

## BAB V

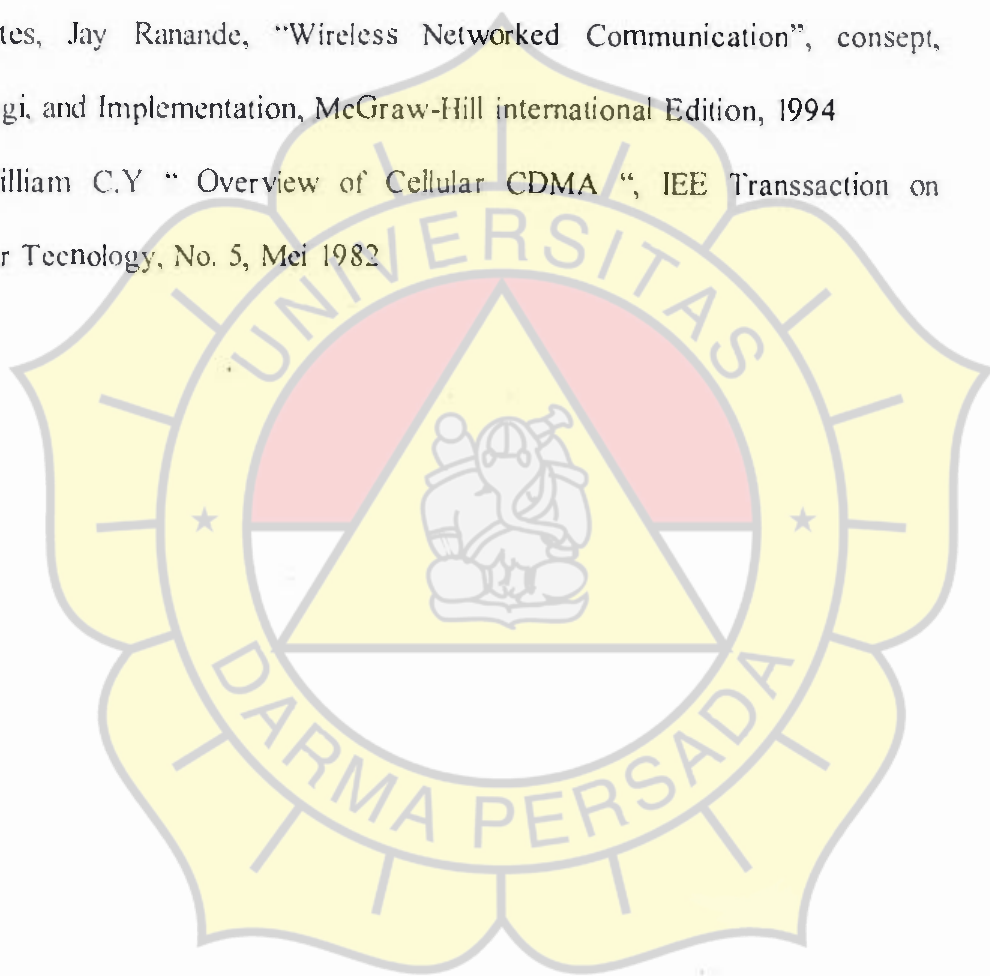
### KESIMPULAN

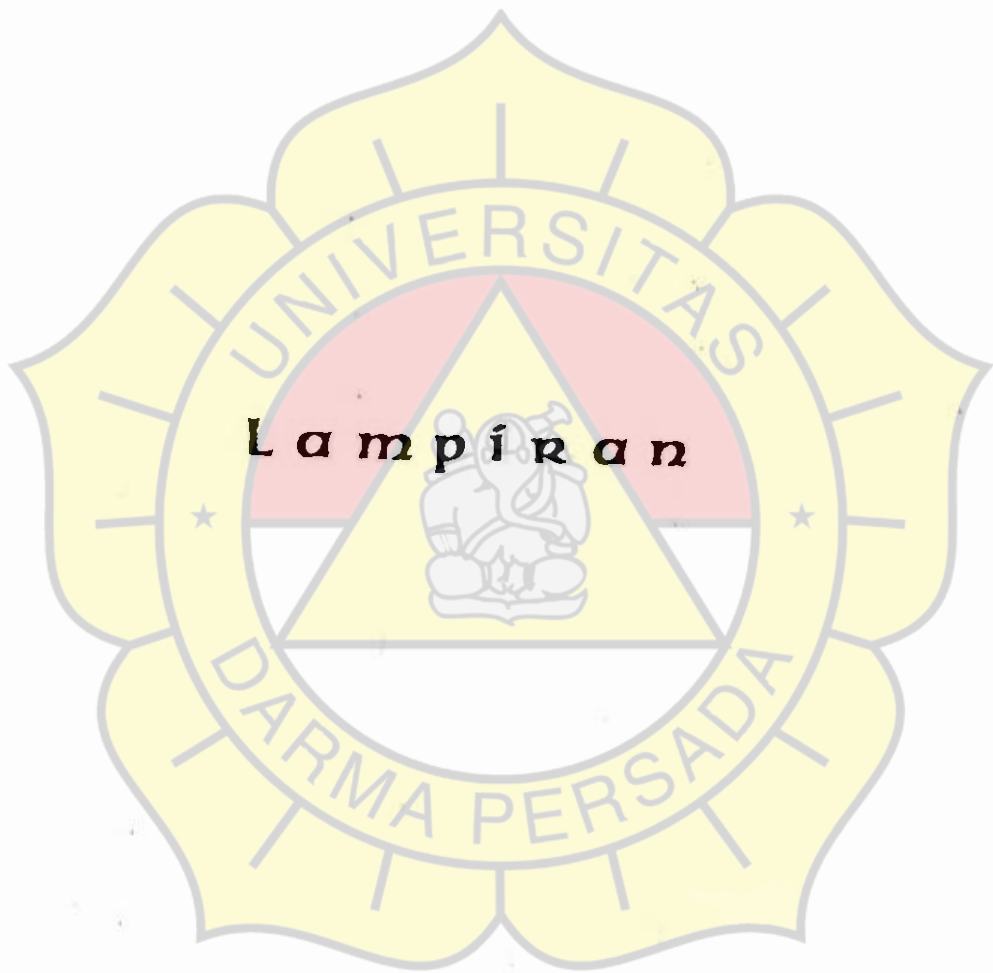
1. Dari hasil analisis dengan menggunakan sektrum frekuensi selebar 1,25 MHz terhadap sistem CDMA dan sistem PHS dengan pembagian sektor 3 sektor maka dapat disimpulkan bahwa sistem CDMA memiliki jumlah kanal sebesar 27 kanal / sektor sedangkan pada PHS diperoleh jumlah kanal sebesar 11 kanal / sektor.
2. Pada penerapan sistem selular untuk daerah sub urban dapat dianalisis bahwa CDMA memiliki jarak radius antar sel sebesar  $6,36 \times 10^6$  Km sedangkan pada sistem PHS diperoleh jarak radius antar sel sebesar  $1 \times 10^6$  Km.

Hasil dari analisis tersebut diperoleh kesimpulan bahwa sistem CDMA memiliki keunggulan atau kelebihan dari hal jumlah kapasitas kanal serta jarak radius sel maka pantaslah bahwa CDMA memiliki peluang yang cerah untuk menjadi basis teknologi Multiple Access dimasa depan dengan kualitas sinyal yang tetap baik dan lebih sedikit perangkat sel untuk mencakup suatu wilayah geografis.

## DAFTAR PUSTAKA

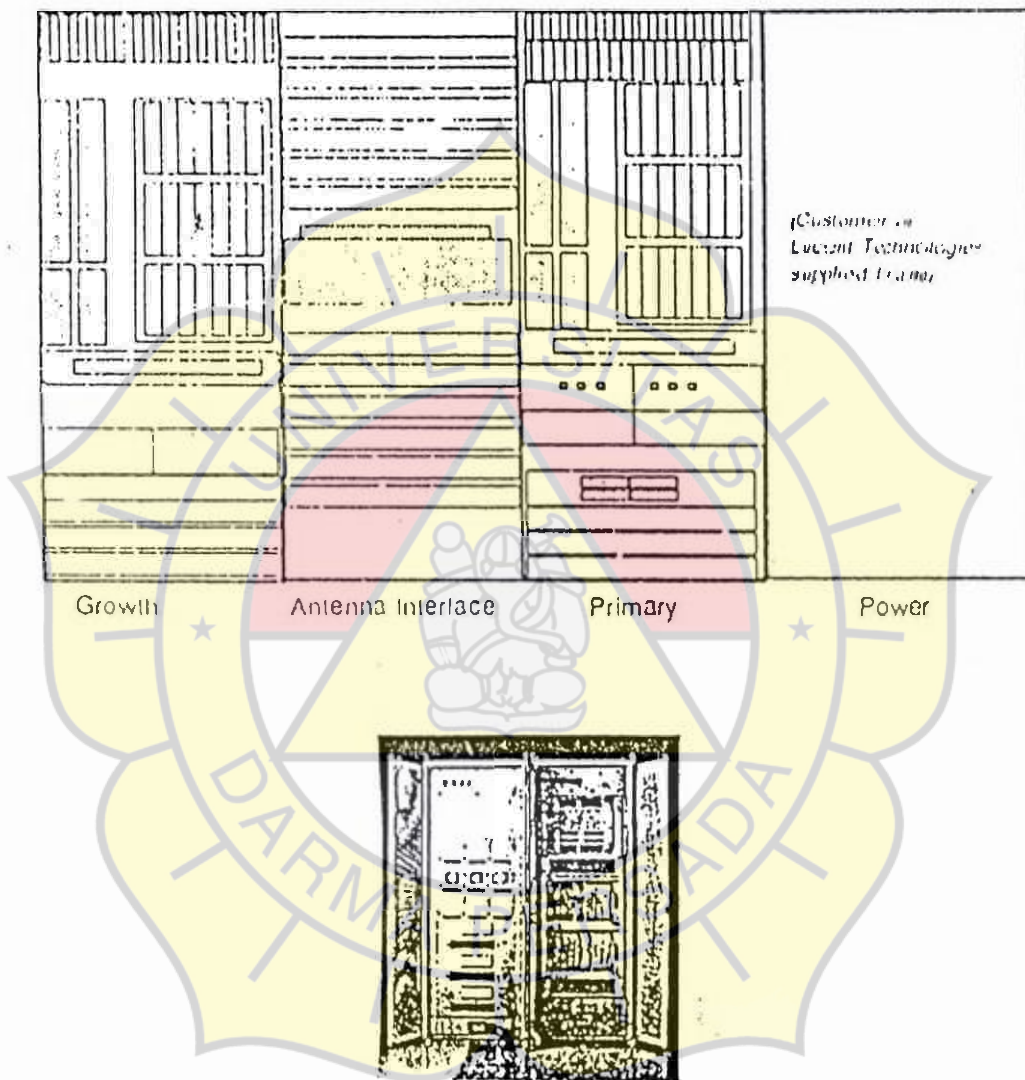
1. Telkom, Dasar Wireless Local Loop , PT. Telekomunikasi Indonesia
2. Telkom, Cordless Telecommunication., Divisi Pelatihan
3. www.Com. Elektro Indonesia Edisi 10 – 13, Juni 1998.
4. But Butes, Jay Ranande, "Wireless Networked Communication", concept, Teknologi, and Implementation, McGraw-Hill international Edition, 1994
5. Lee, William C.Y " Overview of Cellular CDMA ", IEE Transsaction on vehicular Tecnology, No. 5, Mei 1982





# Lampiran 1

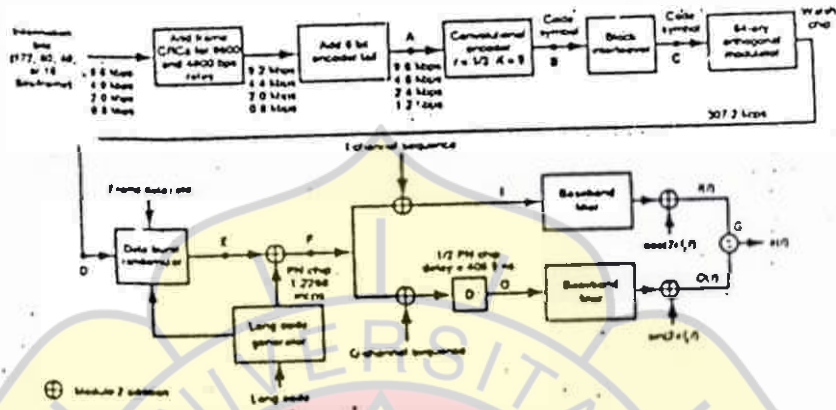
Gambar Perangkat Sel CDMA



Layout kabinet minicell selular CDMA pada BTS

## Lampiran 2

### Kanal-kanal pada CDMA



Gambar skema proses modulasi pada kanal reverse CDMA

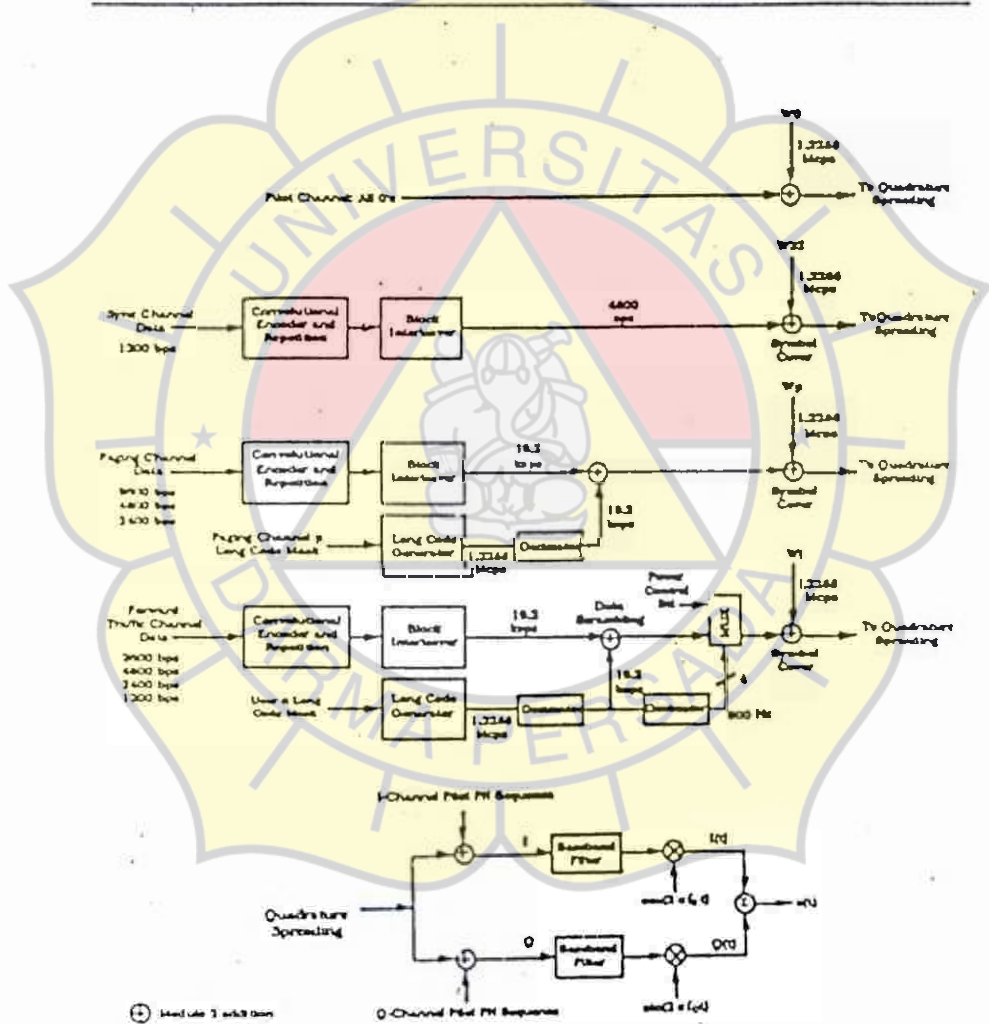
Tabel parameter modulasi kanal trafik pada reverse link CDMA

Parameter	Data rate, bps				Units
	9600	4800	2400	1200	
PN chip rate	1.2288	1.2288	1.2288	1.2288	Mcps
Code rate	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	bits/code symbol
Transmit duty cycle	100.0	50.0	25.0	12.5	%
Code symbol rate	28,800	28,800	28,800	28,800	sps
Modulation	6	6	6	6	code symbol/ mod symbol
Modulation symbol rate	4800	4800	4800	4800	sps
Walsh chip rate	307.20	307.20	307.20	307.20	kcps
Mod. symbol duration	208.33	208.33	208.33	208.33	$\mu$ s
PN chips/code symbol	42.67	42.67	42.67	42.67	PN chip/code symbol
PN chips/mod. symbol	256	256	256	256	PN chip/mod symbol
PN chips/Walsh chip	4	4	4	4	PN chips/Walsh chip



Tabel parameter modulasi kanal akses

Parameter	Data rate, bps		Units
	4800		
PN chip rate	1,2288		Mcps
Code rate	1/3		bits/code symbol
Code symbol repetition	2		symbols/code symbol
Transmit duty cycle	100.0		%
Code symbol rate	28,800		sps
Modulation	6		code sym/mod. symbol
Modulation symbol rate	4800		sps
Walsh chip rate	307.20		kcps
Mod. symbol duration	208.33		μs
PN chips/code symbol	42.67		PN chip/code symbol
PN chips/mod. symbol	256		PN chip/mod. symbol
PN chips/Walsh chip	4		PN chips/Walsh chip



Gambar struktur kanal foward link CDMA:  
 (a) modulasi (b) quadrature spreading

Tabel parameter modulasi kanal sinkronisasi

Parameter	Data rate, bps		Units
	1200		
PN chip rate	1.2288		Mcps
Code rate	$\frac{1}{2}$		bits/code symbol
Code repetition	2		mod. symbol/code symbol*
Modulation symbol rate	4800		sp/s
PN chips/modulation symbol	256		PN chips/mod. symbol
PN chips/bit	1024		PN chips/bit

\*Each repetition of a code symbol is a modulation symbol.

Tabel parameter modulasi kanal paging

Parameter	Data rate, bps			Units
	9600	4800	2400	
PN chip rate	1.2288	1.2288	1.2288	Mcps
Code rate	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	bits/code symbol
Code repetition	1	2	4	mod. symbol/ code symbol*
Modulation symbol rate	19,200	19,200	19,200	sp/s
PN chips/modulation symbol	64	64	64	PN chips/mod. symbol
PN chips/bit	128	256	512	PN chips/bit

\*Each repetition of a code symbol is a modulation symbol.

Tabel parameter modulasi kanal trafik foward

Parameter	Data rate, bps				Units
	9600	4800	2400	1200	
PN chip rate	1.2288	1.2288	1.2288	1.2288	Mcps
Code rate	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	bits/code symbol
Code repetition	1	2	4	8	mod symbol/code symbol*
Modulation symbol rate	19,200	19,200	19,200	19,200	sp/s
PN chips/modulation symbol	64	64	64	64	PN chips/mod. symbol
PN chips/bit	128	256	512	1024	PN chips/bit

\*Each repetition of a code symbol is a modulation symbol.

- Kelemahan:

- ✓ Membutuhkan pembagi frekuensi yang kompleks
- ✓ Tidak berguna untuk mengukur jarak dan kecepatan
- ✓ Memerlukan koreksi kesalahan (error correction)

c). Sistem Time Hopping (TH)

- Kelebihan:

- ✓ Efisiensi lebar pita frekuensi tinggi
- ✓ Implementasi lebih sederhana dibanding FH
- ✓ Berguna ketika pemancar dibatasi daya rata-rata, tidak dibatasi daya puncak
- ✓ Masalah near-far dihilangkan dalam suatu sistem terkoordinasi

- Kelemahan:

- ✓ Waktu akuisisi lama
- ✓ Diperlukan koreksi kesalahan

## II.2. KELEBIHAN DAN KERUGIAN SOFT HANDOFF

### a. Kelebihan soft handoff

1. Mengurangi atau menghilangkan efek pingpong, sehingga mengurangi beban pada jaringan yang disebabkan signalling handoff dan komunikasi lebih "smooth" tanpa "click"
2. Tidak memerlukan margin hysteresis, sehingga
  - a. Delay handoff rendah



- b. Pada komunikasi uplink, dapat mencegah interferensi tambahan yang disebabkan dari pada jika handoff dengan margin hysteresis dilakukan
- c. Mengurangi fading margin saat soft handoff, sehingga daya transmit dapat dikurangi

### 3. Mengurangi probabilitas bloking

#### b). Kerugian soft handoff

1. Overhead kanal trafik/ perlu tambahan resource jaringan
2. Lebih kompleks
3. Interferensi downlink meningkat, namun interferensi yang terjadi ini sifatnya adalah singkat tergantung dari kecepatan mobil

### MULTIPATH

Gelombang radio yang dipancarkan dari base station ke unit bergerak, selain diterima langsung oleh penerima, juga mengalami pantulan oleh lingkungan disekitarnya, misalnya: gunung, bukit, truk, pesawat terbang. Hal ini karena tinggi antena unit bergerak lebih rendah dari sekelilingnya dan panjang gelombang pembawa lebih pendek dari ukuran struktur disekelilingnya.

Fenomena ini menyebabkan sinyal menempuh lebih dari satu lintasan dari pemancar ke penerima dan disebut propagasi multipath. Selain dapat membantu sinyal mencapai penerima yang dituju, propagasi multipath menimbulkan beberapa masalah yang amat mengganggu dalam sistem komunikasi bergerak selular seperti : Delay spread, Rayleigh fading dan Doppler shift

## Mobile Radio Propagation Model

### An Area-to Area Path-Loss Prediction Model

An area to area prediction is usually used to predict a path loss over a general flat terrain without knowing the particular terrain configuration over which the actual path loss is found. If the actual value and the value predicted from an area-to-area prediction curve will be expected. The area-to-area path-loss prediction requires two parameters : (1) The power at the 1-mile point of interception  $P_{r0}$  and (2) a path loss slope  $\gamma$ .

The field strength of the received signal  $P_r$  can be expressed as :

$$P_r = P_{r0} \left( \frac{r}{r_0} \right)^{-\gamma} \left( \frac{f}{f_0} \right)^{-n} \alpha_0 \quad (\text{linear expression})$$
$$= P_{r0} - \gamma \log \left( \frac{r}{r_0} \right) - n \log \left( \frac{f}{f_0} \right) + \alpha_0 \quad (\text{dB expression})$$

Where  $r$  is in miles or kilometer and  $r_0$  equals 1 mile 1.6 km.  $\gamma$  can be expressed as a  $\gamma$  th power in linear expression and a  $\gamma$  dB/dec in dB expression. The reason of taking a 1-mile point of interception is that within a 1-mile radius very few streets are available. Therefore we are should avoid data with limited runs that do not provide the statistical mean. The adjustment factor is  $\alpha_0$ . Equation above is a general formula that can be used for different frequency ranges as long as the frequency is above 30 MHz. The wavelength is usually smaller than the size of the built structure (in the frequencies above 30 MHz) so that the multipath reflection mechanism prevails.

For path-loss prediction we prefer that the received signal be predicted in an absolute power level (dBm) and be compared easily and directly with the experimental data. For this reason the following set of conditions is assumed :

Frequency  $f_0 = 900$  MHz

Base station antenna height ( $h_1$ ) = 30.48 m (100ft)

Base station power at the antenna ( $P_1$ ) = 10 watts

Base station antenna gain ( $g_1$ ) = 6 dB above dipole gain

Mobile unit antenna height ( $h_2$ ) = 3 m (10 ft)

Mobile unit antenna gain ( $g_2$ ) = 0 dB above dipole gain

The parameters of  $\gamma$  and  $P_{r0}$  are found from the empirical data :  
In free space

$$P_{r0} = 10^{-45} \text{ m watts} = -45 \text{ dBm}$$

$$\gamma = 20 \text{ dB/dec}$$

In an open area

$$P_{r0} = 10^{-49} \text{ m watts} = -49 \text{ dBm}$$

$$\gamma = 43.5 \text{ dB/dec}$$

In suburban areas

$$P_{r0} = 10^{-61.7} \text{ m watts} = -61.7 \text{ dBm}$$

$$\gamma = 38.4 \text{ dB/dec}$$

Determining the value of  $n$  in Eq. above.

The value of  $n$  in Eq. above is found from empirical data. Okumura indicates  $n = 30$  dB/dec, and Young indicates  $n = 20$  dB/dec, therefore

$$20 \text{ dB/dec} < n < 30 \text{ dB/dec}$$

When  $n$  is valid for the frequency range from 30 to 2000 MHz and the distance range from 2 to 30 km, or approximately 1.5 to 20 miles. The value  $n$  seems dependent on the geographical locations and the operating frequency below 450 MHz,  $n = 20$  dB/dec is recommended. In an urban area with the operating frequency above 450 MHz,  $n = 30$  dB/dec is recommended.

#### General Formula of the Model

$$P_r = -61.7 - 38.4 \log r - n \log \left[ \frac{f}{900} \right] + \alpha_0 \text{ dBm (suburban)}$$

$$P_r = -70 - 36.8 \log r - n \log \left[ \frac{f}{900} \right] + \alpha_0 \text{ dBm (Philadelphia)}$$

$$P_r = -64 - 43.1 \log r - n \log \left[ \frac{f}{900} \right] + \alpha_0 \text{ dBm (Newark)}$$

$$\alpha_0 = 20 \log n + 10 \log P_t + g_1 + g_2 + 10 \log h_t - 64$$

Where new values are  $P_t$  in watts, base antenna height  $h_t$  and mobile antenna height  $h_r$  in feet, base antenna gain  $g_1$ , and mobile antenna gain  $g_2$  in dB,  $r$  in miles and  $f$  in MHz. With  $\alpha_0 = 0$  dB,  $\alpha_0$  is a correction factor.



**TELKOM**

## **SPEKIFIKASI PERSONAL HANDYPHONE SYSTEM**

Karakteristik sistem wireless adalah sebagai berikut :

- Teknologi sistem radio: PHS (Personal Handyphone System)
- Band Frekuensi Carrier RF : 1895 – 1918 MHz
- Frekuensi spacing: 300 KHz
- Bit Rate Transmisi: 1,152 Mbit/s/ 1152 Kbps
- Modulasi : QPSK (Quadrature Phase Shift Keying)
- Channel bit rate: 384 kbps
- Voice coding: 32 Kbps / ADPCM
- Jumlah kanal / carrier : 300 KHz
- Power Transmitter: + 24 dBm
- Minimum Power Receiver (BER  $10^{-3}$ ) - 82 dBm
- Subscriber Antena Gain : 2,1 dB
- Coverage Area Wireless (LOS : Line of Sight) : 25 Km
- Metode Access: TDMA/TDD
- TDMA frame : 5 ms
- Voice channel : 30
- Gain sektorisasi Antena : 2,4 dB
- Interferensi Dari Kanal : 1,6 dB
- Gain Aktivitas Suara 2,5 dB
- Grade Of Service: 2%



LAMPIRAN 2: TABEL ERLANG-B

Blocked-Calls-Cleared  
(Erlang B)

N	A. Erlangs													
	B													
	1.0%	1.2%	1.5%	2%	3%	5%	7%	10%	15%	20%	30%	40%	60%	
1	.0101	.0121	.0152	.0204	.0309	.0528	.0753	.111	.178	.250	.429	.667	1.00	
2	.183	.188	.190	.223	.282	.381	.470	.595	.796	1.00	1.45	2.00	2.73	
3	.456	.489	.535	.601	.715	.899	1.06	1.27	1.60	1.93	2.63	3.48	4.69	
4	.869	.921	.992	1.09	1.26	1.52	1.75	2.05	2.50	2.95	3.79	5.02	6.60	
6	1.38	1.43	1.52	1.66	1.88	2.22	2.60	2.88	3.45	4.01	5.19	6.60	8.44	
8	1.91	2.00	2.11	2.28	2.54	2.98	3.30	3.78	4.44	5.11	6.51	8.19	10.4	
10	2.60	2.80	2.74	2.94	3.25	3.74	4.14	4.67	5.48	6.23	7.88	9.80	12.4	
12	3.13	3.25	3.40	3.65	3.99	4.54	5.00	5.60	6.60	7.37	9.21	11.4	14.3	
14	3.78	3.92	4.09	4.34	4.75	5.37	5.88	6.55	7.55	8.52	10.6	13.0	16.3	
16	4.48	4.61	4.81	5.08	5.53	6.22	6.78	7.61	8.62	9.58	12.0	14.7	18.3	
18	5.16	5.32	5.54	5.84	6.33	7.08	7.69	8.49	9.69	10.9	13.3	16.3	20.3	
20	5.88	6.05	6.29	6.61	7.14	7.95	8.61	9.47	10.8	12.0	14.7	18.0	22.2	
22	6.61	6.80	7.05	7.40	7.97	8.83	9.34	10.5	11.9	13.2	16.1	19.6	24.2	
24	7.35	7.66	7.82	8.20	8.80	9.73	10.3	11.5	13.0	14.4	17.5	21.2	26.2	
26	8.11	8.33	8.61	9.01	9.65	10.6	11.4	12.5	14.1	15.6	18.9	22.9	28.2	
28	8.88	9.11	9.41	9.83	10.5	11.6	12.4	13.5	15.2	16.8	20.3	24.8	30.2	
30	9.65	9.89	10.2	10.7	11.4	12.5	13.4	14.6	16.3	18.0	21.7	26.2	32.2	
32	10.4	10.7	11.0	11.5	12.2	13.4	14.3	15.5	17.4	19.2	23.1	27.8	34.2	
34	11.2	11.6	11.8	12.3	13.1	14.3	15.3	16.6	18.5	20.4	24.6	29.3	36.2	
36	12.0	12.3	12.7	13.2	14.0	15.2	16.2	17.6	19.6	21.6	25.9	31.2	38.2	
38	12.8	13.1	13.6	14.0	14.9	16.2	17.3	18.7	20.8	22.8	27.3	32.8	40.2	
40	13.7	14.0	14.3	14.9	15.8	17.1	18.2	19.7	21.9	24.1	28.7	34.5	42.1	
42	14.6	14.8	15.2	16.0	16.7	18.1	19.2	20.7	23.0	25.3	30.1	36.1	44.1	
44	15.3	15.6	16.0	16.8	17.6	19.0	20.2	21.8	24.2	26.5	31.8	37.8	46.1	
46	16.1	16.6	16.9	17.5	18.5	20.0	21.2	22.8	25.3	27.7	33.0	39.4	48.1	
48	17.0	17.3	17.8	18.4	19.4	20.9	22.2	23.9	26.4	28.9	34.4	41.1	50.1	
50	17.8	18.2	18.6	19.3	20.3	21.9	23.2	24.9	27.6	30.2	35.5	42.8	52.1	
52	18.6	19.0	19.6	20.2	21.2	22.8	24.2	26.0	28.7	31.4	37.2	44.4	54.1	
54	19.5	19.9	20.4	21.0	22.1	23.8	25.2	27.1	29.9	32.6	38.6	46.1	56.1	
56	20.3	20.7	21.2	21.9	23.1	24.8	26.2	28.1	31.0	33.8	40.0	47.7	58.1	
58	21.2	21.6	22.1	22.8	24.0	25.8	27.2	29.2	32.1	35.1	41.5	49.4	60.1	
60	22.0	22.6	23.0	23.7	24.9	26.7	28.7	30.2	33.3	36.3	42.9	51.1	62.1	
62	22.9	23.3	23.9	24.6	25.8	27.7	29.3	31.3	34.4	37.5	44.3	52.7	64.1	
64	23.8	24.2	24.8	25.5	26.8	28.7	30.3	32.4	35.6	38.8	45.7	54.4	66.1	
66	24.6	25.1	25.8	26.4	27.7	29.7	31.3	33.4	36.7	40.0	47.1	56.0	68.1	
68	25.6	26.0	26.6	27.3	28.6	30.7	32.3	34.6	37.9	41.2	48.6	57.7	70.1	
70	26.4	26.8	27.4	28.3	29.6	31.6	33.3	35.6	39.0	42.4	50.0	59.4	72.1	
72	27.3	27.7	28.3	29.2	30.5	32.6	34.4	36.6	40.2	43.7	51.4	61.0	74.1	
74	28.1	28.6	29.2	30.1	31.3	33.6	35.4	37.7	41.3	44.9	52.8	62.7	76.1	
76	29.0	29.5	30.1	31.0	32.4	34.6	36.4	38.8	42.5	46.1	54.2	64.4	78.1	
78	29.9	30.4	31.0	31.9	33.4	35.6	37.4	39.9	43.6	47.4	55.7	66.0	80.1	
80	30.8	31.3	31.9	32.8	34.3	36.6	38.4	40.9	44.8	48.6	57.1	67.7	82.1	
82	31.7	32.2	32.8	33.8	35.3	37.6	39.5	42.0	45.9	49.9	58.5	69.3	84.1	
84	32.6	33.1	33.7	34.7	36.2	38.6	40.5	43.1	47.1	51.1	59.9	71.0	86.1	
86	33.4	34.0	34.6	35.6	37.2	39.6	41.5	44.2	48.2	52.3	61.3	72.7	88.1	
88	34.3	34.9	35.6	36.6	38.1	40.5	42.8	45.2	49.4	53.5	62.8	74.3	90.1	
90	35.2	35.8	36.6	37.5	39.1	41.5	43.6	46.3	50.6	54.8	64.2	76.0	92.1	
92	36.1	36.7	37.4	38.4	40.0	42.5	44.5	47.4	51.7	56.0	65.4	77.7	94.1	
94	37.0	37.6	38.3	39.3	41.0	43.5	45.7	48.5	52.9	57.3	67.0	79.3	96.1	
96	37.9	38.5	39.2	40.3	41.9	44.5	46.7	49.6	54.0	58.5	68.5	81.0	98.1	



Blocked-Calls-Cleared  
(Erlang B) (Continued)

N	A, erlangs														
	B														
	1.0%	1.2%	1.6%	2%	3%	4%	5%	6%	7%	10%	15%	20%	30%	40%	50%
61	38.8	39.4	40.1	41.2	42.9	45.8	47.7	50.6	55.2	59.7	63.9	67.7	72.1	76.1	80.1
62	39.7	40.3	41.0	42.1	43.9	46.8	48.8	51.7	56.3	60.8	65.0	68.8	73.2	77.2	81.2
63	40.8	41.2	42.0	43.1	44.8	47.5	49.5	52.4	57.0	61.5	65.7	69.5	73.9	77.9	81.9
64	41.8	42.1	42.9	44.0	45.8	48.5	50.5	53.4	58.0	62.5	66.7	70.5	74.9	78.9	82.9
65	42.4	43.0	43.8	44.9	46.7	49.5	51.5	54.4	59.0	63.5	67.7	71.5	75.9	79.9	83.9
66	43.3	43.9	44.7	45.9	47.7	50.5	52.5	55.4	60.0	64.5	68.7	72.5	76.9	80.9	84.9
67	44.2	44.8	45.7	46.8	48.7	51.5	53.5	56.4	61.0	65.5	69.7	73.5	77.9	81.9	85.9
68	45.1	45.8	46.6	47.8	49.6	52.4	54.4	57.3	61.9	66.4	70.6	74.4	78.8	82.8	86.8
69	46.0	46.7	47.5	48.7	50.6	53.4	55.4	58.3	62.9	67.4	71.6	75.4	79.8	83.8	87.8
70	46.9	47.6	48.4	49.6	51.5	54.4	56.4	59.3	63.9	68.4	72.6	76.4	80.8	84.8	88.8
71	47.9	48.6	49.4	50.6	52.5	55.4	57.4	60.3	64.9	69.4	73.6	77.4	81.8	85.8	89.8
72	48.8	49.4	50.3	51.5	53.4	56.4	58.4	61.3	65.9	70.4	74.6	78.4	82.8	86.8	90.8
73	49.7	50.4	51.2	52.4	54.3	57.3	59.3	62.2	66.8	71.3	75.5	79.3	83.7	87.7	91.7
74	50.6	51.3	52.1	53.3	55.2	58.2	60.2	63.1	67.7	72.2	76.4	80.2	84.6	88.6	92.6
75	51.6	52.2	53.1	54.3	56.2	59.2	61.2	64.1	68.7	73.2	77.4	81.2	85.6	89.6	93.6
76	52.4	53.1	54.0	55.2	57.1	60.1	62.1	65.0	69.6	74.1	78.3	82.1	86.5	90.5	94.5
77	53.3	54.0	54.9	56.1	58.0	61.0	63.0	65.9	70.5	75.0	79.2	83.0	87.4	91.4	95.4
78	54.2	54.9	55.8	57.0	58.9	61.9	63.9	66.8	71.4	75.9	80.1	83.9	88.3	92.3	96.3
79	55.1	55.8	56.7	57.9	59.8	62.8	64.8	67.7	72.3	76.8	81.0	84.8	89.2	93.2	97.2
80	56.1	56.8	57.7	58.9	60.8	63.8	65.8	68.7	73.3	77.8	82.0	85.8	90.2	94.2	98.2
81	57.0	57.8	58.7	60.0	61.9	64.9	66.9	69.8	74.4	78.9	83.1	86.9	91.3	95.3	99.3
82	58.0	58.7	59.7	61.0	62.9	65.9	67.9	70.8	75.4	79.9	84.1	87.9	92.3	96.3	100.3
83	58.9	59.6	60.6	62.0	63.9	66.9	68.9	71.8	76.4	80.9	85.1	88.9	93.3	97.3	101.3
84	59.8	60.6	61.6	63.0	64.9	67.9	69.9	72.8	77.4	81.9	86.1	89.9	94.3	98.3	102.3
85	60.7	61.6	62.6	64.0	65.9	68.9	70.9	73.8	78.4	82.9	87.1	90.9	95.3	99.3	103.3
86	61.7	62.4	63.4	64.9	66.8	69.8	71.8	74.7	79.3	83.8	88.0	91.8	96.2	100.2	104.2
87	62.6	63.4	64.4	65.8	67.7	70.7	72.7	75.6	80.2	84.7	88.9	92.7	97.1	101.1	105.1
88	63.5	64.3	65.3	66.8	68.7	71.7	73.7	76.6	81.2	85.7	89.9	93.7	98.1	102.1	106.1
89	64.4	65.2	66.2	67.7	69.6	72.6	74.6	77.5	82.1	86.6	90.8	94.6	99.0	103.0	107.0
90	65.4	66.2	67.2	68.7	70.6	73.6	75.6	78.5	83.1	87.6	91.8	95.6	100.0	104.0	108.0
91	66.3	67.1	68.2	69.6	71.5	74.5	76.5	79.4	84.0	88.5	92.7	96.5	100.9	104.9	108.9
92	67.2	68.0	69.1	70.6	72.5	75.5	77.5	80.4	85.0	89.5	93.7	97.5	101.9	105.9	109.9
93	68.2	69.0	70.1	71.6	73.5	76.5	78.5	81.4	86.0	90.5	94.7	98.5	102.9	106.9	110.9
94	69.1	69.9	71.0	72.5	74.4	77.4	79.4	82.3	86.9	91.4	95.6	99.4	103.8	107.8	111.8
95	70.0	70.9	71.9	73.4	75.3	78.3	80.3	83.2	87.8	92.3	96.5	100.3	104.7	108.7	112.7
96	70.9	71.8	72.9	74.4	76.3	79.3	81.3	84.2	88.8	93.3	97.5	101.3	105.7	109.7	113.7
97	71.9	72.7	73.8	75.3	77.2	80.2	82.2	85.1	89.7	94.2	98.4	102.2	106.6	110.6	114.6
98	72.8	73.7	74.8	76.3	78.2	81.2	83.2	86.1	90.7	95.2	99.4	103.2	107.6	111.6	115.6
99	73.7	74.6	75.7	77.2	79.1	82.1	84.1	87.0	91.6	96.1	100.3	104.1	108.5	112.5	116.5
100	74.7	75.6	76.7	78.2	80.1	83.1	85.1	88.0	92.6	97.1	101.3	105.1	109.5	113.5	117.5
91	76.6	76.6	77.6	79.1	81.0	84.0	86.0	88.9	93.5	98.0	102.2	106.0	110.4	114.4	118.4
92	76.6	77.4	78.4	80.2	82.1	85.1	87.1	90.0	94.6	99.1	103.3	107.1	111.5	115.5	119.5
93	77.6	78.4	79.4	81.2	83.1	86.1	88.1	91.0	95.6	100.1	104.3	108.1	112.5	116.5	120.5
94	78.4	79.3	80.6	82.2	84.1	87.1	89.1	92.0	96.6	101.1	105.3	109.1	113.5	117.5	121.5
95	79.4	80.3	81.6	83.1	85.0	88.0	90.0	92.9	97.5	102.0	106.2	110.0	114.4	118.4	122.4
96	80.3	81.2	82.4	84.1	86.0	89.0	91.0	93.9	98.5	103.0	107.2	111.0	115.4	119.4	123.4
97	81.2	82.2	83.4	85.1	87.0	90.0	92.0	94.9	99.5	104.0	108.2	112.0	116.4	120.4	124.4
98	82.2	83.1	84.3	86.0	87.9	90.9	92.9	95.8	100.4	104.9	109.1	112.9	117.3	121.3	125.3
99	83.1	84.1	85.3	87.0	88.9	91.9	93.9	96.8	101.4	105.9	110.1	113.9	118.3	122.3	126.3
100	84.1	85.0	86.2	88.0	89.9	92.9	94.9	97.8	102.4	106.9	111.1	114.9	119.3	123.3	127.3

Blocked-Calls-Cleared  
(Erlang B) (Continued)

N	A, erlangs												
	1.0%	1.2%	1.5%	2%	3%	5%	7%	10%	15%	20%	30%	40%	50%
102	85.9	86.9	88.1	89.9	92.8	97.3	101.1	106.3	114.6	123.1	142.6	147.6	202.0
104	87.8	88.8	90.1	91.9	94.8	99.3	103.2	108.5	116.9	125.8	145.4	170.9	206.0
106	89.7	90.7	92.0	93.8	96.7	101.4	106.3	110.7	119.3	128.1	148.3	174.1	210.0
108	91.6	92.6	93.9	95.7	98.7	103.4	107.4	112.9	121.6	130.6	151.1	177.6	214.0
110	93.6	94.6	95.8	97.7	100.7	105.6	109.6	116.1	124.0	133.1	154.0	180.9	218.0
112	95.4	96.4	97.7	99.6	102.7	107.6	111.7	117.3	126.3	135.6	156.9	184.2	222.0
114	97.3	98.3	99.7	101.6	104.7	109.6	113.8	119.5	128.6	138.1	159.7	187.6	226.0
116	99.2	100.2	101.6	103.6	106.7	111.7	116.9	121.7	131.0	140.6	162.6	190.9	230.0
118	101.1	102.1	103.5	105.6	108.7	113.7	118.0	123.9	133.3	143.1	165.4	194.2	234.0
120	103.0	104.0	105.4	107.4	110.7	115.8	120.1	126.1	135.7	145.6	168.3	197.6	238.0
122	104.9	105.9	107.4	109.4	112.8	117.8	122.2	128.3	138.0	148.1	171.1	200.9	242.0
124	106.8	107.9	109.3	111.3	114.6	119.9	124.4	130.5	140.3	150.6	174.0	204.2	246.0
126	108.7	109.8	111.2	113.3	116.6	121.9	126.6	132.7	142.7	153.0	176.8	207.6	250.0
128	110.6	111.7	113.2	115.2	118.6	124.0	128.8	134.9	145.0	155.8	179.7	210.9	254.0
130	112.6	113.6	115.1	117.2	120.6	126.1	130.7	137.1	147.4	158.0	182.6	214.2	258.0
132	114.4	115.5	117.0	119.1	122.6	128.1	132.8	139.3	149.7	160.6	185.4	217.6	262.0
134	116.3	117.4	118.9	121.1	124.6	130.2	134.9	141.5	152.0	163.0	188.3	220.9	266.0
136	118.2	119.4	120.9	123.1	126.6	132.3	137.1	143.7	154.4	165.8	191.1	224.2	270.0
138	120.1	121.3	122.8	125.0	128.6	134.3	139.2	146.9	157.7	169.0	194.0	227.6	274.0
140	122.0	123.2	124.8	127.0	130.6	136.4	141.3	148.1	159.1	170.5	196.8	230.9	278.0
142	123.9	125.1	126.7	128.9	132.6	138.4	143.4	150.3	161.4	173.0	199.7	234.2	282.0
144	125.8	127.0	128.6	130.9	134.6	140.6	145.6	152.5	163.8	175.8	202.6	237.6	286.0
146	127.7	129.0	130.6	132.9	136.6	142.6	147.7	154.7	166.1	178.0	205.4	240.9	290.0
148	129.7	130.9	132.6	134.8	138.6	144.6	149.8	156.9	168.6	180.6	208.2	244.2	294.0
150	131.6	132.8	134.5	136.8	140.6	146.7	151.9	159.1	170.8	183.0	211.1	247.6	298.0
152	133.6	134.8	136.4	138.8	142.6	148.8	154.0	161.3	173.1	185.6	214.0	250.9	302.0
154	135.4	136.7	138.4	140.7	144.6	150.8	156.2	163.6	175.8	188.0	216.8	254.2	306.0
156	137.3	138.6	140.3	142.7	146.6	152.9	158.3	165.7	177.8	190.8	219.7	257.6	310.0
158	139.2	140.6	142.3	144.7	148.6	155.0	160.4	167.9	180.2	193.0	222.6	260.9	314.0
160	141.2	142.6	144.2	146.6	150.6	157.0	162.6	170.2	182.6	195.3	225.4	264.2	318.0
162	143.1	144.4	146.1	148.6	152.7	159.1	164.7	172.4	184.9	198.0	228.2	267.6	322.0
164	145.0	146.3	148.1	150.6	154.7	161.2	166.8	174.6	187.2	200.4	231.1	270.9	326.0
166	146.9	148.3	150.0	152.6	156.7	163.3	168.9	176.8	189.6	202.9	233.9	274.2	330.0
168	148.9	150.2	152.0	154.6	158.7	165.3	171.0	179.0	191.9	205.4	236.8	277.6	334.0
170	150.8	152.1	153.9	156.6	160.7	167.4	173.2	181.3	194.2	207.9	239.7	280.9	338.0
172	152.7	154.1	155.9	158.6	162.7	169.6	175.3	183.4	196.6	210.4	242.6	284.2	342.0
174	154.6	156.0	157.8	160.6	164.7	171.5	177.4	185.6	198.9	212.9	245.4	287.6	346.0
176	156.6	158.0	159.8	162.6	166.7	173.6	179.6	187.8	201.3	215.4	248.2	290.9	350.0
178	158.6	159.9	161.8	164.4	168.7	175.7	181.7	190.0	203.6	217.9	251.1	294.2	354.0
180	160.4	161.8	163.7	166.4	170.7	177.8	183.8	192.2	206.0	220.4	253.9	297.5	358.0
182	162.3	163.8	165.7	168.3	172.8	179.8	185.9	194.4	208.3	222.9	256.8	300.9	362.0
184	164.3	165.7	167.6	170.3	174.8	181.9	188.1	196.6	210.7	225.4	259.6	304.2	366.0
186	166.2	167.7	169.6	172.3	176.8	184.0	190.2	198.9	213.0	227.9	262.5	307.5	370.0
188	168.1	169.6	171.6	174.3	178.8	186.1	192.3	201.1	215.4	230.4	265.4	310.9	374.0
190	170.1	171.6	173.6	176.3	180.8	188.1	194.5	203.3	217.7	232.9	268.2	314.2	378.0
192	172.0	173.6	175.4	178.2	182.8	190.2	196.6	205.3	220.1	235.4	271.1	317.5	382.0
194	173.9	175.4	177.4	180.2	184.8	192.3	198.7	207.3	222.4	237.9	273.9	320.9	386.0
196	175.9	177.4	179.4	182.2	186.9	194.4	200.8	209.9	224.8	240.4	276.8	324.2	390.0
198	177.8	179.3	181.3	184.2	188.9	196.4	202.0	211.1	227.1	242.9	279.6	327.5	394.0
200	179.7	181.3	183.3	186.2	190.9	198.5	205.1	214.3	229.4	245.4	282.5	330.9	398.0