization of limited resources. In [21] coverage analysis i.e. link level simulation result along with link budget preparation and capacity analysis-system level simulation have been performed. Taking related pre-planning information of Dhaka: population: 15 million (0.75% to be covered), assumed overbooking factor: 50, area: 1463.6 km^2 in terms of Cost-Hata propagation model no. of eNodeB for coverage was found as 53 while for capacity it was found as 50. In this case, number of cell required for coverage exceeds that of capacity which means capacity can be effectively handled. The target capacity and coverage values are here attempted in the nominal and detailed radio planning stage involving radio planning tool-Atoll.

5. ATOLL SIMULATIONS

Digital map of Dhaka (shown in Fig.1) has been used for radio planning in this stage. These maps consisted of Dhaka airport, main road, secondary road, street, railway and water. At first to cover the whole Dhaka city eNodeBs were placed (shown in Fig 3) where the no. comes from the coverage and capacity analysis performed in [21]. After placing the eNodeBs coverage prediction was done that helped to justify the placement of the eNodeBs. Traffic maps were created for each of the Dhaka map subsections. Automatic frequency planning and automatic cell planning were performed before running each of these simulations. In detail simulation result is obtained which contains: connected UL+DL, connected DL, connected UL, No service, Scheduler saturation, Resource saturation cases. Legends show each of them with different color. A separate table shows the simulation properties for each of the simulated traffic maps.

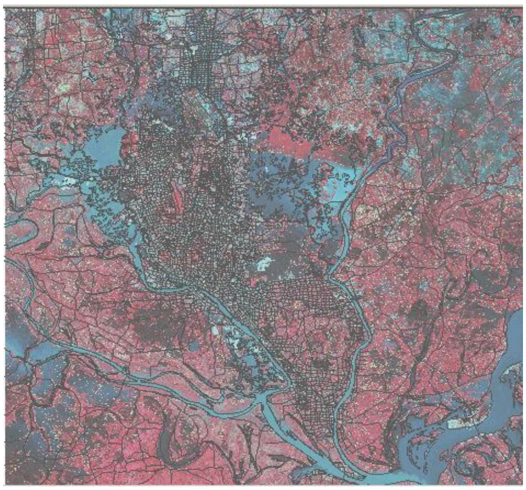
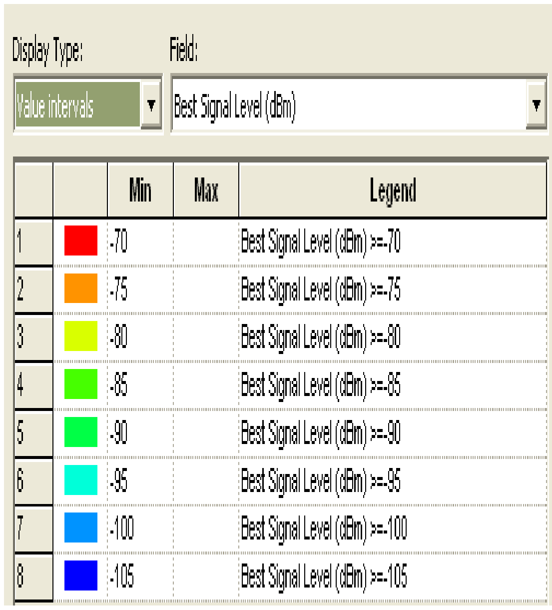


Fig 1: Dhaka Digital Map

5.1 Coverage Prediction

Coverage predictions have been performed by: transmitter, signal level, downlink throughput and Channel to Interference plus Noise Ratio (CINR). Coverage prediction properties: (a) by signal level, (b) channel throughput (DL) and (c) Downlink C/(I+N) have been shown in Fig. 2. Corresponding coverage prediction results have been shown in Fig 4 to Fig 7.

(a)



Display Type: Value intervals
Field: Best Signal Level (dBm)

		Min	Max	Legend
1		-70		Best Signal Level (dBm) >=-70
2		-75		Best Signal Level (dBm) >=-75
3		-80		Best Signal Level (dBm) >=-80
4		-85		Best Signal Level (dBm) >=-85
5		-90		Best Signal Level (dBm) >=-90
6		-95		Best Signal Level (dBm) >=-95
7		-100		Best Signal Level (dBm) >=-100
8		-105		Best Signal Level (dBm) >=-105

Display Type: Value intervals Field: Peak RLC Channel Throughput (DL) (kbps)

		Min	Max	Legend
1		20,000		Peak RLC Channel Throughput (DL) (kbps) >=20,000
2		19,000		Peak RLC Channel Throughput (DL) (kbps) >=19,000
3		18,000		Peak RLC Channel Throughput (DL) (kbps) >=18,000
4		17,000		Peak RLC Channel Throughput (DL) (kbps) >=17,000
5		16,000		Peak RLC Channel Throughput (DL) (kbps) >=16,000
6		15,000		Peak RLC Channel Throughput (DL) (kbps) >=15,000
7		14,000		Peak RLC Channel Throughput (DL) (kbps) >=14,000
8		13,000		Peak RLC Channel Throughput (DL) (kbps) >=13,000
9		12,000		Peak RLC Channel Throughput (DL) (kbps) >=12,000
10		11,000		Peak RLC Channel Throughput (DL) (kbps) >=11,000
11		10,000		Peak RLC Channel Throughput (DL) (kbps) >=10,000
12		9,000		Peak RLC Channel Throughput (DL) (kbps) >=9,000
13		8,000		Peak RLC Channel Throughput (DL) (kbps) >=8,000
14		7,000		Peak RLC Channel Throughput (DL) (kbps) >=7,000
15		6,000		Peak RLC Channel Throughput (DL) (kbps) >=6,000
16		5,000		Peak RLC Channel Throughput (DL) (kbps) >=5,000
17		4,000		Peak RLC Channel Throughput (DL) (kbps) >=4,000
18		3,000		Peak RLC Channel Throughput (DL) (kbps) >=3,000
19		2,000		Peak RLC Channel Throughput (DL) (kbps) >=2,000
20		1,000		Peak RLC Channel Throughput (DL) (kbps) >=1,000

(b)

Display Type: Value intervals Field: PDSCH & PDCCH C/(I+N) Level (DL) (dB)

		Min	Max	Legend
1		30		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=30
2		29		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=29
3		28		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=28
4		27		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=27
5		26		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=26
6		25		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=25
7		24		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=24
8		23		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=23
9		22		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=22
10		21		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=21
11		20		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=20
12		19		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=19
13		18		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=18
14		17		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=17
15		16		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=16
16		15		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=15
17		14		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=14
18		13		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=13
19		12		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=12
20		11		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=11
21		10		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=10
22		9		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=9
23		8		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=8
24		7		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=7
25		6		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=6
26		5		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=5
27		4		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=4
28		3		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=3
29		2		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=2
30		1		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=1
31		0		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=0
32		-1		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=-1
33		-2		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=-2
34		-3		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=-3
35		-4		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=-4
36		-5		PDSCH & PDCCH C/(I+N) Level (DL) (dB) >=-5

(c)

Fig 2: Coverage Prediction Properties by: (a) Signal Level (b) Channel Throughput (c) C/ (I+N) Level (DL)

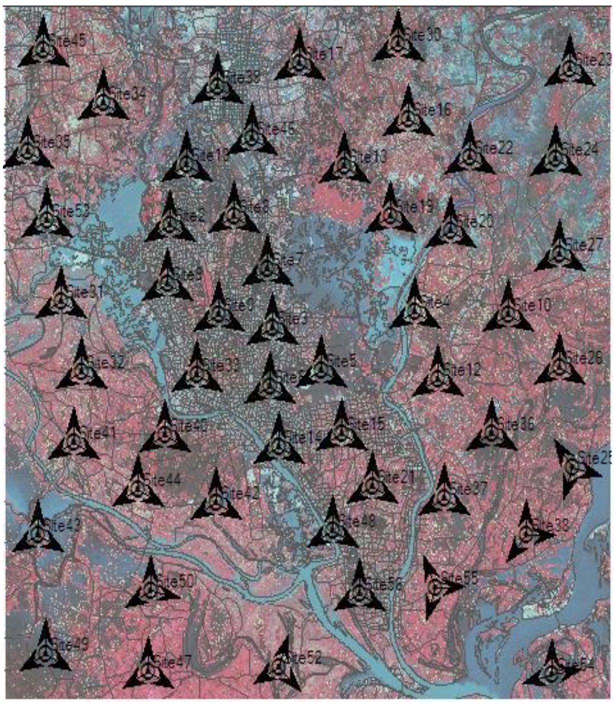


Fig 3: Transmitter Placed on Dhaka Map

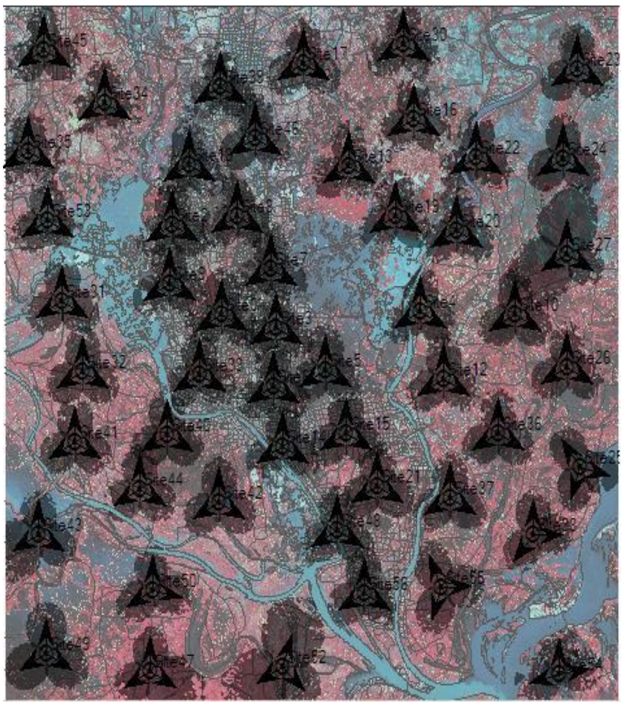


Fig 4: Coverage Prediction by Transmitter

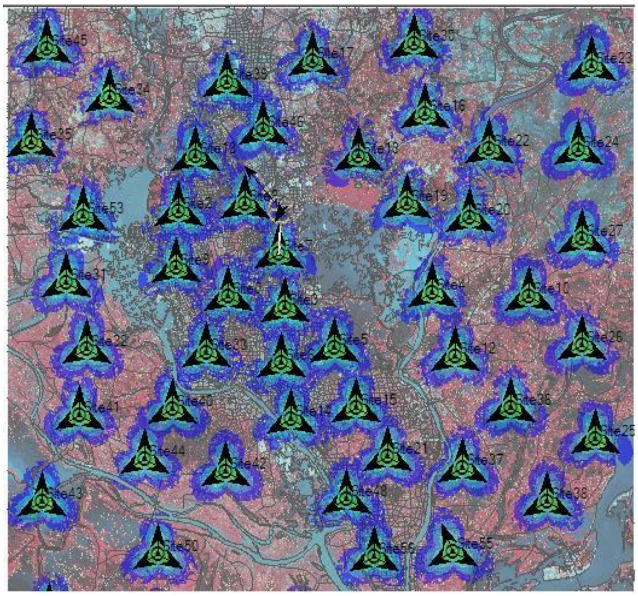


Fig 5: Coverage Prediction by Signal Level

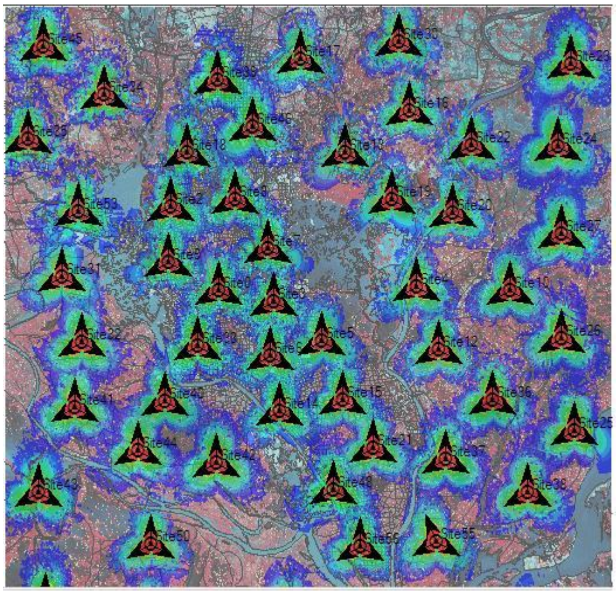


Fig 6: Coverage Prediction by Throughput (DL)

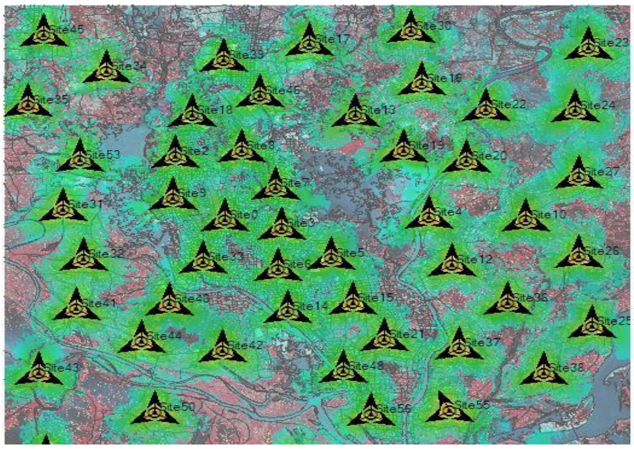


Fig 7: Coverage Prediction by CINR (DL)

LTE Simulations properties

Display

Display Type: Discrete values

Field: Connection Status

	Value	Legend
1	Connected DL+UL	Connected DL+UL
2	Connected DL	Connected DL
3	Connected UL	Connected UL
4	No Service	No Service
5	Scheduler Saturation	Scheduler Saturation
6	Resource Saturation	Resource Saturation

Fig 8: LTE Simulation Properties

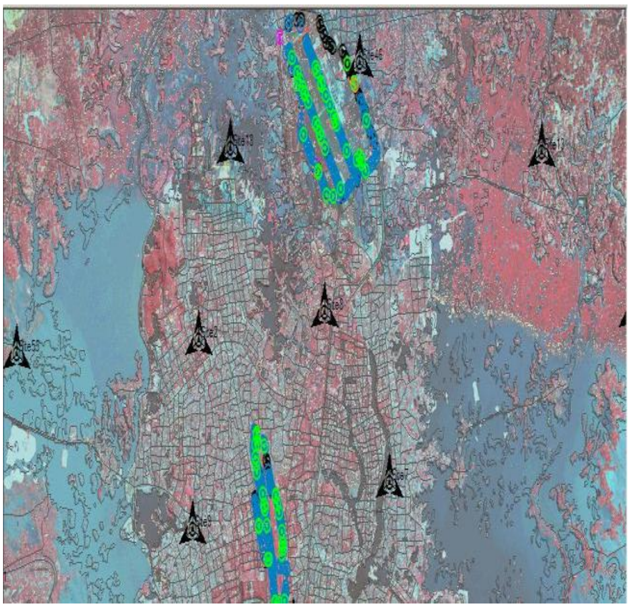


Fig 9(a): Dhaka Airport Traffic Map after Simulation

Service	Reference Cell	Total Path Loss (DL) (dB)	Application Channel Throughput (DL) (kbps)	Transmission Power (UL) (dBm)	Reference Signal C/(I+N) (DL) (dB)
FTP Download	Site46_1 (0)	151.49	0	23	-19.67
FTP Download	Site46_1 (0)	153.59	0	23	-8.74
FTP Download	Site46_1 (0)	165.39	0	23	-9.36
FTP Download	Site18_1 (0)	163.13	2,706.7	22.5	-0.96
FTP Download	Site18_1 (0)	171.38	0	23	-10.06
VoIP	Site39_3 (0)	156.43	0	23	-23.5
Web Browsing	Site46_3 (0)	156.72	990.34	22.5	-5
FTP Download	Site18_2 (0)	176.48	0	23	-19.84
FTP Download	Site46_3 (0)	154.1	3,911.94	22.9	0.16
FTP Download			0	0	
Web Browsing	Site46_3 (0)	155.64	3,911.94	22.9	0.12
VoIP	Site39_2 (0)	175.9	0	23	-26.68
FTP Download	Site18_2 (0)	176.92	0	23	-13.35
FTP Download	Site46_3 (0)	159.02	0	23	-9.79
FTP Download	Site18_2 (0)	166.28	0	23	-15.75
Web Browsing	Site46_3 (0)	166.32	0	23	-13.87
FTP Download	Site46_3 (0)	174	0	23	-15.33
Web Browsing	Site18_1 (0)	152.05	947.28	22.2	-4.51
FTP Download	Site46_3 (0)	167.31	0	23	-28.4
FTP Download	Site46_3 (0)	154.65	0	23	-7.9
VoIP	Site46_3 (0)	163.31	3,911.94	22.5	0.54
VoIP	Site46_3 (0)	163.54	0	23	-9.65
FTP Download	Site46_3 (0)	157.13	0	23	-10.95
Video Conferencing	Site46_3 (0)	155.43	9,601.68	23	7.55
FTP Download	Site46_3 (0)	157.32	0	23	-10.78

Fig 9(b): Dhaka Airport Traffic Map Simulation Properties

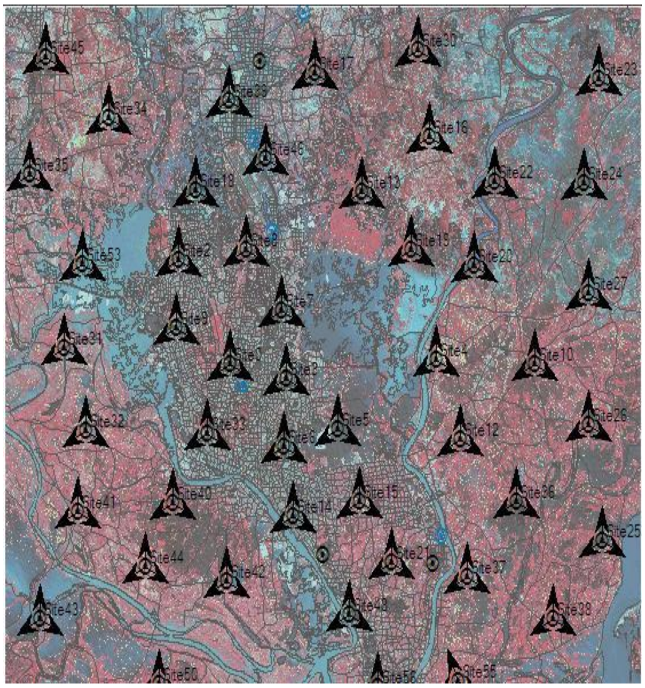


Fig 10(a): Dhaka Railway Traffic Map after Simulation

Service	Serving Base Station	Total Path Loss (DL) (dB)	BLER (DL)	Transmission Power (UL) (dBm)	Application User Throughput (DL) (kbps)	Received Reference Signal Power (DL) (dBm)	Reference Signal C/(I+N) (DL) (dB)
VoIP	Site46_1	132.98	0	23	11.59	-82.76	9.96
FTP Download	Site7_1	157.49	0	23	950	-104.06	7.35
FTP Download	Site0_2	152.54	0.03306	23	918.59	-99.1	-3.31
Web Browsing	Site48_1	153.77	0	23	0	-100.55	-9.9
VoIP	Site39_1	151.94	0	23	0	-101.72	-12.52
FTP Download	Site17_1	157.69	0	23	950	-104.25	4.26
FTP Download	Site37_1	159.33	0.01482	23	935.92	-106.11	-2.13
FTP Download	Site37_3	163.64	0	23	0	-110.42	-8.45

Fig 10(b): Dhaka Railway Traffic Map Simulation Properties

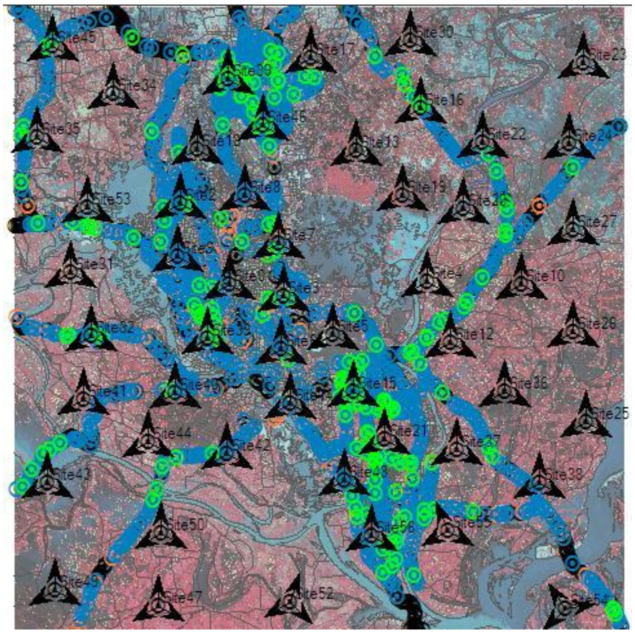


Fig 11(a): Dhaka Mainroad Traffic Map after Simulation

Service	Reference Cell	Total Path Loss (DL) (dB)	Application Channel Throughput (DL) (kbps)	Transmission Power (UL) (dBm)	Application User Throughput (DL) (kbps)	Reference Signal C/(I+N) (DL) (dB)
VoIP	Site14_1 (0)	159.65	3,741.86	23	11.59	-0.2
FTP Download	Site6_3 (0)	154.8	34,549.34	23	950.01	18.65
FTP Download	Site33_2 (0)	164.64	7,645.71	23	404.34	6.36
FTP Download	Site42_1 (0)	143.48	5,702.75	23	950	1.87
FTP Download	Site33_1 (0)	151.14	362.57	23	13.3	-6.16
FTP Download	Site7_3 (0)	151.87	828.06	22.8	350.44	-3.93
Web Browsing	Site0_3 (0)	135.79	7,313.29	22.8	121.6	3.81
FTP Download	Site0_1 (0)	146.48	7,313.29	22.4	950	6.33
FTP Download	Site7_3 (0)	153.24	947.28	23	400.9	-4.03
Web Browsing	Site7_1 (0)	148.39	31,815.73	23	121.6	17.33
FTP Download	Site8_2 (0)	144.42	9,184.22	21.7	950	9.04
Web Browsing	Site8_2 (0)	140.88	34,549.34	22.3	121.6	19.01
FTP Download	Site3_1 (0)	141.46	9,184.22	21.5	950	9.28
FTP Download	Site7_1 (0)	148.25	2,344.88	23	741.65	-1.47
FTP Download	Site7_1 (0)	150.54	16,983.27	23	950	13
FTP Download	Site7_2 (0)	134.44	31,815.73	21.4	950	17.56
Web Browsing	Site0_2 (0)	151.86	24,271.68	23	121.6	14.8
Web Browsing	Site6_1 (0)	140.58	16,983.27	23	121.6	12.85
FTP Download	Site0_2 (0)	153.86	6,867.9	23	892.14	3.35
FTP Download	Site6_1 (0)	149.05	34,549.34	23	950.01	23.26
FTP Download	Site7_3 (0)	121.49	8,220.91	23	850.36	6.79
Web Browsing	Site7_3 (0)	154.01	9,184.22	22.7	121.6	8.12
Web Browsing	Site7_3 (0)	158.92	9,184.22	23	121.6	9.98
Web Browsing	Site7_3 (0)	142.11	34,549.34	22.7	121.6	19.05
Web Browsing	Site5_1 (0)	143.71	9,184.22	22.3	121.6	8.39

Fig 11(b): Dhaka Mainroad Traffic Map Simulation Properties

5.2 Traffic Simulation

LTE traffic simulation properties have been shown in Fig 8. Fig 9 to Fig 13 shows Dhaka airport, railway, mainroad, secondary road and street traffic maps after simulation (in (a)) along with their properties (in (b)). The properties chart shows service, reference cell, total pathloss, transmission power throughput and reference signal CINR.

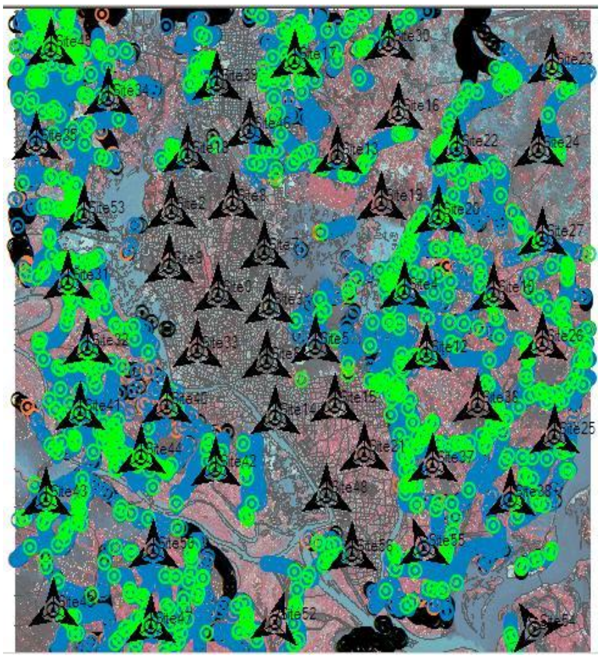


Fig 12(a): Dhaka Secondary Road Traffic Map after Simulation

Service	Reference Cell	Total Path Loss (DL) (dB)	Application Channel Throughput (DL) (kbps)	Application User Throughput (DL) (kbps)	Received Reference Signal Power (DL) (dBm)
FTP Download	Site8_1 (0)	157.72	1,358.92	885.48	-104.29
Web Browsing	Site5_1 (0)	143.94	7,313.29	121.6	-90.51
FTP Download	Site5_1 (0)	146.19	9,457.13	183.93	-92.76
FTP Download	Site5_1 (0)	132.02	11,905.4	231.55	-78.59
Web Browsing	Site5_1 (0)	144.75	3,741.86	121.6	-91.32
FTP Download	Site5_1 (0)	145.41	28,134.82	547.19	-91.98
FTP Download	Site5_1 (0)	158.22	2,344.88	45.61	-104.79
FTP Download	Site14_3 (0)	146.48	7,313.29	258.49	-93.05
FTP Download	Site40_3 (0)	153.4	9,184.22	690.77	-99.97
Web Browsing	Site40_2 (0)	151.49	5,454.8	121.6	-98.06
Web Browsing	Site40_2 (0)	147.17	9,184.22	121.6	-93.74
FTP Download	Site40_2 (0)	150.26	34,549.34	950.01	-96.82
FTP Download	Site44_1 (0)	147.2	4,453.67	94.96	-93.98
FTP Download	Site40_2 (0)	156.74	20,664.17	950	-103.31
FTP Download	Site44_1 (0)	155.27	9,601.68	204.74	-102.06
VoIP	Site32_2 (0)	151.88	766.73	8.97	-101.67
FTP Download	Site40_1 (0)	134.1	34,549.34	950.01	-80.67
FTP Download	Site40_1 (0)	138.61	6,751.42	333.85	-85.18
FTP Download	Site40_1 (0)	151.7	16,373.33	809.65	-98.27
Web Browsing	Site40_3 (0)	140.05	9,184.22	121.6	-86.62
FTP Download	Site40_3 (0)	140.9	28,134.82	950	-87.47
Web Browsing	Site40_3 (0)	143.38	26,349.6	113.89	-89.95
FTP Download	Site44_1 (0)	151.47	990.34	21.12	-98.25
Web Browsing	Site40_2 (0)	152.79	2,657.06	86.35	-99.36
FTP Download	Site42_1 (0)	152.98	7,645.71	108.06	-99.76

Fig 12(b): Dhaka Secondary Road Traffic Map Simulation Properties

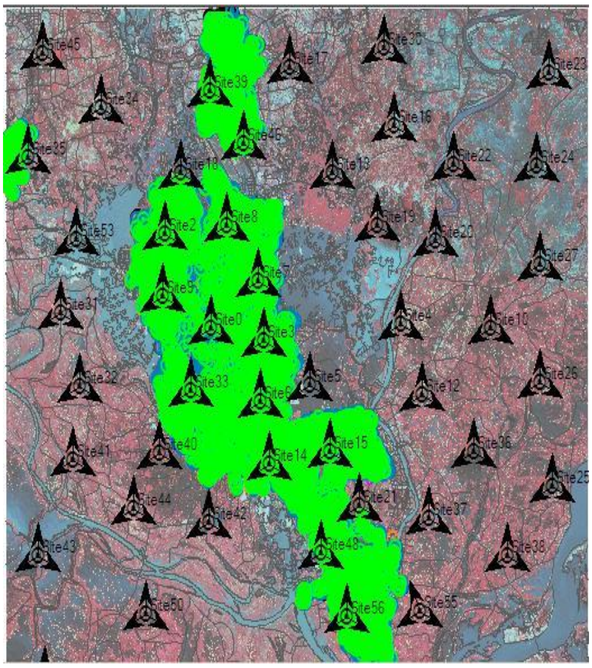


Fig 13(a): Dhaka Street Traffic Map after Simulation

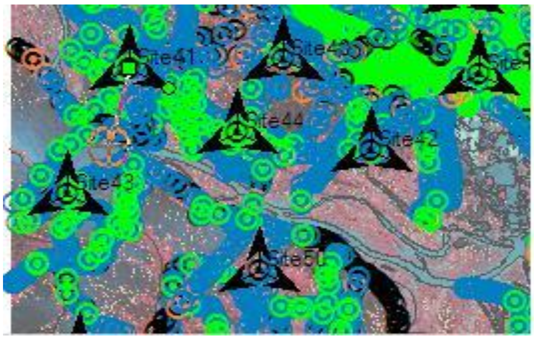
Service	Reference Cell	Total Path Loss (DL) (dB)	Application Channel Throughput (DL) (kbps)	Transmission Power (UL) (dBm)	Application User Throughput (DL) (kbps)	Reference Signal C/(I+N) (DL) (dB)
VoIP	Site33_1 (0)	131.05	29,233.32	23	11.52	16.09
VoIP	Site0_3 (0)	148.31	2,344.88	23	11.59	-1.89
VoIP	Site0_3 (0)	149.77	9,184.22	21.8	11.59	9.05
VoIP	Site33_1 (0)	155.51	9,601.68	23	11.59	7.3
VoIP	Site33_1 (0)	149.75	979.8	22.7	11.47	-5.22
VoIP	Site0_3 (0)	148.79	5,454.8	22.9	11.59	2.37
VoIP	Site9_2 (0)	144.87	5,454.8	23	11.59	1.97
VoIP	Site0_3 (0)	153.11	5,707.35	22.2	9.05	3.07
FTP Download	Site9_2 (0)	143.45	2,344.88	23	0	-1.53
VoIP	Site0_2 (0)	155.62	3,124.55	23	9.68	-0.87
VoIP	Site0_2 (0)	152	7,313.29	22.3	11.59	4.78
VoIP	Site0_2 (0)	160.5	34,549.34	23	11.59	18.85
VoIP	Site0_2 (0)	159.29	9,184.22	23	11.59	7.48
VoIP	Site33_1 (0)	164.29	649.12	23	7.6	-5.78
VoIP	Site0_2 (0)	147.11	2,344.88	23	11.59	-1.61
Video Conferencing	Site3_3 (0)	155.3	3,025.68	22.5	49.16	-0.89
VoIP	Site3_3 (0)	155.12	11,644.85	23	11.34	10.41
VoIP	Site3_3 (0)	150.38	24,271.68	23	11.59	14.46
VoIP	Site3_3 (0)	155.23	8,020.89	23	10.12	6.75
VoIP	Site6_1 (0)	147.99	7,313.29	23	11.59	3.98
VoIP	Site0_2 (0)	139.69	24,271.68	22.7	11.59	15.13
VoIP	Site0_2 (0)	150.29	3,741.86	23	11.59	0.13
VoIP	Site0_2 (0)	142.31	9,184.22	21.7	11.59	9.08
VoIP	Site0_2 (0)	136.15	34,549.34	23	11.59	20.8
VoIP	Site0_1 (0)	139.84	8,659.73	23	10.93	6.97

Fig 13(b): Dhaka Street Traffic Map Simulation Properties

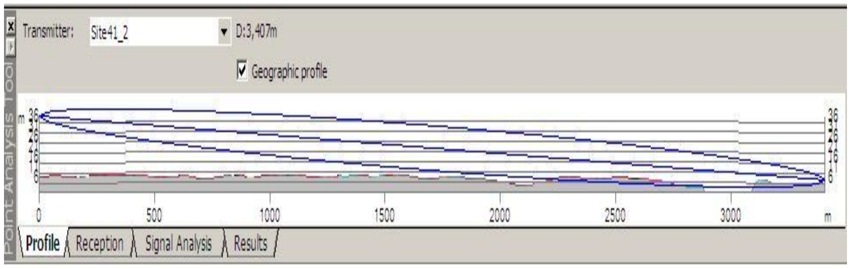
6. PERFORMANCE ANALYSIS OF THE PLANNED NETWORK

Using point analysis tool of Atoll site 41_2 was chosen from the Dhaka map along with a receiver to analyze the cell edge throughput scenario and all other uplink and downlink parameters. The point analysis results appeared as the following shown in Fig 14 (a)-(e). Again, link budget scenario from the point analysis tool for another site 33_3 comes as the one shown in Table 1.This one almost matches with the prepared link budget and other obtained values using link and system simulators in [21].

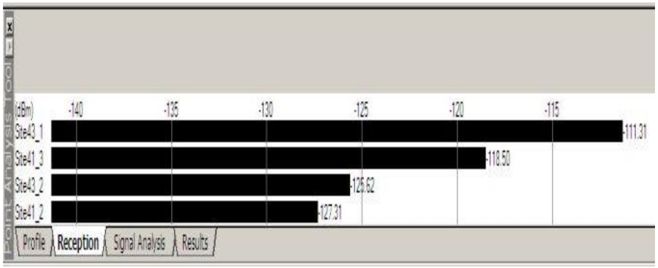
Fig.14 (b): shows the geographic profile of the site 41_2, (c) shows the reception level including the adjacent sites, (d) gives the signal analysis involving SCH & PBCH, Downlink and Uplink parameters of the adjacent sites while (e) provides the result taking the comparatively better transmitters into account.



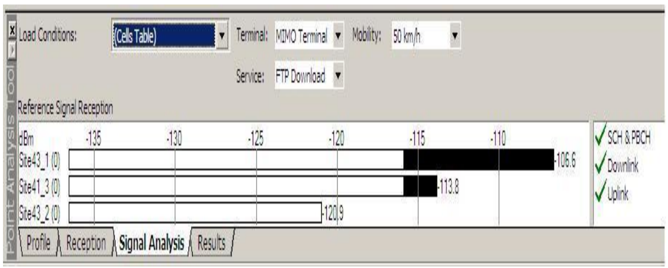
(a)



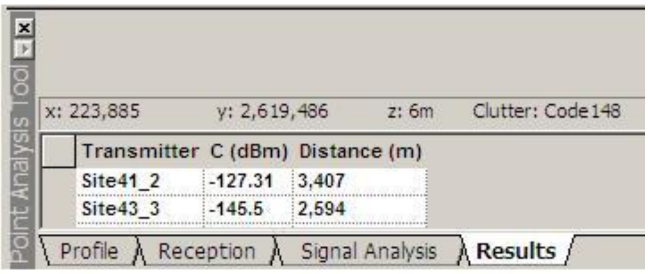
(b)



(c)



(d)



(e)

Fig 14: Chosen site and receiver for point analysis and performance result-(a), (b), (c), (d), (e)

Table 1: Link budget Obtained from point analysis tool

Transmitter:	Site33_3
Receiver:	(230,172 ; 2,626,698)
Distance:	2,571m
Power:	43dBm
EIRP:	53.22dBm
Reception gain:	0 dB
Path Loss:	160.01 dB
Shadowing margin:	4.72 dB
Indoor Loss:	0 dB
Signal Level:	-111.51dBm

Analyzing the coverage prediction results with the placed eNodeB with respect to [21] it is quite evident that the planned network provides a satisfactory coverage. Again, evaluation of traffic map after simulation makes it clear that subscribers mostly remain connected at both UL & DL which also indicates a very positive sign for the planned network. Performance analysis with point analysis tool strengthens the base behind the planned network as an effective one.

7. CONCLUSION AND FUTURE WORK

The ultimate objectives of the present study of LTE radio network planning guidelines are to introduce the relevant LTE features, to define the basic models for radio propagation planning, to estimate coverage and network element count. The prepared guideline may assist in the development of various tools used in Radio Network Planning (RNP). Obtained result of coverage and capacity analysis has been used in nominal and detailed radio planning stage with Atoll taking Dhaka digital map as input. In detail Atoll simulations have been run on Dhaka digital map containing both coverage predictions and traffic simulations. Again, performance evaluation has been done using point analysis tool. For initial network deployment, at the very beginning only a small number of subscribers are considered for coverage and capacity calculation. So, there remains the challenge for future capacity enhancement. But still it can be considered as a standard radio planning platform for the densely populated South-Asian city Dhaka.

8. ACKNOWLEDGMENTS

Our heartiest thanks go to Mohammad Tawhid Kawser, Assistant Prof., EEE Dept., IUT and Mohammad Nur-A-Alam, Solution Manager, Nokia Siemens Network (NSN) for providing numerous help and support in this work.

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