International Journal of Engineering & Technology, 7 (3.25) (2018) 96-99

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Analysis of the Addition e Node B in 4G LTE Network for Coverage Area

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Abstract

As the number of LTE 4G network subscribers increases, telecom operators must expand their coverage area to be able to serve the telecommunications needs of customers. Research on 4G LTE is still interesting to be studied because 4G LTE network is still developed.This study discusses the effect of the addition of e Node B to the coverage area of 4G LTE network. The research method used is survey, simulation. This research is done by taking data of telecommunication operator in north Balikpapan. From the research results for the 4G LTE network need to add 4 e Node B from 14 to 18 e Node B. By addition of e Node B number increased coverage area of 4G LTE network from 89.108 km^2 to 132 km^2

Keywords: *4G, LTE, e Node B*

1. Introduction

The development of telecommunications technology is increasingly growing, this is with the presence of new technologies that have network quality, especially in terms of data speed. Telecommunication technology today is needed for both personal and collective interests. The technology of mobile telecommunication systems is growing every day from first generation to next generation, that is 4G or LTE [1]. LTE is a development of previous technologies of UMTS (3G) and HSPA (3.5G) while LTE is referred to as the 4th generation (4G) given on a Third Generation Partnership Project (3GPP) project to improve the standard 3rd generation mobile phone.

Predicting the next few years LTE network planning in Indonesia is not only focused on the city of its big city just because the data service needs arising from the development of content and applications from smartphones require operators to provide services to support the content and applications [2]. The advantages of LTE compared to the previous technology is the speed of data access, coverage and greater service capacity.

The growing number of telecommunication users in North Balikpapan increasing every year enlarges network traffic, thereby reducing service quality. Operators are expected to be able to face customer complaints that want high quality data access and strong signal. Customers need speed and convenience, especially data communications that are capable of covering the region, thereby providing challenges for service providers.

The quality of the network can be done with real field observations through measuring the quality of a region's 4G signal. The method that can be done is the addition of e Node B site. Therefore, it is important to plan the addition of eNodeB site to cover all areas in North Balikpapan.

2. Literature Review

2.1. 4G LTE (Long Term Evolution)

Telecommunications technology initially only carrying analog technology or better known as 1G or Advanced Mobile Phone Service (AMPS), then developed again to the technology using the first digital technology (2G) and 2G technology previously developed again so that faster data transfer speed known as third generation digital technology (3G) [3].
This latest mobile technology is called LTE (Long Term Evolution) and also LTE-A (Long Term Evolution Advance) technology has DL speed up to 100 Mbps and UL up to 50 Mbps. [1]

The LTE architecture is known as SAE (System Architecture Evolution) which describes an architectural evolution compared to previous technology. Overall LTE adopts EPS (Evolved Packet System) technology. There are three main components: UE (User Equipment), E-UTRAN (Evolved UMTS Terrestrial Radio Access Network), and EPC (Evolved Packet Core).

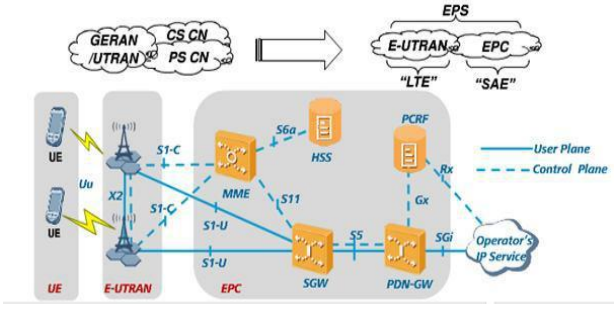

Fig. 1: LTE Architecture [3]

2.2. Long Term Evolution (LTE) Design System

The cell planning process can describe all the activities that will be used in the mobile communication planning process and how to configure it so that it matches the existing conditions of the field. Cell planning begins with analyzing traffic and the desired coverage area by knowing in advance the geographical conditions as well as the amount required to cover all customers. Required data:
a. Area coverage
b. Frequency
c. Number of e Node B
d. Name eNodeB exsisting

Traffic needs describe how we design the systems we design and how we configure them, so that they fit the geographic area of the region. Things to consider in terms of estimating geographic conditions:
1. Population
2. Area area
3. Customers
4. User handset (number of users) [1]

Table 1: LTE design system calculation [4]

No	Calculation	Equation	Description
1	Knowing the population of area X	Un = Uo (1 + Fp) n	Un = Number of population year n Uo = Number of years of initial population planning Fp = Population increase factor n = Year of prediction
2	Site Planning	$N = \frac{BW\ Allocation}{BW\ RF} \ X \ \frac{user\ per\ channel}{Cluster}$	Bandwidth RF Bandwidth Users per channel Cluster Traffic / User Number of cluster cells GOS (service level)
3	Traffic demand per year	$N\ cell = \frac{An}{Acell}$	An = number of subscribers x traffic / user Acell = result of table Erlang
4	Wide cell	$Wide\ cell = \frac{Wide\ area}{N\ cell}$	
5	Radius of cell	$Radius\ of\ cell = \sqrt{\frac{Wide\ cell}{2,6}}$	
6	Total number of e Node B	$Total\ number\ of\ e\ Node\ B = \frac{Wide\ Area}{Wide\ Cell}$	

2.3. Software Atoll

Software Atoll is a software used by RNP engineers (Radio Network Planning) that provides a comprehensive and integrated feature that enables users to create microwave planning projects or radio plans in one application. The function of Atoll software is to see, check, or know the coverage prediction of an area to be examined. Atoll supports GSM / GPRS / EDGE, UMTS / HSPA, LTE, CDMA20001xRTT / EV-DO, TD-SCDMA, WiMAX and Microwave Link

Common features of Atoll are multi tool technology with project dedication templates and model propagation for all technologies, easy to use like Windows Support, to export or import all required data and support copy or paste all data [5].

3. Methodology

Research methods used include:
1. Survey
2. Data processing e Node B Existing
3. Data processing e Node B Additional
4. Analysis of the design results of 4G LTE network

Following the research flow diagram.

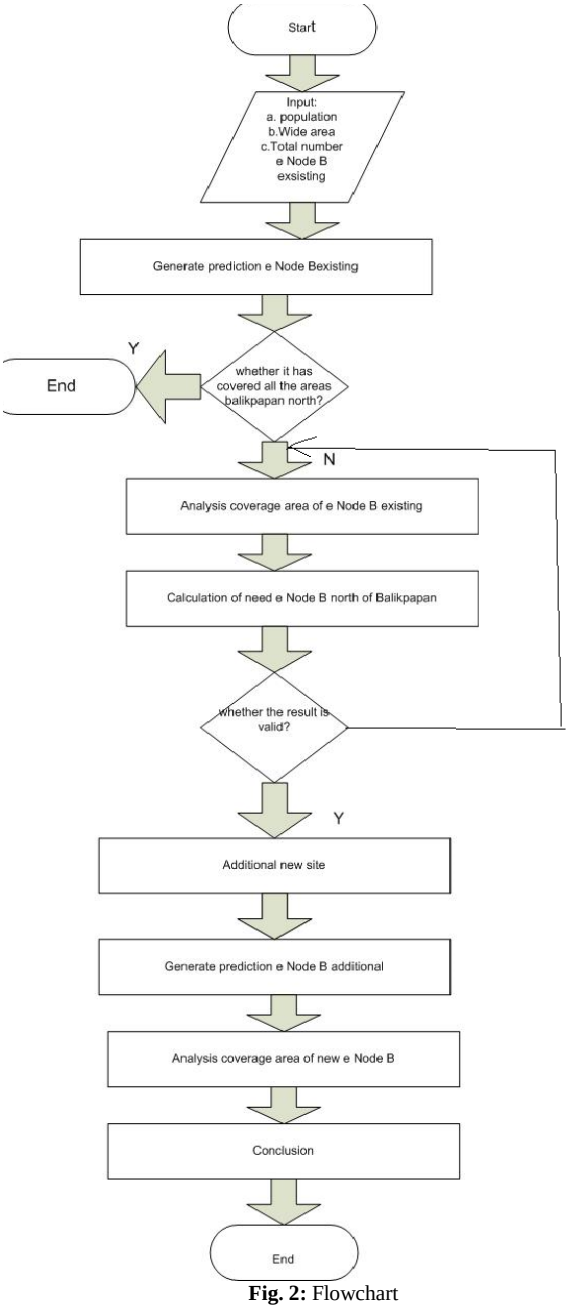

Fig. 2: Flowchart

4. Results and Discussion

4.1 Coverage Area e Node B Existing

Existing existing B node there are 14 units, specifically North Balikpapan area. The following coverage area e Node B existing:

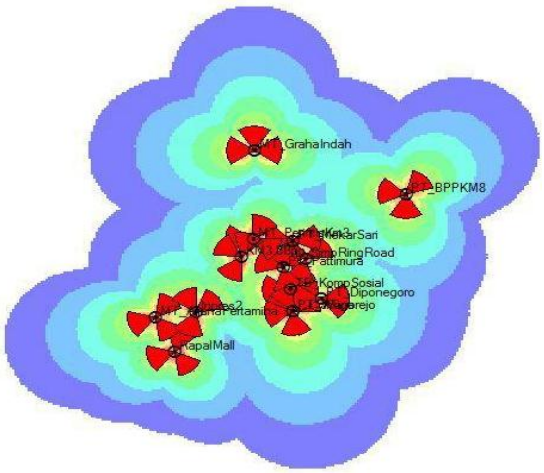

Fig. 3: Coverage area E node B Eksisting

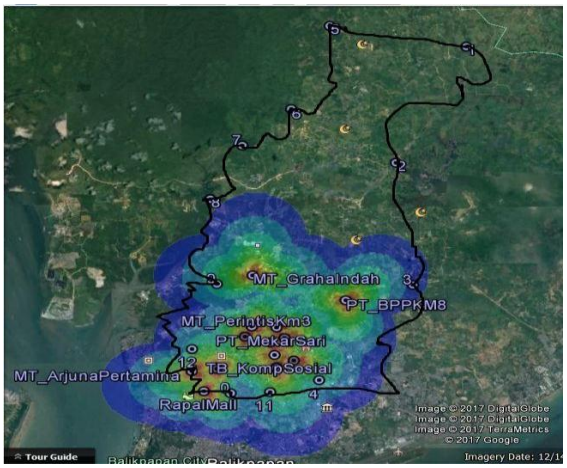

Fig. 4: Display Coverage area on Google earth E Node Eksisiting

Table 2: Report E Node B Eksisting

Zone	Prediction	Legend	Zone surface (km^2)	Surface (km^2)	% of Covered Area
-	Coverage by Signal Level (DL) 2		-	89.108	100
		Best Signal Level (dBm) >=-70	-	2.16	2.424
		Best Signal Level (dBm) >=-75	-	5.29	5.937
		Best Signal Level (dBm) >=-80	-	9.633	10.81
		Best Signal Level (dBm) >=-85	-	15.728	17.65
		Best Signal Level (dBm) >=-90	-	25.258	28.345
		Best Signal Level (dBm) >=-95	-	40.265	45.187
		Best Signal Level (dBm) >=-100	-	59.965	67.295
		Best Signal Level (dBm) >=-105	-	89.108	100

From the report for coverage e Node B existing operator service X amounted to 89.108 km^2, whereas if compared with Balikpapan area north of 132 km^2 then still there is 42,8 km^2 still not reached by service 4G LTE.

4.2 Calculation of the Addition of 4G LTE Node B

Here are the results of site planning calculation of the addition of e Node B

Table 3. Site Planning e Node B calculation results

Year Prediction	Approximate total number of subscribers	Traffic	An (Year)	total number of cell	Cell area	Radius of cell	Total number of e Node B
U2017	114615	30	3438450	26,41	4,9	1,37	27

From the calculation of the addition of e Node B for the North Balikpapan area required 27 e Node B for 4G LTE Operator X service can be felt maximal by the users

4.3 Addition of e Node B

I this study the authors, conducted a survey to the North Balikpapan area to determine the potential location for the addition of new e Node B. From the survey results obtained 4 potential locations to be used as a location, among others: kilometers 10, 13, 15 and 23. Where is the location of the new e Node B additions based on existence:

1.Potensial user (many settlements)
2.Company
3.School

Here is the data of the existing Existing Node B and the additional e Node B shown in table 4

Table 4. Site Planning e Node B calculation results

No	Name	Longtitude	Lattitude	Support Height (meter)
1	Inpres2	116.839611	-1.232692	18
2	Km3,5Bpp	116.848687	-1.219983	12
3	MT_ArjunaPertamina	116.831601	-1.233677	22
4	MT_GrahaIndah	116.851125	-1.195718	25
5	MT_PerintisKm3	116.850890	-1.215954	15
6	PT_BPPKm8	116.881130	-1.205579	22
7	PT_Diponegoro	116.864389	-1.229467	20
8	PT_JlTiga	116.858775	-1.232276	15
9	PT_MekarSari	116.858889	-1.216349	15
10	PT_Pattimura	116.856771	-1.222294	22
11	PT_Wonorejo	116.858775	-1.232276	30
12	RapakMall	116.835441	-1.241643	12
13	SimpRingRoad	116.861427	-1.220498	25
14	TB_KompSosial	116.858216	-1.227231	30

Tabel 5. e Node B Additional

No	Name	Longtitude	Lattitude	Support Height (meter)
1	Km 10	116.886186	-1.186201	20
2	Km 13	116.880530	-1.170545	19
3	Km 15	116.871741	-1.146323	25
4	Km 23	116.903884	-1.109865	24

4.4 Coverage Area Additional e Node B

Below is the result of Coverage area for North Balikpapan in 2017 as much as 18 sites from eNodeB addition.

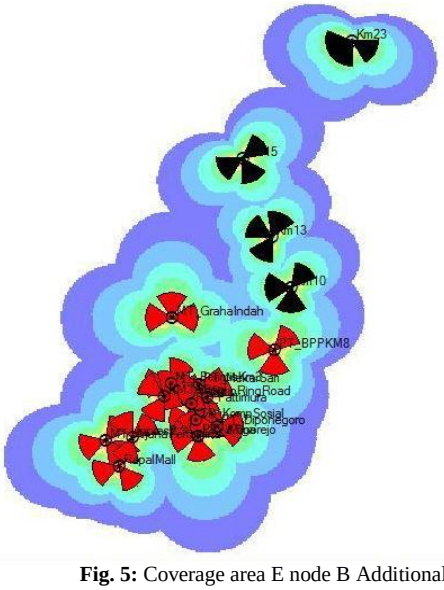

Fig. 5: Coverage area E node B Additional

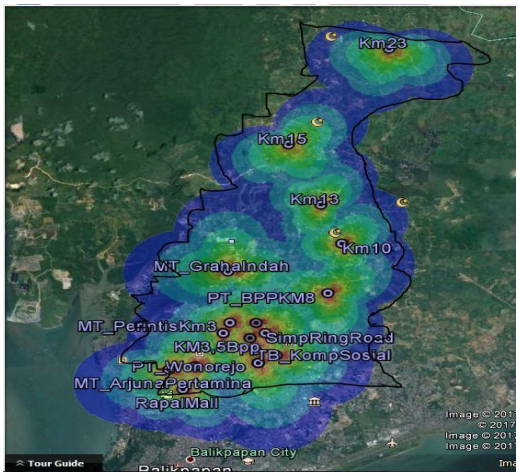

Fig. 6: Display Coverage area on Google earth E Node Additional

Table 6: Report E Node B Additionsl

Zone	Prediction	Legend	Zone surface (km^2)	Surface (km^2)	% of Covered Area
-	Coverage by Signal Level (DL) 1		-	132.48	100
		Best Signal Level (dBm) >=-70	-	2.4	1.812
		Best Signal Level (dBm) >=-75	-	6.298	4.754
		Best Signal Level (dBm) >=-80	-	12.033	9.083
		Best Signal Level (dBm) >=-85	-	20.743	15.657
		Best Signal Level (dBm) >=-90	-	35.118	26.508
		Best Signal Level (dBm) >=-95	-	58.28	43.992
		Best Signal Level (dBm) >=-100	-	89.533	67.582
		Best Signal Level (dBm) >=-105	-	132.48	100

From coverage area report results for e Node B existing and e node B additional operator X has reached all North Balikpapan area of 132.38 km^2. Here is the comparison of coverage coverage of existing e Node B and e Node B additional

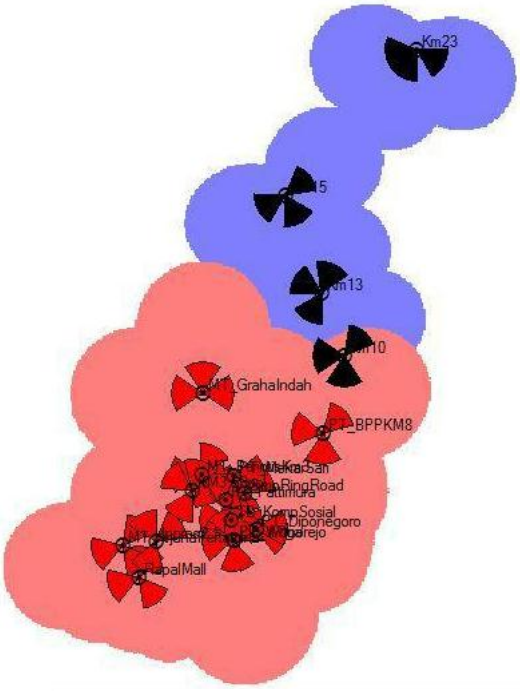

Fig 7: Comparation Coverage area e Existing and additional E Node B

5. Conclusions

From the calculation of the number of e Node B for the area of Balikpapan required as much as 27 e Node B to be able to reach the North of Balikpapan to the maximum. With the addition of at least 4 e Node B has been able to reach all areas of northern Balikpapan 132.48 km^2..Difference of area coverage between existing e node B with additional e node b of width 43,272 km^2

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