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Hasil Perhitungan Coverage

Service Model LTE

<i>Traffic Parameters</i>	<i>Uplink</i>				<i>Downlink</i>			
	<i>Bearer Rate (Kbps)</i>	<i>PPP Session Time (s)</i>	<i>PPP Session Duty Ratio</i>	<i>BLER (%)</i>	<i>Bearer Rate (Kbps)</i>	<i>PPP Session Time (s)</i>	<i>PPP Session Duty Ratio</i>	<i>BLER (%)</i>
VoIP	26,9	108	0,6	1	26,9	108	0,6	1
<i>Video Phone</i>	62,53	36	1	1	62,53	36	1	1
<i>Video Conference</i>	62,53	1800	1	1	62,53	1800	1	1
<i>Real Time Gaming</i>	31,26	1800	0,2	1	125,06	1800	0,4	1
<i>Streaming Media</i>	31,26	3600	0,05	1	250	3600	0,05	1
<i>IMS Signalling</i>	15,63	7	0,2	1	15,63	7	0,2	1
<i>Web Browsing</i>	62,53	1800	0,05	1	250,11	1800	0,05	1
<i>File Transfer</i>	140,69	600	1	1	750,34	600	1	1
<i>Email</i>	140,69	50	1	1	750,34	15	1	1
<i>P2P File Sharing</i>	250,11	1200	1	1	750,34	1200	1	1

a. *Uplink Throughput*

1. VoIP

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 26,9 \text{ Kbps} \times 108 \text{ s} \times 0,6 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 1743,12 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 1760,727273 \text{ Kbit}$$

2. *Video Phone*

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 62,53 \text{ Kbps} \times 36 \text{ s} \times 1 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 2251,08 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 2273,818182 \text{ Kbit}$$

3. **Video Conference**

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 62,53 \text{ Kbps} \times 1800 \text{ s} \times 1 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 112554 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 113690,9091 \text{ Kbit}$$

4. **Real Time Gaming**

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 31,26 \text{ Kbps} \times 1800 \text{ s} \times 0,2 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 11253,6 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 11367,27273 \text{ Kbit}$$

5. **Streaming Media**

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 31,26 \text{ Kbps} \times 3600 \text{ s} \times 0,05 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 5626,8 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 5683,636364 \text{ Kbit}$$

6. IMS Signalling

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 15,63 \text{ Kbps} \times 7 \text{ s} \times 0,2 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 21,882 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 22,1030303 \text{ Kbit}$$

7. Web Browsing

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 62,53 \text{ Kbps} \times 1800 \text{ s} \times 0,05 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 5627,7 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 5684,545455 \text{ Kbit}$$

8. File Transfer

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 140,69 \text{ Kbps} \times 600 \text{ s} \times 1 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 84414 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 85266,66667 \text{ Kbit}$$

9. Email

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 140,69 \text{ Kbps} \times 50 \text{ s} \times 1 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 7034,5 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 7105,555556 \text{ Kbit}$$

10. P2P File Sharing

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 26,9 \text{ Kbps} \times 108 \text{ s} \times 0,6 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 300132 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 303163,6364 \text{ Kbit}$$

b. Downlink Throughput

1. VoIP

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 26,9 \text{ Kbps} \times 108 \text{ s} \times 0,6 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 1743,12 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 1760,727273 \text{ Kbit}$$

2. Video Phone

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 62,53 \text{ Kbps} \times 36 \text{ s} \times 1 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 2251,08 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 2273,818182 \text{ Kbit}$$

3. Video Conference

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 62,53 \text{ Kbps} \times 1800 \text{ s} \times 1 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 112554 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 113690,9091 \text{ Kbit}$$

4. Real Time Gaming

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 125,06 \text{ Kbps} \times 1800 \text{ s} \times 0,4 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 90043,2 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 90952,72727 \text{ Kbit}$$

5. Streaming Media

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 250 \text{ Kbps} \times 3600 \text{ s} \times 0,05 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 45000 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 45454,54545 \text{ Kbit}$$

6. IMS Signalling

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 15,63 \text{ Kbps} \times 7 \text{ s} \times 0,2 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 21,882 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 22,1030303 \text{ Kbit}$$

7. Web Browsing

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 250,11 \text{ Kbps} \times 1800 \text{ s} \times 0,05 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 22509,9 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 22737,27273 \text{ Kbit}$$

8. **File Transfer**

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 750,34 \text{ Kbps} \times 600 \text{ s} \times 1 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 450204 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 454751,5152 \text{ Kbit}$$

9. **Email**

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 750,34 \text{ Kbps} \times 15 \text{ s} \times 1 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 11255,1 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 11368,78788 \text{ Kbit}$$

10. **P2P File Sharing**

$$\text{Throughput} = \text{Bearer Rate} \times \text{Session Time} \times \text{Session Duty Ratio} \times [1/(1 - \text{BLER})]$$

$$\text{Throughput} = 750,34 \text{ Kbps} \times 1200 \text{ s} \times 1 \times [1/(1 - 1\%)]$$

$$\text{Throughput} = 900408 \times (1/0,99) \text{ Kbit}$$

$$\text{Throughput} = 909503,0303 \text{ Kbit}$$

Perhitungan Singel User Thoughtput

Tabel Parameter *Single User Throughput*

<i>Traffic Parameters</i>	<i>Downlink Throughput (Kbit)</i>	<i>Throuhput Downlink (Kbit)</i>	<i>Uplink dan Downlink</i>		
			BHCA	<i>Penetration Ratio (PR) %</i>	<i>Peak to Average Ratio (%)</i>
VoIP	1760,727273	1760,727273	1,4	100	20
<i>Video Phone</i>	2273,818182	2273,818182	0,2	20	20
<i>Video Conference</i>	113690,9091	113690,9091	0,2	20	20
<i>Real Time Gaming</i>	11367,27273	90952,72727	0,2	30	20
<i>Streaming Media</i>	5683,636364	45454,54545	0,2	15	20
<i>IMS Signalling</i>	22,1030303	22,1030303	5	40	20
<i>Web Browsing</i>	5684,545455	22737,27273	0,4	100	20
<i>File Transfer</i>	85266,66667	454751,5152	0,2	20	20
<i>Email</i>	7105,555556	11368,78788	0,2	10	20
<i>P2P File Sharing</i>	303163,6364	909503,0303	0,4	20	20

a. *Uplink Single User Throughput*

1. VoIP

$$Throughput_{SU} = \frac{[(\frac{Throughput}{Session}) \times BHCA \times PR \times (1 + Peak\ to\ Average\ Ratio)]}{3600\ s}$$

$$Throughput_{SU} = \frac{[1760,727273\ Kbit \times 1,4 \times 1 \times (1 + 0,2)]}{3600\ s}$$

$$Throughput_{SU} = \frac{2958,02181}{3600\ s}$$

$$Throughput_{SU} = 0,821672727\ Kbps$$

2. *Video Phone*

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[2273,81818 \text{ Kbit} \times 0,2 \times 0,2 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{1009,143273}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 0,030317576 \text{ Kbps}$$

3. *Video Conferense*

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[113690,909 \text{ Kbit} \times 0,2 \times 0,2 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{5457,16363}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 1,515878788 \text{ Kbps}$$

4. *Real Time Gaming*

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[11367,2727 \text{ Kbit} \times 0,2 \times 0,3 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{818,443634}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 0,227345455 \text{ Kbps}$$

5. *Streaming Media*

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[5683,63636 \text{ Kbit} \times 0,2 \times 0,15 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{204,610909}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 0,056836364 \text{ Kbps}$$

6. IMS Signalling

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[22,1030303 \text{ Kbit} \times 5 \times 0,4 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{53,047273}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 0,014735354 \text{ Kbps}$$

7. Web Browsing

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[5683,63636 \text{ Kbit} \times 0,4 \times 1 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{2728,62545}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 0,757939394 \text{ Kbps}$$

8. File Transfer

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[85266,6667 \text{ Kbit} \times 0,2 \times 0,2 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{4092,80002}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 1,136888889 \text{ Kbps}$$

9. Email

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[7015,55556 \text{ Kbit} \times 0,2 \times 0,1 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{170,533333}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 0,047370370 \text{ Kbps}$$

10. P2P File Sharing

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}} \right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio}) \right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[303163,636 \text{ Kbit} \times 0,4 \times 0,2 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{29103,7091}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 8,084363637 \text{ Kbps}$$

b. Downlink Single User Throughput

1. VoIP

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}} \right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio}) \right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[1760,727273 \text{ Kbit} \times 1,4 \times 1 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{2958,02181}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 0,821672727 \text{ Kbps}$$

2. Video Phone

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}} \right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio}) \right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[2273,81818 \text{ Kbit} \times 0,2 \times 0,2 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{1009,143273}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 0,030317576 \text{ Kbps}$$

3. Video Conferense

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[113690,909 \text{ Kbit} \times 0,2 \times 0,2 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{5457,16363}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 1,515878788 \text{ Kbps}$$

4. **Real Time Gaming**

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[90952,7273 \text{ Kbit} \times 0,2 \times 0,3 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{6548,596366}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 1,819054545 \text{ Kbps}$$

5. **Streaming Media**

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[45454,5455 \text{ Kbit} \times 0,2 \times 0,15 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{1636,36364}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 0,454545455 \text{ Kbps}$$

6. **IMS Signalling**

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[22,1030303 \text{ Kbit} \times 5 \times 0,4 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{53,047273}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 0,014735354 \text{ Kbps}$$

7. *Web Browsing*

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[22737,2727 \text{ Kbit} \times 0,4 \times 1 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{10913,8909}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 3,031636364 \text{ Kbps}$$

8. *File Transfer*

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[454751,515 \text{ Kbit} \times 0,2 \times 0,2 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{21828,0727}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 6,063353536 \text{ Kbps}$$

9. *Email*

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[11368,7879 \text{ Kbit} \times 0,2 \times 0,1 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{272,850910}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 0,075791919 \text{ Kbps}$$

10. *P2P File Sharing*

$$\text{Throughput}_{SU} = \frac{\left[\left(\frac{\text{Throughput}}{\text{Session}}\right) \times \text{BHCA} \times \text{PR} \times (1 + \text{Peak to Average Ratio})\right]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{[909503,03 \text{ Kbit} \times 0,4 \times 0,2 \times (1+0,2)]}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = \frac{87312,2909}{3600 \text{ s}}$$

$$\text{Throughput}_{SU} = 24,25341414 \text{ Kbps}$$

c. Total Uplink Single Throughput

$$\begin{aligned} \Sigma \text{Throughput}_{SU} = & 0,821672727 \text{ Kbps} + 0,030317576 \text{ Kbps} + \\ & 1,515878788 \text{ Kbps} + 0,227345455 \text{ Kbps} + \\ & 0,056836364 \text{ Kbps} + 0,014735354 \text{ Kbps} + \\ & 0,757939394 \text{ Kbps} + 1,136888889 \text{ Kbps} + \\ & 0,047370370 \text{ Kbps} + 8,084363637 \text{ Kbps} \end{aligned}$$

$$\Sigma \text{Throughput}_{SU} = 12,69334855 \text{ Kbps}$$

d. Total Downlink Single Throughput

$$\begin{aligned} \Sigma \text{Throughput}_{SU} = & 0,821672727 \text{ Kbps} + 0,030317576 \text{ Kbps} + \\ & 1,515878788 \text{ Kbps} + 1,819054545 \text{ Kbps} + \\ & 0,454545455 \text{ Kbps} + 0,014735354 \text{ Kbps} + \\ & 3,031636364 \text{ Kbps} + 6,063353536 \text{ Kbps} + \\ & 0,075791919 \text{ Kbps} + 24,25341414 \text{ Kbps} \end{aligned}$$

$$\Sigma \text{Throughput}_{SU} = 38,0804004 \text{ Kbps}$$

Network Throughput Mall Nipah Makassar

Total Pelanggan	Uplink Single User Throughput	Downlink Single User Throughput
5000	12,69334855 Kbps	38,0804004 Kbps

1. Uplink Network Throughput

$$\text{UL Network Throughput} = \text{Total Pelanggan} \times \text{Uplink Throughput}_{SU}$$

UL Network Throughput = $5000 \times 12,69334855$ Kbps

UL Network Throughput = 63466,74275 Kbps

UL Network Throughput = 63,46674275 Mbps

2. Downlink Network Throughput

DL Network Throughput = Total Pelanggan \times Downlink Throughput_{SU}

DL Network Throughput = $5000 \times 38,0804004$ Kbps

DL Network Throughput = 190402,002 Kbps

DL Network Throughput = 190,402002 Mbps

Cell Throughput

a. Uplink Cell Throughput 1800 Mhz

- **Modulasi 16 QAM**
- **Code Rate 1/2**
- **Bandwith LTE 1800 = 15 Mhz (PRB=75)**
- **SISO**

<i>Code Bit</i>	<i>Code Rate</i>	<i>Number of Resource Block (Nrb)</i>	<i>Antena Mode</i>	<i>1 Resource Element (CRC)</i>
4 bit	0,5 per sekon	75	1	24

$$UL\ Cell\ Throughput = ((168 - 24) \times Code\ Bit \times Code\ Rate \times Nrb \times C \times 1000) - 24$$

$$UL\ Cell\ Throughput = (144 \times 4 \times 0,5 \times 75 \times 1 \times 1000) - 24$$

$$UL\ Cell\ Throughput = 21600000 - 24$$

$$UL\ Cell\ Throughput = 21599976\ Kbps$$

$$\text{UL Cell Throughput} = 21,599976 \text{ Mbps}$$

b. Uplink Cell Throughput 2300 Mhz

- **Modulasi 16 QAM**
- **Code Rate $\frac{1}{2}$**
- **Bandwith LTE 1800 = 20 Mhz (PRB 100) = 100**
- **SISO**

<i>Code Bit</i>	<i>Code Rate</i>	<i>Number of Resource Block (Nrb)</i>	<i>Antena Mode</i>	<i>1 Resource Element (CRC)</i>
4 bit	0,5 per sekon	100	1	24

$$\text{UL Cell Throughput} = ((168 - 24) \times \text{Code Bit} \times \text{Code Rate} \times \text{Nrb} \times C \times 1000) - 24$$

$$\text{UL Cell Throughput} = (144 \times 4 \times 0,5 \times 100 \times 1 \times 1000) - 24$$

$$\text{UL Cell Throughput} = 28800000 - 24$$

$$\text{UL Cell Throughput} = 28799976 \text{ bps}$$

$$\text{UL Cell Throughput} = 28,799976 \text{ Mbps}$$

$$\text{Total Uplink Cell Throughput 4,5G} = (\text{LTE 1800} + \text{LTE 2300})$$

$$\text{Total Uplink Cell Throughput 4,5G} = 21,599976 + 28,799976 \text{ Mbps}$$

$$\text{Total Uplink Cell Throughput 4,5G} = 50,399952 \text{ Mbps}$$

c. Downlink Cell Throughput

Uplink Cell Throughput 1800 Mhz

- **Modulasi 64 QAM**

- **Code Rate 3/4**
- **Bandwith LTE 1800 = 15 Mhz (PRB=75)**
- **MIMO 2x2**

Parameter Downlink Cell Throughput

<i>Code Bit</i>	<i>Code Rate</i>	<i>Number of Resource Block (Nrb)</i>	<i>Mimo Mode</i>	<i>1 Resource Element (CRC)</i>
6 bit	0,75 per sekon	75	2	24

$$DL\ Cell\ Throughput = ((168 - 36 - 12) \times Code\ Bit \times Code\ Rate \times Nrb \times C \times 1000) - 24$$

$$DL\ Cell\ Throughput = (120 \times 8 \times 0,75 \times 75 \times 2 \times 1000) - 24$$

$$DL\ Cell\ Throughput = 108000000 - 24$$

$$DL\ Cell\ Throughput = 107999976\ bps$$

$$DL\ Cell\ Throughput = 107,999976\ Mbps$$

d. Downlink Cell Throughput

Uplink Cell Throughput 2300 Mhz

- **Modulasi 64 QAM**
- **Code Rate 3/4**
- **Bandwith LTE 1800 = 20 Mhz (PRB=100)**
- **MIMO 2x2**

Parameter Downlink Cell Throughput

<i>Code Bit</i>	<i>Code Rate</i>	<i>Number of Resource Block (Nrb)</i>	<i>Mimo Mode</i>	<i>1 Resource Element (CRC)</i>
6 bit	0,75 per sekon	100	2	24

$$DL\ Cell\ Throughput = ((168 - 36 - 12) \times Code\ Bit \times Code\ Rate \times Nrb \times C \times 1000) - 24$$

$$DL\ Cell\ Throughput = (120 \times 8 \times 0,75 \times 100 \times 2 \times 1000) - 24$$

$$DL\ Cell\ Throughput = 144000000 - 24$$

$$DL\ Cell\ Throughput = 143999976\ bps$$

$$DL\ Cell\ Throughput = 143,999976\ Mbps$$

$$Total\ Downlink\ Cell\ Throughput\ 4,5G = (LTE\ 1800 + LTE\ 2300)$$

$$Total\ Downlink\ Cell\ Throughput\ 4,5G$$

$$= 107,999976 + 143,999976\ Mbps$$

$$Total\ Downlink\ Cell\ Throughput\ 4,5G = 251,999952\ Mbps$$

Jumlah Sel MALL NIPAH MAKASSAR

Parameter	<i>Uplink</i> (Mbps)	<i>Downlink</i> (Mbps)
<i>Network Throughput</i>	63,46674275	190,402002
<i>Cell Throughput</i>	50,3995	252,999952

1. Jumlah Sel *Uplink*

$$\text{Jumlah Sel} = \frac{\text{Network Throughput}}{\text{Cell Throughput}}$$

$$\text{Jumlah Sel} = \frac{63,46674275 \text{ Mbps}}{50,3995 \text{ Mbps}}$$

$$\text{Jumlah Sel} = 1,259$$

$$\text{Jumlah Sel} = 2$$

2. Jumlah Sel *Downlink*

$$\text{Jumlah Sel} = \frac{\text{Network Throughput}}{\text{Cell Throughput}}$$

$$\text{Jumlah Sel} = \frac{190,402002 \text{ Mbps}}{252,999952 \text{ Mbps}}$$

$$\text{Jumlah Sel} = 0,7525771$$

$$\text{Jumlah Sel} = 1$$

Planning Coverage

MAPL Uplink LTE 1800

1. EIRP

<i>Max. Tx Power</i> (P_{Max-Tx})	<i>Tx. Antenna Gain</i> ($G_{Antenna-Tx}$)	<i>Line Loss</i> (L_{Cable})
23 dBm	0 dBi	0 dBi

$$EIRP_{UL} = P_{Max-Tx} + G_{Antenna-Tx} - L_{Cable}$$

$$EIRP_{UL} = 23 + 0 - 0$$

$$EIRP_{UL} = 23 \text{ dBm}$$

2. Receiver Noise Floor

<i>Noise Figure</i> (NF)	<i>Thermal Noise</i> (P_n)
2,3 dB	-102,6

$$Nf_{Rx} = NF + P_n$$

$$Nf_{Rx} = 2,3 + (-102,69)$$

$$Nf_{Rx} = -100,39 \text{ dBm}$$

3. Receiver Sensitivity

<i>Receiver Noise Floor</i> (NF)	SINR
-100,39 dB	11

$$S_{Rx} = Nf_{Rx} + SINR$$

$$S_{Rx} = -100,39 + 11$$

$$S_{Rx} = -89,39 \text{ dBm}$$

4. MAPL

Parameter	Nilai
EIRP	23 dBm
<i>Receiver Sensitivity</i> (S_{Rx})	-89,39 dBm
Interference Margin (IM)	4 dB
Rx. <i>Antenna Gain</i> ($G_{Antenna-Rx}$)	0 dBi
Rx. <i>Line Loss</i> (L_{Body})	0 dB

$$MAPL_{UL-LTE} = EIRP_{UL} - S_{Rx} - IM - G_{Antenna-Rx} + L_{Body}$$

$$MAPL_{UL-LTE} = 23 - (-89,39) - 4 - 0 + 0$$

$$MAPL_{UL-LTE} = 108,39 \text{ dB}$$

MAPL *Uplink* LTE 2300

5. EIRP

<i>Max. Tx Power</i> (P_{Max-Tx})	<i>Tx. Antenna Gain</i> ($G_{Antenna-Tx}$)	<i>Line Loss</i> (L_{Cable})
23 dBm	0 dBi	0 dBi

$$EIRP_{UL} = P_{Max-Tx} + G_{Antenna-Tx} - L_{Cable}$$

$$EIRP_{UL} = 23 + 0 - 0$$

$$EIRP_{UL} = 23 \text{ dBm}$$

6. Receiver Noise Floor

<i>Noise Figure (NF)</i>	<i>Thermal Noise (Pn)</i>
4,5 dB	-101,4

$$Nf_{Rx} = NF + Pn$$

$$Nf_{Rx} = 4,5 + (-101,4)$$

$$Nf_{Rx} = -96,94 \text{ dBm}$$

7. Receiver Sensitivity

<i>Receiver Noise Floor (NF)</i>	SINR
-96,94 dB	11

$$S_{Rx} = Nf_{Rx} + \text{SINR}$$

$$S_{Rx} = -96,94 + 11$$

$$S_{Rx} = -85,94 \text{ dBm}$$

8. MAPL

Parameter	Nilai
EIRP	23 dBm
<i>Receiver Sensitivity (S_{Rx})</i>	-85,94 dBm
Interference Margin (IM)	4 dB
Rx. <i>Antenna Gain (G_{Antenna-Rx})</i>	0 dBi
Rx. <i>Line Loss (L_{Body})</i>	0 dB

$$\text{MAPL}_{\text{UL-LTE}} = \text{EIRP}_{\text{UL}} - S_{\text{Rx}} - \text{IM} - G_{\text{Antenna-Rx}} + L_{\text{Body}}$$

$$\text{MAPL}_{\text{UL-LTE}} = 23 - (-85,94) - 4 - 0 + 0$$

$$\text{MAPL}_{\text{UL-LTE}} = 104,94 \text{ dB}$$

MAPL *Downlink* LTE

a. Frekuensi 1800 MHz

1. EIRP

<i>Max. Tx Power</i> ($P_{\text{Max-Tx}}$)	<i>Tx. Antenna Gain</i> ($G_{\text{Antenna-Tx}}$)	<i>Line Loss</i> (L_{Cable})
23 dBm	0 dBi	0 dBi

$$\text{EIRP}_{\text{UL}} = P_{\text{Max-Tx}} + G_{\text{Antenna-Tx}} - L_{\text{Cable}}$$

$$\text{EIRP}_{\text{UL}} = 23 + 0 - 0$$

$$\text{EIRP}_{\text{UL}} = 23 \text{ dBm}$$

2. Receiver Noise Floor

<i>Noise Figure</i> (NF)	<i>Thermal Noise</i> (Pn)
7 dB	-102,6

$$Nf_{\text{Rx}} = \text{NF} + Pn$$

$$Nf_{\text{Rx}} = 7 + (-102,6)$$

$$Nf_{\text{Rx}} = -95,6 \text{ dBm}$$

3. Receiver Sensitivity

<i>Receiver Noise Floor</i> (NF)	SINR
-95,6dB	20

$$S_{Rx} = Nf_{Rx} + \text{SINR}$$

$$S_{Rx} = -95,6 + 20$$

$$S_{Rx} = -75,6 \text{ dBm}$$

4. MAPL

Parameter	Nilai
EIRP	23 dBm
<i>Receiver Sensitivity</i> (S_{Rx})	-75,6dBm
Interference Margin (IM)	8 dB
Rx. <i>Antenna Gain</i> ($G_{Antenna-Rx}$)	0 dBi
Rx. <i>Line Loss</i> (L_{Body})	0 dB

$$\text{MAPL}_{\text{DL-LTE}} = \text{EIRP}_{\text{DL}} - S_{\text{Rx}} - \text{IM} - G_{\text{Antenna-Rx}} + L_{\text{Body}}$$

$$\text{MAPL}_{\text{DL-LTE}} = 23 - (-75,6) - 8 - 0 + 0$$

$$\text{MAPL}_{\text{DL-LTE}} = 90,6 \text{ dB}$$

b. Frekuensi 2300 MHz

5. EIRP

<i>Max. Tx Power</i> ($P_{\text{Max-Tx}}$)	<i>Tx. Antenna Gain</i> ($G_{\text{Antenna-Tx}}$)	<i>Line Loss</i> (L_{Cable})
23 dBm	0 dBi	0 dBi

$$\text{EIRP}_{\text{UL}} = P_{\text{Max-Tx}} + G_{\text{Antenna-Tx}} - L_{\text{Cable}}$$

$$\text{EIRP}_{\text{UL}} = 23 + 0 - 0$$

$$\text{EIRP}_{\text{UL}} = 23 \text{ dBm}$$

6. Receiver Noise Floor

<i>Noise Figure (NF)</i>	<i>Thermal Noise (Pn)</i>
7 dB	-101,4

$$Nf_{Rx} = NF + Pn$$

$$Nf_{Rx} = 7 + (-101,4)$$

$$Nf_{Rx} = -94,4 \text{ dBm}$$

7. Receiver Sensitivity

<i>Receiver Noise Floor (NF)</i>	SINR
-94,4dB	20

$$S_{Rx} = Nf_{Rx} + \text{SINR}$$

$$S_{Rx} = -94,4 + 20$$

$$S_{Rx} = -74,4 \text{ dBm}$$

8. MAPL

Parameter	Nilai
EIRP	23 dBm
<i>Receiver Sensitivity (S_{Rx})</i>	-74,4 dBm
Interference Margin (IM)	8 dB
Rx. <i>Antenna Gain (G_{Antenna-Rx})</i>	0 dBi
Rx. <i>Line Loss (L_{Body})</i>	0 dB

$$\text{MAPL}_{\text{DL-LTE}} = \text{EIRP}_{\text{DL}} - S_{\text{Rx}} - \text{IM} - G_{\text{Antenna-Rx}} + L_{\text{Body}}$$

$$\text{MAPL}_{\text{DL-LTE}} = 23 - (-74,4) - 8 - 0 + 0$$

$$\text{MAPL}_{\text{DL-LTE}} = 89,4 \text{ dB}$$

Propagasi Cost-231 Multiwall Indoor MALL NIPAH MAKASSAR

1. Propagasi Arah Uplink

- Frekuensi Centre = 1775 Mhz

Total Path Loss (L_P)	Tinggi Transmitter (h_{Ms})	Tinggi Receiver (h_{Bs})
108,4 dB	1,5 m	10 m

Propagation Model Cost 231 Multiwall Indoor

$$L_{\text{Cost 231 MW}} = L_{\text{FSL}} + \sum_{i=1}^l K_{wi} L_{wi} + K_f \left[\frac{k_f+2}{k_f+1} - b \right] L_f$$

Dimana,

$$L_{\text{Free Space } L_{pss}} = 32,45 + 20 \log d \text{ (km)} + 20 \log f \text{ (Mhz)},$$

$\sum_{i=1}^l K_{wi} L_{wi}$ adalah loss horizontal, dimana K_w = Jumlah dinding dan L_w =

Loss Dinding

$K_f \left[\frac{k_f+2}{k_f+1} - b \right] L_f$ adalah loss vertical, dimana K_f = Jumlah Lantai dan L_f = Loss

Lantai

Maka,

$$L_{\text{Free Space } L_{pss}} = 32,45 + 20 \log d \text{ (km)} + 20 \log 1775 \text{ (Mhz)}$$

$$L_{Free\ Space\ Lpss} = 32,45 + 20 \log d (km) + 64,98$$

$$L_{Free\ Space\ Lpss} = 20 \log d (km) + 97,43 \dots \dots \dots (1)$$

Kemudian, Loss vertical sebagai berikut :

$$\sum_{i=1}^l K_{wi} L_{wi} =$$

Material	Loss	Jumlah	Total
Kaca	0,8	2	1,6
Beton	3,4	4	13,6

$$\sum_{i=1}^l K_{wi} L_{wi} = 15,2 \text{ dB} \dots \dots \dots (2)$$

Loss Vertikal adalah sebagai berikut :

$$K_f^{\left[\frac{k_f+2}{k_f+1} - b \right]} L_f =$$

$$K_f = 4 \text{ Lantai}, L_f = 3,4 \text{ (Beton)}$$

$$b = \text{Empirical Parameter} = 0,6$$

Maka,

$$K_f^{\left[\frac{k_f+2}{k_f+1} - b \right]} L_f = 9,48 \dots \dots \dots (3)$$

Maka,

$$L_{Cost\ 231\ MW} = L_{FSL} + \sum_{i=1}^l K_{wi} L_{wi} + K_f^{\left[\frac{k_f+2}{k_f+1}-b\right]} L_f$$

$$108,4 = 97,43 + 20 \log d (km) + 15,2 + 9,48$$

$$108,4 = 122,11 + 20 \log d (km)$$

$$-13,718 = 20 \log d (km)$$

$$d(km) = 0,2061$$

$$d(m) = 206,1\ m$$

2. Propagasi Arah Uplink

- Frekuensi Centre = 2310 Mhz

Total Path Loss (L_P)	Tinggi Transmitter (h_{Ms})	Tinggi Receiver (h_{Bs})
104,94 dB	1,5 m	10 m

Propagation Model Cost 231 Multiwall Indoor

$$L_{Cost\ 231\ MW} = L_{FSL} + \sum_{i=1}^l K_{wi} L_{wi} + K_f^{\left[\frac{k_f+2}{k_f+1}-b\right]} L_f$$

Dimana,

$$L_{Free\ Space\ Lpss} = 32,45 + 20 \log d (km) + 20 \log f (Mhz),$$

$\sum_{i=1}^l K_{wi} L_{wi}$ adalah loss horizontal, dimana K_w = Jumlah dinding dan L_w =

Loss Dinding

$K_f^{\left[\frac{k_f+2}{k_f+1}-b\right]}$ adalah loss vertical, dimana K_f = Jumlah Lantai dan L_f = Loss

Lantai

Maka,

$$L_{Free\ Space\ Lpss} = 32,45 + 20 \log d (km) + 20 \log 2310 (Mhz)$$

$$L_{Free\ Space\ Lpss} = 32,45 + 20 \log d (km) + 67,27$$

$$L_{Free\ Space\ Lpss} = 20 \log d (km) + 99,72 \dots \dots \dots (1)$$

Kemudian, Loss Horizontal sebagai berikut :

$$\sum_{i=1}^l K_{wi} L_{wi} =$$

Material	Loss	Jumlah	Total
Kaca	0,8	2	1,6
Beton	3,4	4	13,6

$$\sum_{i=1}^l K_{wi} L_{wi} = 15,2 \text{ dB} \dots \dots \dots (2)$$

Loss Vertical adalah sebagai berikut :

$$K_f^{\left[\frac{k_f+2}{k_f+1}-b\right]} L_f =$$

$$K_f = 4 \text{ Lantai}, L_f = 3,4 \text{ (Beton)}$$

$$b = \text{Empirical Parameter} = 0,46$$

Maka,

$$K_f^{\left[\frac{k_f+2}{k_f+1}-b\right]} L_f = 9,48 \dots \dots \dots (3)$$

Maka,

$$L_{Cost\ 231\ MW} = L_{FSL} + \sum_{i=1}^l K_{wi} L_{wi} + K_f^{\left[\frac{k_f+2}{k_f+1}-b\right]} L_f$$

$$104,94 = 99,72 + 20 \log d (km) + 15,2 + 9,48$$

$$104,94 = 124,4065 + 20 \log d (km)$$

$$-19,46 = 20 \log d (km)$$

$$d(km) = 0,1063$$

$$d(m) = 106,33\ m$$

3. Propagasi Arah Downlink

- Frekuensi Centre = 1775 Mhz

Total Path Loss (L_P)	Tinggi Transmitter (h_{Ms})	Tinggi Receiver (h_{Bs})
90,6 dB	10 m	1,5 m

Propagation Model Cost 231 Multiwall Indoor

$$L_{Cost\ 231\ MW} = L_{FSL} + \sum_{i=1}^l K_{wi} L_{wi} + K_f^{\left[\frac{k_f+2}{k_f+1}-b\right]} L_f$$

Dimana,

$$L_{Free\ Space\ Lpss} = 32,45 + 20 \log d (km) + 20 \log f (Mhz),$$

$\sum_{i=1}^l K_{wi} L_{wi}$ adalah loss horizontal, dimana K_w = Jumlah dinding dan L_w = Loss Dinding

$K_f^{\left[\frac{k_f+2}{k_f+1}-b\right]} L_f$ adalah loss vertical, dimana K_f = Jumlah Lantai dan L_f = Loss Lantai

Maka,

$$L_{Free\ Space\ Lpss} = 32,45 + 20 \log d (km) + 20 \log 1775 (Mhz)$$

$$L_{Free\ Space\ Lpss} = 32,45 + 20 \log d (km) + 64,98$$

$$L_{Free\ Space\ Lpss} = 20 \log d (km) + 97,43 \dots \dots \dots (1)$$

Kemudian, Loss vertical sebagai berikut :

$$\sum_{i=1}^l K_{wi} L_{wi} =$$

Material	Loss	Jumlah	Total
Kaca	0,8	2	3,2
Beton	3,4	4	13,6

$$\sum_{i=1}^l K_{wi} L_{wi} = 15,2 \text{ dB} \dots \dots \dots (2)$$

Loss Horizontal adalah sebagai berikut :

$$K_f^{\left[\frac{k_f+2}{k_f+1}-b\right]} L_f =$$

$K_f = 4$ Lantai, $L_f = 3,4$ (Beton)

$b =$ Empirical Parameter $= 0,46$

Maka,

$$K_f^{\left[\frac{k_f+2}{k_f+1}-b\right]} L_f = 9,48 \dots \dots \dots (3)$$

Maka,

$$L_{Cost\ 231\ MW} = L_{FSL} + \sum_{i=1}^l K_{wi} L_{wi} + K_f^{\left[\frac{k_f+2}{k_f+1}-b\right]} L_f$$

$$90,6 = 97,43 + 20 \log d (km) + 15,2 + 9,48$$

$$90,6 = 122,118 + 20 \log d (km)$$

$$-31,51 = 20 \log d (km)$$

$$d(km) = 0,0266$$

$$d(m) = 26.66\ m$$

4. Propagasi Arah *Downlink*

- Frekuensi Centre = 2310 Mhz

Total Path Loss (L_P)	Tinggi Transmitter (h_{Ms})	Tinggi Receiver (h_{Bs})
104,94 dB	1,5 m	10 m

Propagation Model Cost 231 Multiwall Indoor

$$L_{Cost\ 231\ MW} = L_{FSL} + \sum_{i=1}^l K_{wi} L_{wi} + K_f^{\left[\frac{k_f+2}{k_f+1}-b\right]} L_f$$

Dimana,

$$L_{Free\ Space\ Lpss} = 32,45 + 20 \log d (km) + 20 \log f (Mhz),$$

$\sum_{i=1}^l K_{wi} L_{wi}$ adalah loss horizontal, dimana K_w = Jumlah dinding dan L_w =

Loss Dinding

$K_f^{\left[\frac{k_f+2}{k_f+1}-b\right]} L_f$ adalah loss vertical, dimana K_f = Jumlah Lantai dan L_f = Loss

Lantai

Maka,

$$L_{Free\ Space\ Lpss} = 32,45 + 20 \log d (km) + 20 \log 2310 (Mhz)$$

$$L_{Free\ Space\ Lpss} = 32,45 + 20 \log d (km) + 67,27$$

$$L_{Free\ Space\ Lpss} = 20 \log d (km) + 99,72 \dots \dots \dots (1)$$

Kemudian, Loss vertical sebagai berikut :

$$\sum_{i=1}^l K_{wi} L_{wi} =$$

Material	Loss	Jumlah	Total
Kaca	0,8	2	1,6
Beton	3,4	4	13,6

$$\sum_{i=1}^l K_{wi} L_{wi} = 15,2 \text{ dB} \dots \dots \dots (2)$$

Loss Horizontal adalah sebagai berikut :

$$K_f \left[\frac{k_f+2}{k_f+1} - b \right] L_f =$$

$$K_f = 4 \text{ Lantai}, L_f = 3,4 \text{ (Beton)}$$

$$b = \text{Empirical Parameter} = 0,6$$

Maka,

$$K_f \left[\frac{k_f+2}{k_f+1} - b \right] L_f = 9,48 \dots \dots \dots (3)$$

Maka,

$$L_{Cost \ 231 \ MW} = L_{FSL} + \sum_{i=1}^l K_{wi} L_{wi} + K_f \left[\frac{k_f+2}{k_f+1} - b \right] L_f$$

$$89,4 = 99,72 + 20 \log d \ (km) + 15,2 + 9,48$$

$$89,4 = 124,046 + 20 \log d \ (km)$$

$$-35,065 = 20 \log d \ (km)$$

$$d(km) = 0,01778$$

$$d(m) = 17,78 \text{ m}$$

Dengan demikian Cell Range untuk Mall Nipah Makassar sebagai berikut

	<i>Uplink</i>	<i>Downlink</i>
1800 MHz	171,43 m	22,08 m
2300 MHz	88,44 m	17,72 m

Cell range yg akan kita gunakan ialah 14,78 m dan jumlah cell sebagai berikut

$$\text{Jumlah Sel} = \frac{\text{Total Area Mall Nipah}}{\text{Luas Cell}}$$

$$\text{Jumlah Sel} = \frac{50 \times 150}{2,6 \times 17,72^2} = 9,2 \cong 10 \text{ Cell}$$