LTE PLANNING
Capacity Planning

Wireless Access Communication

Telkom Engineering School

Faculty of Electrical Engineering
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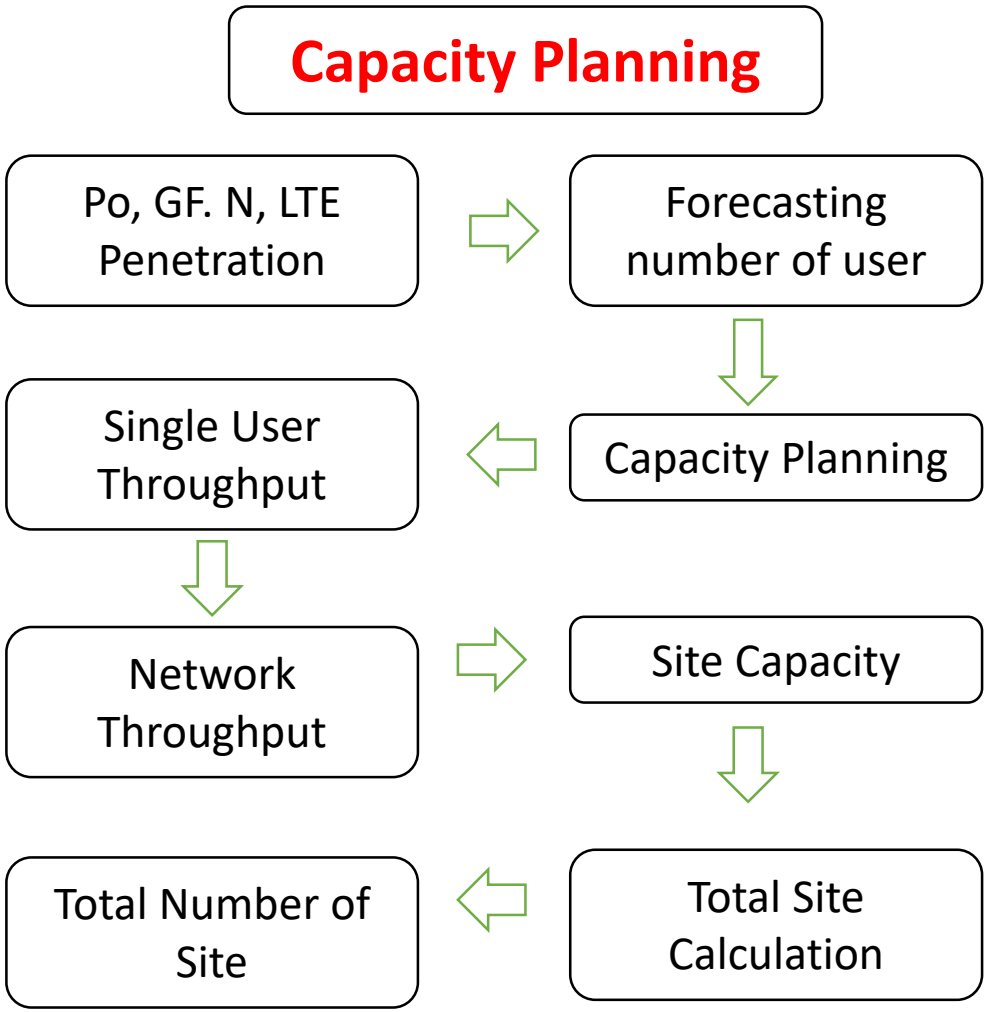
NETWORK PLANNING

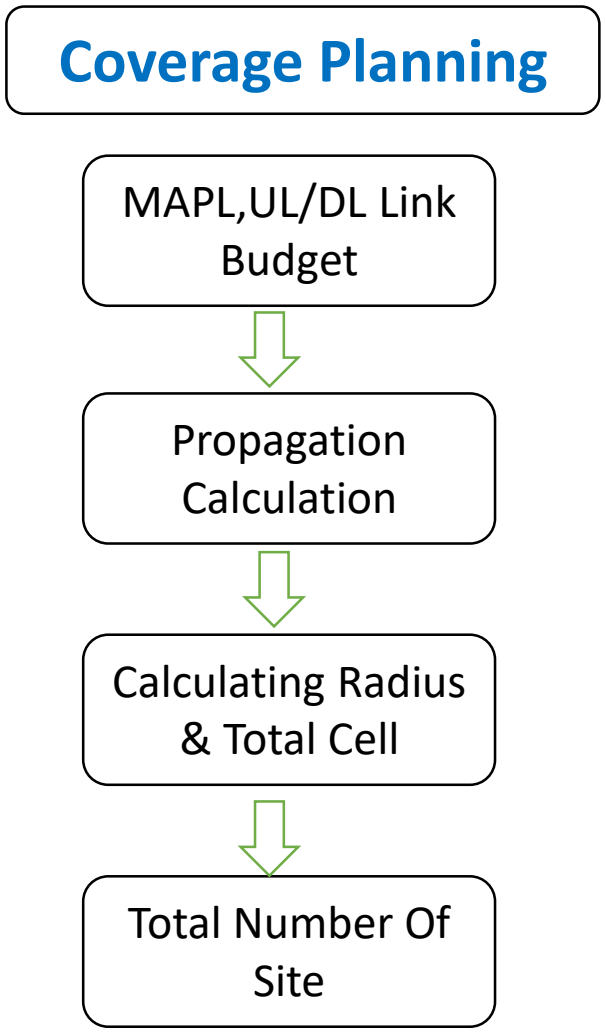
Network Planning is to provide a cost-effective solution for radio network in terms of ***Coverage***, ***Capacity*** and **Quality.**

Cellular network planning:

- Capacity Planning
- Coverage Planning

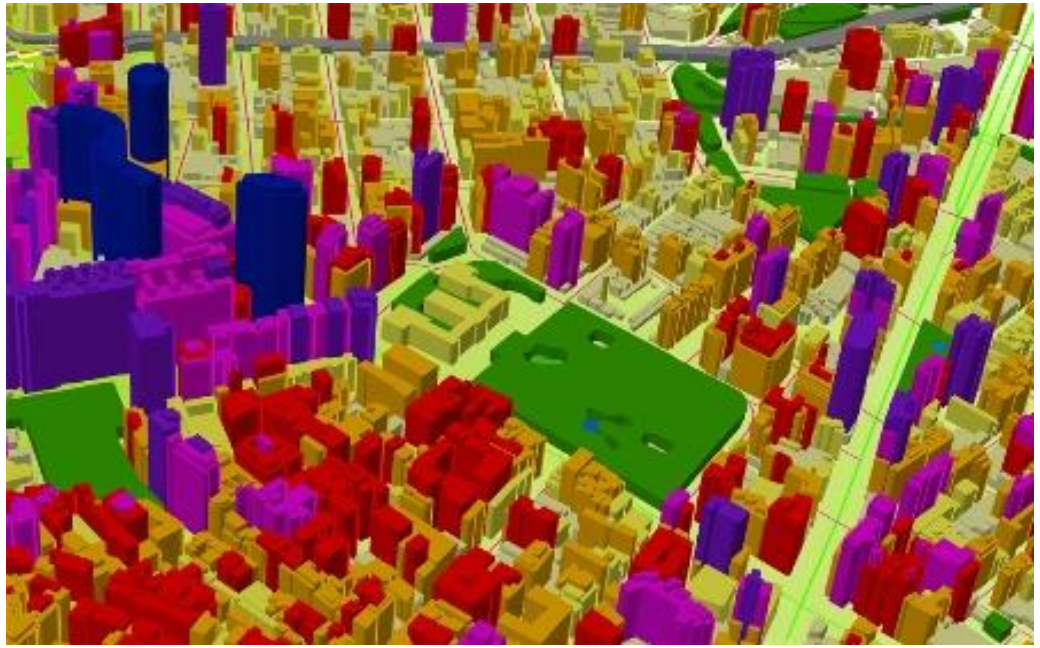
Procedure of Planning





Capacity Planning

Capacity Planning deals with the ability of the network to provide services to the users with a desired level of quality.



Forecasting Number Of User

Forecasting Users is a method to predict number of customer based on specified time.

$$Pn = Po(1 + GF)^n$$

Po = Current Population,
GF = Growth Factor (1.89%)
N = Number of forecasting years

Forecasting Number Of User

Po = 2.483.977
GF = 1,98%
N = 5

$P_5 = 2.483.977 (1+0,0198)^5 = 2.739.824$

Productive population percentage is 64%= 1.753.487
Operator Market Share is 50% = 876.744 user
LTE Penetration of Operator X is 45% = 394.535 user

Service Model Parameter

Throughput = Bearer Rate x Session duty Ratio x $[\frac{1}{(1-BLER)}]$

Session Time = Duration per session
Session duty ratio = Data Transmission Ratio Per Session
BLER = Tolerated Block Error Rate
Bearer Rate = Application Layer Bit Rate
Penetration Rate= How Good Services can affect customers
BHSA= Busy Hour Service Attempt

Service Model

Traffic Parameter	Uplink				Downlink				UL Throughput/Session (Kbps)	DL Throughput/Session (Kbps)
	Bearer Rate (Kbps)	PPP Session Time (s)	PPP Session Duty Ratio	BLER (%)	Bearer Rate (Kbps)	PPP Session Time (s)	PPP Session Duty Ratio	BLER (%)		
VoIP	26.90	80	0.4	1%	26.90	80	0.4	1%	869.4949495	869.4949495
Video Phone	62.53	70	1	1%	62.53	70	1	1%	4421.313131	4421.313131
Video Conference	62.53	1800	1	1%	62.53	1800	1	1%	113690.9091	113690.9091
Real Time Gaming	31.26	1800	0.2	1%	125.06	1800	0.4	1%	11367.27273	90952.72727
Streaming Media	31.26	3600	0.05	1%	250.11	3600	0.95	1%	5683.636364	864016.3636
IMS Signalling	15.63	7	0.2	1%	15.63	7	0.2	1%	22.1030303	22.1030303
Web Browsing	62.53	1800	0.05	1%	250.11	1800	0.05	1%	5684.545455	22737.27273
File Transfer	140.69	600	1	1%	750.34	600	1	1%	85266.66667	454751.5152
Email	140.69	50	1	1%	750.34	15	1	1%	7105.555556	11368.78788
P2P File Sharing	250.11	1200	1	1%	750.34	1200	1	1%	303163.6364	909503.0303

Traffic Model For Various Environment

TRAFFIC MODEL PARAMETER						
User Behaviour	Dense Urban		Urban		Sub Urban	
	Traffic Penetration Ratio	BHSA	Traffic Penetration Ratio	BHSA	Traffic Penetration Ratio	BHSA
VoIP	100%	1.4	100%	1.3	50%	1
Video Phone	20%	0.2	20%	0.16	10%	0.1
Video Conference	20%	0.2	15%	0.15	10%	0.1
Real Time Gaming	30%	0.2	20%	0.2	10%	0.1
Streaming Media	15%	0.2	15%	0.15	5%	0.1
IMS Signalling	40%	5	30%	4	25%	3
Web Browsing	100%	0.6	100%	0.4	40%	0.3
File Transfer	20%	0.3	20%	0.2	20%	0.2
Email	10%	0.4	10%	0.3	10%	0.2
P2P File Sharing	20%	0.2	20%	0.3	20%	0.2

Peak To Average in Environment

Peak to average Ratio is used to assume the highest percentage of excess load on a network to anticipate the surge in traffic of an area.

Peak to Average in Environment	Dense Urban	Urban	Sub Urban
Peak to Average Ratio	40%	20%	10%

Single User Throughput

$$\text{Single User Throughput} = \left[\frac{\sum\left(\frac{Throughput}{Session}\right) \text{x BHSA x Penetration Ratio x (1+Peak to Average Ratio)}}{3600}\right]$$

SINGLE USER THROUGHPUT		
Traffic Parameter	Urban	
	UL	DL
VoIP	1356.412121	1356.412121
Video Phone	169.7784242	169.7784242
Video Conference	3069.654545	3069.654545
Real Time Gaming	545.6290909	4365.730909
Streaming Media	153.4581818	23328.44182
IMS Signalling	31.82836364	31.82836364
Web Browsing	2728.581818	10913.89091
File Transfer	4092.8	21828.07273
Email	255.8	409.2763636
P2P File Sharing	21827.78182	65484.21818
Total	34231.72436	130957.3044
SUT (Kbps)	9.508812323	36.37702899

Network Throughput

UL Network Throughput = Total User Number x UL Single User Throughput
DL Network Throughput = Total User Number x DL Single User Throughput

Total user number *= Forecasting number of users in an operator.*
UL Single User Throughput *=Total Uplink Throughput of a single user in desired service area.*
DL Single User Throughput *=Total downlink throughput of a single user in desired service area.*

NETWORK THROUGHPUT		
Item	Urban	
	UL	DL
Total User	394535	
Network Throughput (IP) (Kbps)	3751555.504	14351996.73
Network Throughput (IP)(Mbps)	3751.555504	14351.99673

Radio Overhead

Protocol Layer	Average Packet Size (Byte)	Relative Efficiency	Symbol
IP	300		
PDCP	302	0,993377483	(A)300/302x100%=99,34%
RLC	304	0,993421052	(B)302/304x100%=99,34%
MAC	306	0,993464952	(C)304/306x100%=99,34%
PHY	-	-	-

The Relative Efficiency from IP layer to MAC layer is : 99,34% x 99,34% x 99,34% = 98%

DL Network Throughput (MAC Layer)= Network Throughput (DL) : (A x B x C)
DL Network Throughput (MAC Layer)= 14.351,99673 *: 0.98 = 14.644,89 Mbps*
UL Network Throughput (MAC Layer)= Network Throughput (UL) : (A x B x C)
UL Network Throughput (MAC Layer)= 3.751,555504 *: 0.98 =* 3.828,117862 *Mbps*

Downlink Cell Capacity

DL Cell Capacity + CRC = (168-36-12) x (Code bits) x (Code Rate) x Nrb x C x 1000

CRC	= 24
168	= The number of RE (Resource Element) in 1 ms
36	= The Number of control channel RE in 1 ms
12	= The number of reference signal RE in 1 ms
Code bits	= Modulation efficient
Code Rate	= Channel coding rate
Nrb	= Number of Resources blocks (RBs)
C	= MIMO Antenna Mode (2x2)

Uplink Cell Capacity

UL Cell Capacity + CRC=(168-24) x (Code bits) x (Code Rate) x Nrb x C x 1000

CRC	= 24
168	= The number of RE (Resource Element) in 1 ms
Code bits	= Modulation efficient
Code Rate	= Channel coding rate
Nrb	= Number of Resources blocks (RBs)
C	= MIMO Antenna Mode (2x2)

Average SINR 1800 MHz Distribution

Average SINR Distribution						
Modulation	SINR (dB)	SINR Probability	UL Cell Throughput (Mbps)	UL Cell Avg. Throughput (Mbps)	DL Cell Throughput (Mbps)	DL Cell Avg. Throughput (Mbps)
QPSK 1/3		0.28	19.20	5.38	16.00	4.48
QPSK 1/2		0.25	28.80	7.20	24.00	6.00
QPSK 2/3		0.17	38.40	6.53	32.00	5.44
16 QAM 1/3		0.13	57.60	7.49	48.00	6.24
16 QAM 1/2		0.1	76.80	7.68	64.00	6.40
16 QAM 2/3		0.05	92.16	4.61	76.80	3.84
64 QAM 1/3		0.01	86.40	0.86	72.00	0.72
64 QAM 1/2		0.01	115.20	1.15	96.00	0.96
Cell Average Throughput (MAC) (Mbps)			40.90		34.08	

TOTAL SITE CALCULATION

Urban	UL	DL
Area Wide	168.23	
Users	394535	
Network Throughput (Mbps)	3828.117862	14644.89462
Cell Average Throughput (Mbps)	40.90	34.08
Site Capacity (Mbps)	122.687928	102.239928
Number of Site	32	144
Number of Users/Site	12329	11577
Cell Coverage (Km2)	5.26	1.17
Cell Radius (Km)	1.642	0.774