

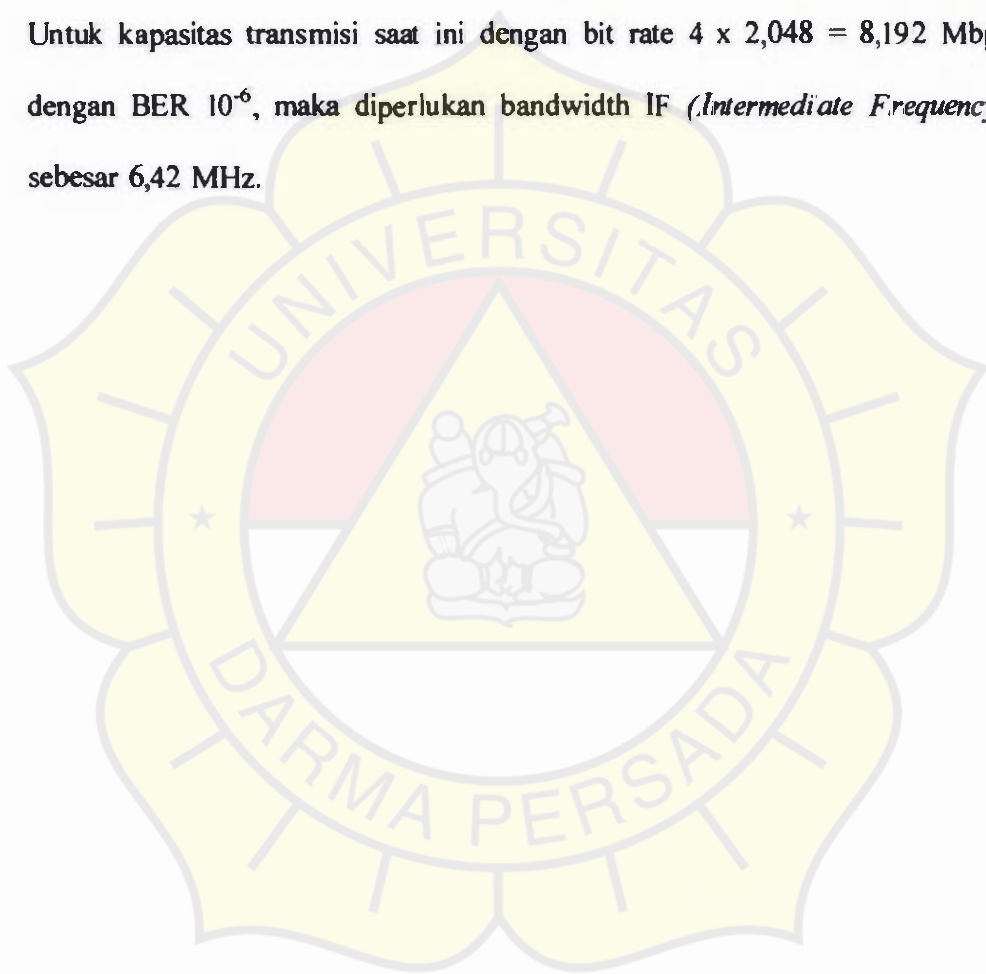
## BAB V

### KESIMPULAN

1. Dari hasil analisis *Fresnel Zone* frekuensi 22,011 GHz untuk *uplink* dan 23,019 GHz untuk *downlink* dengan ketinggian antenna 26 meter dari permukaan laut pada BTS RS Husada dan ketinggian antenna 22 meter dari permukaan laut pada BTS Lautze menunjukkan ruang bebas propagasi sebesar 7,134 meter.
2. Dari hasil perhitungan secara teoritis dengan menggunakan antenna 0,3 meter, maka diperoleh RSL untuk *uplink* sebesar  $-34,89$  dBm dan untuk *downlink* sebesar  $-35,28$  dBm. Bila ditinjau dari power threshold sebesar  $-88$  dBm, maka untuk hasil RSL baik untuk *uplink* maupun *downlink* memenuhi syarat. Dan bila ditinjau dari *Fade Margin* diperoleh sebesar 52,11 dB untuk *uplink* dan sebesar 51,72 dB untuk *downlink*, hal ini menunjukkan level kualitas transmisi *microwave link* baik.
3. Dari hasil perhitungan diperoleh *Eb/No* sebesar 66,98 dB untuk *uplink* dan sebesar 66,59 dB untuk *downlink*. Sedangkan untuk mencapai standar BER =

$10^{-6}$  (standart QPSK) diperlukan  $E_b/N_0$  sebesar 10,6 dB, sehingga kualitas penerimaan data memenuhi syarat karena diatas standar ( $BER < 10^{-6}$ ).

4. Untuk kapasitas transmisi saat ini dengan bit rate  $4 \times 2,048 = 8,192$  Mbps dengan BER  $10^{-6}$ , maka diperlukan bandwidth IF (*Intermediate Frequency*) sebesar 6,42 MHz.



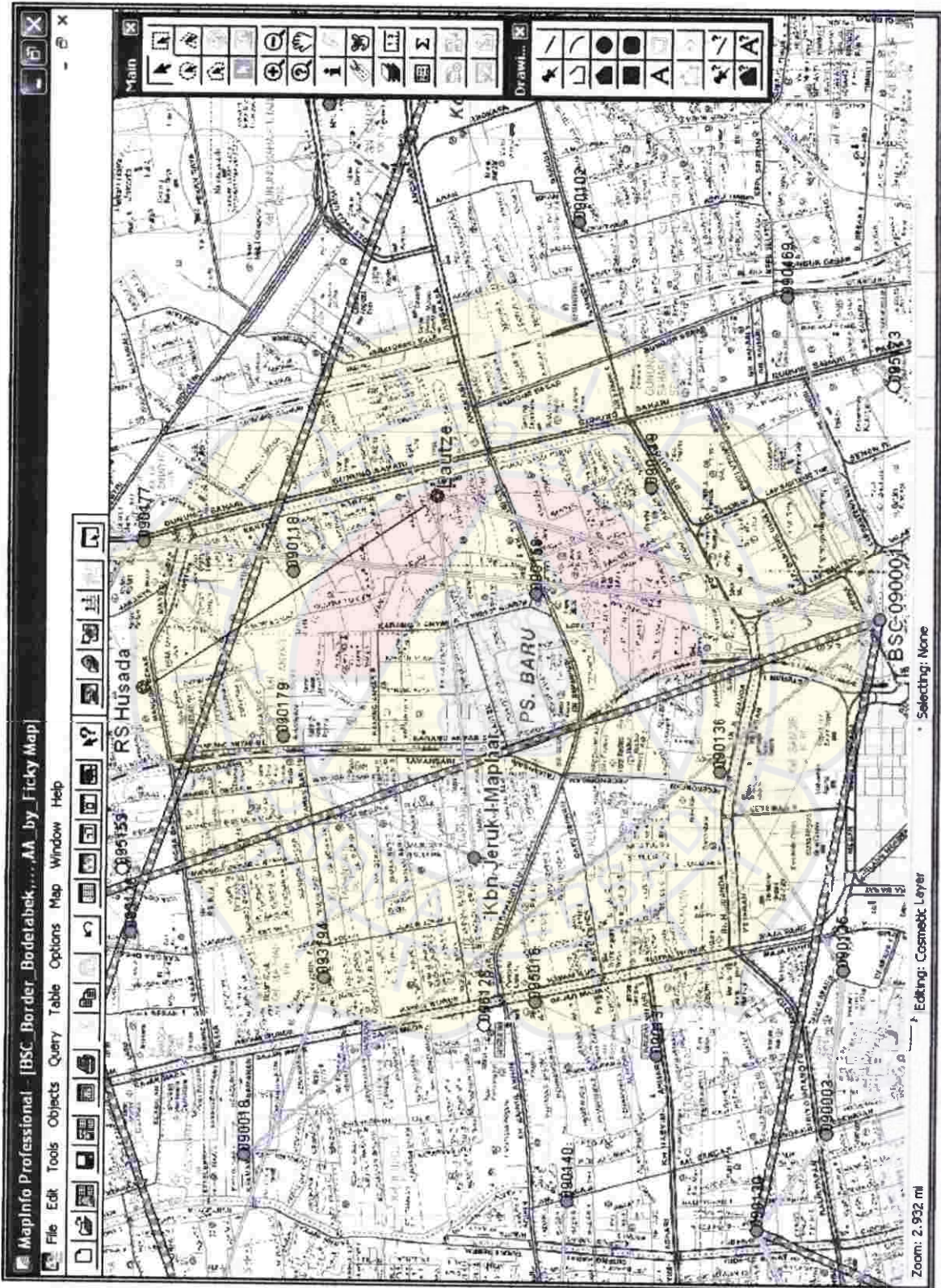
## DAFTAR PUSTAKA

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2. Freeman Roger L, "Telecommunication Transmission Hard Book" third edition, Jhon Wiley & Son, 1996
3. Gouzali Saydam Drs, BC, TT, "Prinsip Dasar Teknologi Jaringan Telekomunikasi", Angkasa, Bandung, 1997
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5. Suhana Ir, "Buku Pegangan Teknik Telekomunikasi", PT Pradnya Paramitha, Jakarta, 1991
6. .... " Instruction Manual Flexihopper Digital Radio System " Nokia Corp.

# Lampiran



## Peta Jaringan



Postal Address  
PT. Nokia Siemens Network  
INDONESIA

Nokia Siemens Network Office Menara Mulia : Jl. Gatot Subroto Kav 9-11 Karet  
Setiabudi Jakarta Selatan, 12930

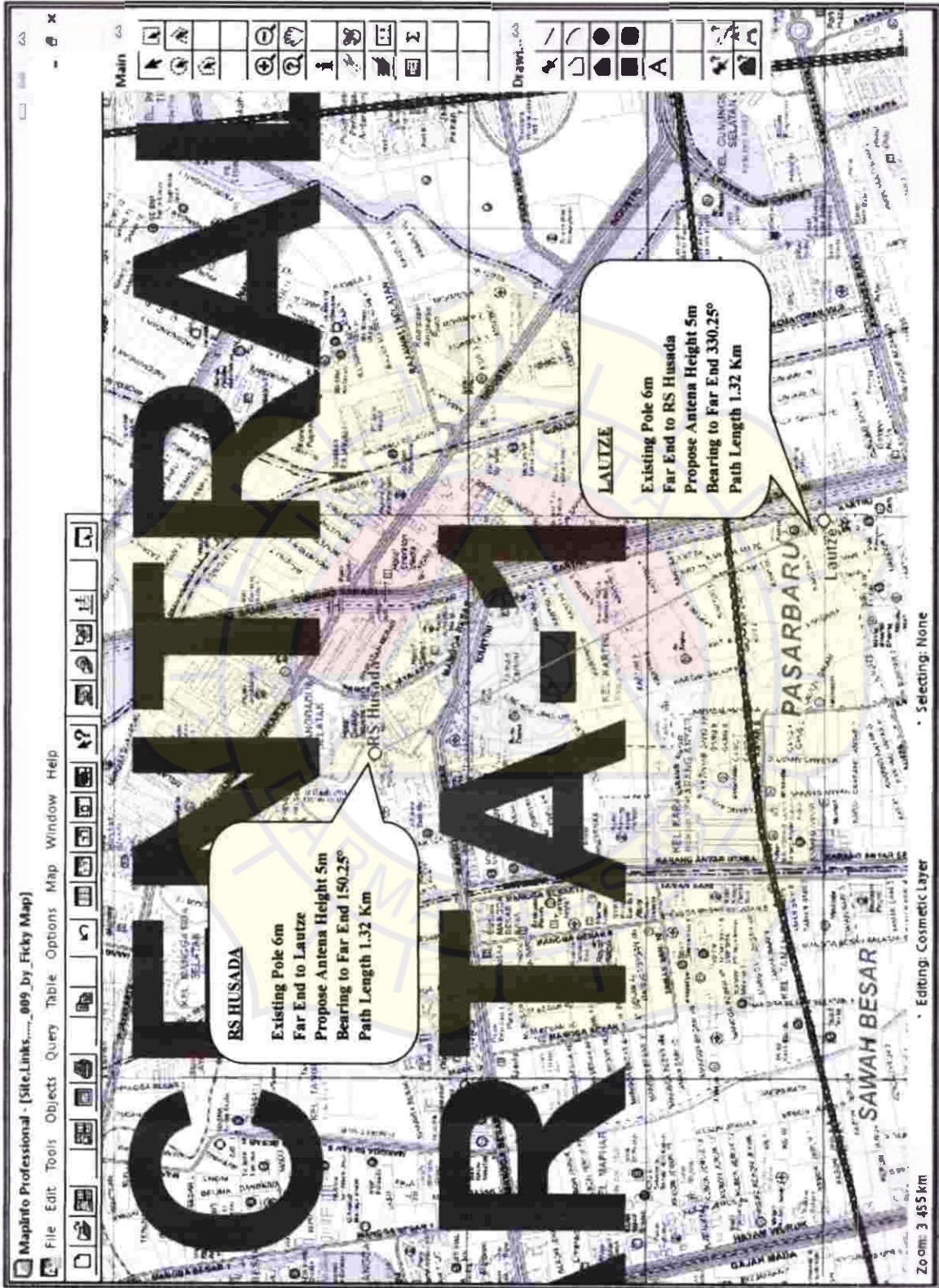
Internet: [www.nsn.com](http://www.nsn.com)

# **Lampiran**

**2**

**Peta Lintasan**

**RS Husada *Far End* Lautze**



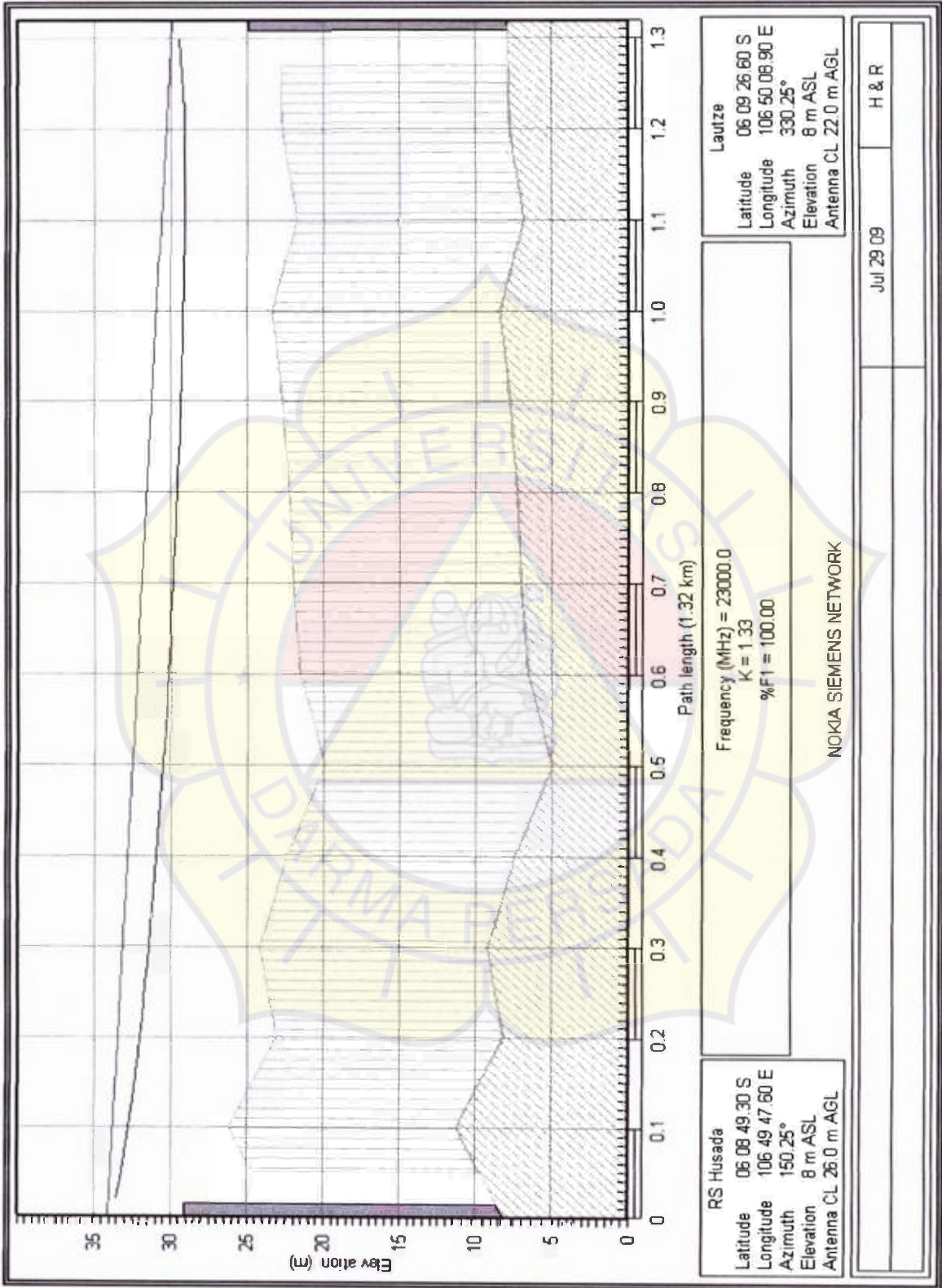
# Lampiran

3

**Path Profile**







Jul 29 09

H & R

Postal Address  
 PT. Nokia Siemens Network  
 INDONESIA

Nokia Siemens Network Office Menara Mulia : Jl. Gatot Subroto Kav 9-11 Karet  
 Setiabudi Jakarta Selatan, 12930

Internet: [www.nsn.com](http://www.nsn.com)

# Lampiran

4

**Terrain Data**



Terrain Data : RS Husada-Lautze

	RS Husada	Lautze
Latitude	06 08 49.30 S	06 09 26.60 S
Longitude	106 49 47.60 E	106 50 08.90 E
True azimuth (°)	150 15 03.34	330 15 01.06
Calculated Distance (km)	1.320	
Profile Distance (km)	1.320	
Datum	WGS 1984	
UTM zone	48S	48S
Easting (km)	702.492	703.143
Northing (km)	9320.196	9319.048
Elevation (m)	8.12	7.90

Distance (km)	Elevation (m)	Ground	Structure (m)
0.000	8.12	AG	21.0 m Building
0.050	9.66	AG	15.0 m Building - Start of Range
0.100	11.21	AG	
0.200	8.14	AG	
0.300	9.19	AG	
0.400	7.41	AG	
0.500	4.94	AG	
0.600	6.51	AG	
0.700	6.98	AG	
0.800	7.23	AG	
0.900	7.74	AG	
1.000	8.37	AG	
1.100	6.77	AG	
1.200	7.73	AG	
1.270	7.83	AG	End of Range
1.320	7.90	AG	17.0 m Building

Ground Elevations - AMSL, Structure & Antenna Heights - AGL

Ground Type

PG - Poor, AG - Average, GG - Good, FW - Fresh Water, SW - Salt Water

# **Lampiran**

**5**

**Data Spesifikasi Alat**



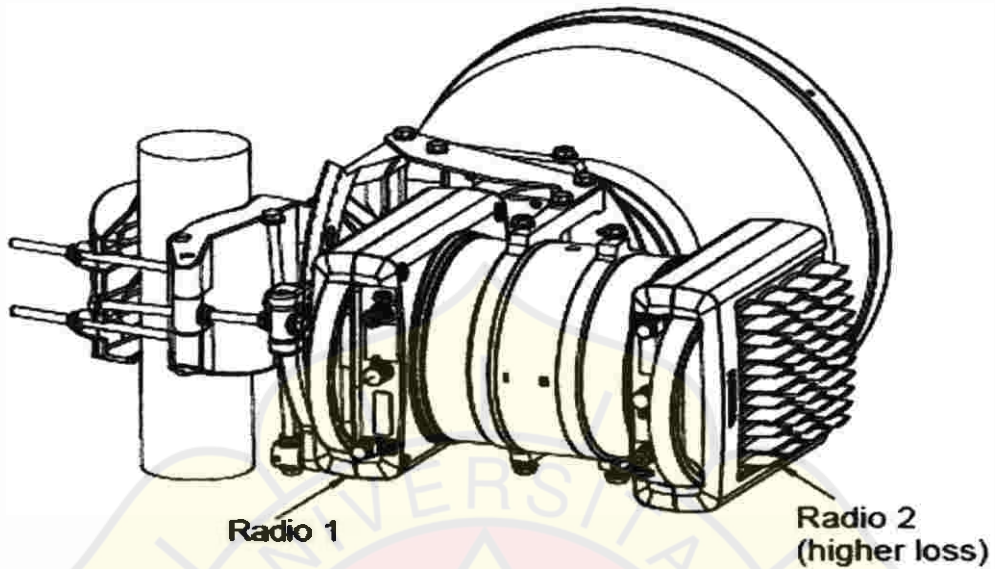


Figure 33. Nokia FlexiHopper 18, 23, or 26 in 1-antenna HSB operation

Table 52. Coupler dimensions

Dimensions of the 13/15 GHz coupler	Height 300 mm Width 430 mm Depth 260 mm Weight 6.8 kg
Dimensions of the 18 - 26 GHz coupler	Height 250 mm Width 280 mm Depth 300 mm Weight 5.0 kg
Dimensions of the 38 GHz coupler	Height 250 mm Width 240 mm Depth 300 mm Weight 4.8 kg

Table 42. Antenna connector

Frequency band	Waveguide flange
13 GHz	UBR120
15 GHz	UBR140
18, 23, 26 GHz	UBR220
38 GHz	UBR320

Table 36. Receiver threshold at antenna connector

Frequency band	Capacity (Mbit/s)	BER 10 <sup>-3</sup> threshold (dBm)		BER 10 <sup>-6</sup> threshold (dBm)	
		Typical	Guaranteed	Typical	Guaranteed
13, 15, 18, 23 GHz	2 x 2	-93	-89	-90	-86
	4 x 2	-90	-86	-87	-83
	8 x 2	-87	-83	-84	-80
	16 x 2	-84	-80	-81	-77
26 GHz	2 x 2	-92	-88	-89	-85
	4 x 2	-89	-85	-86	-82
	8 x 2	-86	-82	-83	-79
	16 x 2	-83	-79	-80	-76
38 GHz	2 x 2	-90	-86	-87	-83
	4 x 2	-89	-85	-86	-82
	8 x 2	-86	-82	-83	-79
	16 x 2	-83	-79	-80	-76

## Power levels

Table 32. Maximum transmit power and noise figure at antenna connector

Frequency band	Transmit power (dBm), nominal	Receive noise figure (dB), typical over temperature
13, 15 GHz	20	<6.5
18, 23 GHz	18	<7
26 GHz	18	<7.5
38 GHz	16	<8

Table 33. Minimum transmit power

Frequency band	Capacity (Mbit/s)	Minimum transmit power (dBm), nominal
13, 15 GHz	All capacities	-6
18, 23, 26, 38 GHz	2 x 2	-10
	4 x 2	-7
	8 x 2	-4
	16 x 2	-1

## Capacities

Table 7. Capacity options (programmable)

Traffic capacity (Mbit/s)	Gross bit rate (Mbit/s, $\pm 10$ ppm)
2 x 2	4.715 127 5
4 x 2	9.430 255
8 x 2	18.860 510
16 x 2	37.721 020
<b>Bit rate tolerances</b>	
2 Mbit/s interface	$\pm 50$ ppm

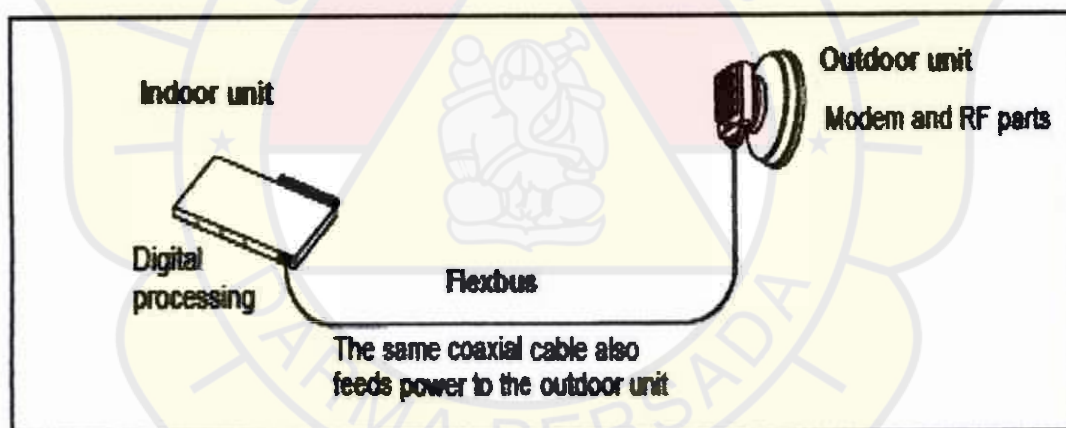


Figure 3. The basic Nokia FlexiHopper node configuration, one indoor unit and one outdoor unit



Table 2. Antenna and alignment unit

Frequency band	Antenna size alternatives				
13 GHz		60 cm	120 cm	180 cm	
15 GHz	30 cm	60 cm	120 cm	180 cm	
18 GHz	30 cm	60 cm	120 cm	180 cm	
23 GHz	20 cm	30 cm	60 cm	120 cm	180 cm
26 GHz	20 cm	30 cm	60 cm	120 cm	
38 GHz	20 cm*	30 cm	60 cm		

\*) Available with the Nokia FlexiHopper alignment unit or with the Nokia MetroHopper alignment bracket and the fastener

## Modulation and demodulation

Table 24. Modulation

Modulation method	$\pi/4$ -DQPSK
Demodulation method	Partially differential

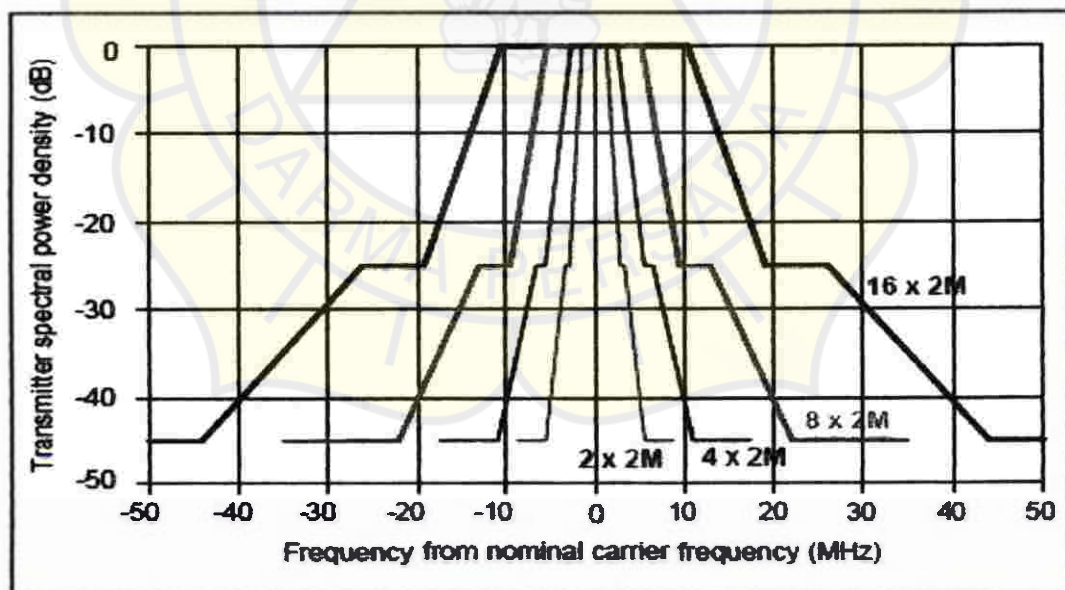


Figure 27. Spectrum mask

Table 20. Nokia Flexi-topper 23, frequency tuning range

Subband	2 x 2 Mbit/s capacity		4 x 2 Mbit/s capacity		8 x 2 Mbit/s capacity		16 x 2 Mbit/s capacity	
	Lowest channel (MHz)	Highest channel (MHz)	Lowest channel (MHz)	Highest channel (MHz)	Lowest channel (MHz)	Highest channel (MHz)	Lowest channel (MHz)	Highest channel (MHz)
1232 MHz duplex spacing, subbands A - C and A' - C'								
A	21225.75	21622.25	21227.50	21620.50	21231.00	21617.00	21238.00	21610.00
B	21585.75	21982.25	21587.50	21980.50	21591.00	21977.00	21598.00	21970.00
C	21945.75	22342.25	21947.50	22340.50	21951.00	22337.00	21958.00	22330.00
A'	22457.75	22854.25	22459.50	22852.50	22463.00	22849.00	22470.00	22842.00
B'	22817.75	23214.25	22819.50	23212.50	22823.00	23209.00	22830.00	23202.00
C'	23177.75	23574.25	23179.50	23572.50	23183.00	23569.00	23190.00	23562.00
1008 MHz duplex spacing, subbands M - N and M' - N'								
M	22003.75	22400.25	22005.50	22398.50	22009.00	22395.00	22016.00	22388.00
N	22193.75	22589.00	22195.50	22588.50	22199.00	22585.00	22206.00	22578.00
M'	23011.75	23408.25	23013.50	23406.50	23017.00	23403.00	23024.00	23396.00
N'	23201.75	23597.00	23203.50	23596.50	23207.00	23593.00	23214.00	23586.00

## Antenna and alignment unit

### Electrical characteristics

Table 45. Antenna specifications

Frequency band	Antenna size	Gain (low/mid/high-band) (dBi)	Gain tolerance (dB)	3 dB beam-width	F/B ratio (Vert./Horiz. pol.) (dB)	XPD (dB)	Return loss (dB)
23 GHz	20 cm	30.5/31.0/31.5	±0.5	4.5°	56	30	15
	30 cm	35.0/35.5/36.0	±0.9	2.7°	61	30	17.7
	60 cm	40.1/40.6/41.1	±0.8	1.5°	65	30	17.7
	120 cm	45.5/46.0/46.5	±0.5	0.7°	72	30	17.7
	180 cm	48.9/49.5/50.0	±0.5	0.5°	75	32	20

## Frequencies

Table 19. Frequency bands, sub-bands and duplex-spacings

Outdoor unit	ITU-R Rec.	Frequency band (GHz)	Duplex spacing (MHz)	Number of subbands	Sub-band bandwidth (MHz)	CEPT
Nokia FlexiHopper 7	F.785-7	7.125-7.435	161 <sup>1</sup>	4+4 (A to D)	56	-
		7.425-7.725	154 <sup>1</sup>	4+4 (E to H)	65	-
		7.415-7.725	161 <sup>1</sup>	4+4 (I to L)	58	-
		7.240-7.560	161 <sup>1</sup>	4+4 (M to P)	65	-
		7.440-7.740	168 <sup>1</sup>	3+3 (Q to S)	65	-
Nokia FlexiHopper 8	F.386-6	7.725-8.275	311.32 <sup>1</sup>	3+3 (A to C)	125	-
		8.260-8.485	119 <sup>1</sup>	3+3 (D to F)	42	-
		8.275-8.500	126 <sub>1</sub>	3+3 (G to I)	42	-
Nokia FlexiHopper 13	F.497-6	12.75-13.25	266	3+3 (A to C)	64	REC 12-02
Nokia FlexiHopper 15	F.636-3	14.5- 15.35	420 <sup>1</sup>	3+3 (A to C)	150	-
		14.5- 15.35	644 <sup>1</sup>	1+1 (M)	203	-
		14.5- 15.35	726 <sup>1</sup>	1+1 (N)	119	REC 12-07
Nokia FlexiHopper 18	F.585-8	17.7-19.7	1010	4+4 (A to D)	270	REC 12-03
Nokia FlexiHopper 23	F.637-3	21.2-23.6	1232 <sup>1</sup>	3+3 (A to C)	400	-
		22.0-23.6	1008 <sup>1</sup>	2+2 (M,N)	400	T/R 13-02

Table 39.  $10^{-6}$  BER signature data

		Minimum phase		Non-minimum phase	
f (GHz)	df (MHz)	w (MHz)	$B_n$ (dB)	w (MHz)	$B_n$ (dB)
7	154/161/168	$23 \pm 2$	$15.4 \pm 1.0$	$22 \pm 2$	$15.4 \pm 1.0$
8	119/126	$24 \pm 2$	$15.8 \pm 1.0$	$24 \pm 2$	$15.9 \pm 1.0$
8	311.32	$24 \pm 2$	$15.9 \pm 1.0$	$24 \pm 2$	$16.0 \pm 1.0$
13	266	$26 \pm 2$	$13.1 \pm 1.0$	$26 \pm 2$	$13.1 \pm 1.0$
15	420	$30 \pm 2$	$10.8 \pm 1.0$	$30 \pm 2$	$10.7 \pm 1.0$
15	644	$30 \pm 2$	$10.7 \pm 1.0$	$30 \pm 2$	$10.5 \pm 1.0$
15	728	$31 \pm 2$	$10.5 \pm 1.0$	$31 \pm 2$	$10.5 \pm 1.0$
18	1010	$31 \pm 2$	$10.7 \pm 1.0$	$31 \pm 2$	$10.6 \pm 1.0$

Table 73. Electrical specifications for FlexiHopper 20 cm antenna at 23 GHz

Frequency/ Size	(23 GHz); 21200-23600 MHz/ 20 cm (Squarad)
Type, Item	Single T55075.03
Gain	Low 30.5/ Middle 31.0/ High 31.5 dBi (min 30.3/ max 31.7 dBi)
BW (-3 dB)	4.5 deg
F/B	56 dB
XPD	30 dB
RL	17.7 dB
RPE ETSI EN 300 833 V1.4.1	R3 C3

- Forward error correction improves radio performance in demanding conditions.
- Automatic fading margin measurement during commissioning.
- Several protection methods: hot standby, frequency and space diversity.
- High Mean Time Between Failure ratio.

When combined with Nokia's network reliability features, such as loop protection, you can achieve virtually

error free transmission in even the most demanding conditions.

**Main benefits**

- Nokia Flexibus single cable interconnections together with integrated software controlled cross connections provide revolutionary easy and flexible site configurations.
- Four different indoor units, either fully Nokia BTS integrated or 19", for all transmission requirements.

- Common indoor unit platform for both Nokia FlexiHopper Microwave Radios and Nokia MetroHopper Radios.
- One indoor unit supports multiple outdoor units - saves equipment and installation costs and reduces space requirements.
- Versatile design with a single platform for all frequencies.
- Compact and easy to install outdoor unit with integrated low profile or square antennas speed up roll out.

**Technical Specifications of Nokia FlexiHopper Microwave Radio / Outdoor Unit**

General	13	15	18	23	26	38
Frequency range (GHz)	12.76 - 13.24	14.51 - 15.34	17.71 - 19.69	21.23 - 23.60	24.55 - 26.45	37.05 - 39.44
Transmission capacity	2 x 2, 4 x 2, 8 x 2 or 16 x 2 Mbit/s (Software programmable)					
Modulation	π/4 DQPSK					
Channel spacing (MHz)	3.5 - 28.0 depending on capacity					
Power consumption	max 25 W					
Operational temperature	-45 to +50 °C					
Weight and dimensions	5.5 kg 230 x 210 x 210			4.6 kg 230 x 210 x 165		4.0 kg 230 x 210 x 120
Antenna type	Integrated low profile antenna with vertical/horizontal polarisation					
Antenna gain (dBi)	35.5 - 45.0	32.0 - 46.2	34.4 - 48.2	31.0 - 49.5	32.3 - 46.9	35.0 - 44.3
<b>Transmitter</b>						
Typical values in dBm						
Output power	20 dBm			18 dBm		16 dBm
Power adjustment range	-10 dB					
<b>Receiver Threshold level at antenna port</b>						
Capacity (Mbit/s)	Typical values in dBm BER 10-3 / BER 10-6					
2 x 2	-93/-90		-92/-89		-90/-87	
4 x 2	-90/-87		-89/-86		-89/-86	
8 x 2	-87/-84		-86/-83		-86/-83	
16 x 2	-84/-81		-83/-80		-83/-80	

**Technical Specifications of Indoor Units**

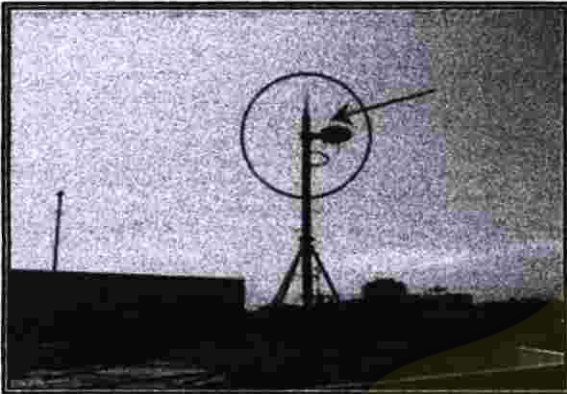
Base Station Integrated Indoor Unit	Integration into	Number of Outdoor Units
FC RRI	Nokia MetroSite and Nokia UltraSite Base Stations	1
FXC RRI	Nokia MetroSite and Nokia UltraSite Base Stations and Nokia MetroHub T ransmission Node	1-2
RRIC	Nokia Intratalk BTS and Nokia Citytalk BTS	1-2
<b>19" Indoor Unit FIU 19</b>		
Integration into		Number of Outdoor Units*
Standard 19" rack and Nokia Extratalk cabinet		1-3
<b>Main Channels</b>		
Electrical interface	4-16 x 2 Mbit/s, ITU-T G.703, 75 ohm SMB or 120 ohm TQ	
Auxiliary data channels (plug-in unit)	EIA-232 or ITU-T V.11: max. 9600 bit/s ITU-T V.11 or ITU-T G.703: max. 64 kbit/s Four programmable I/O interfaces	
Weight and dimensions	2.45kg, 2/3 U x 440 x 300	
Power consumption	max 17 W	

\*Nokia FlexiHopper Microwave Radios and Nokia MetroHopper Radios can be mixed and one Nokia FlexiHopper Microwave Radio can be protected

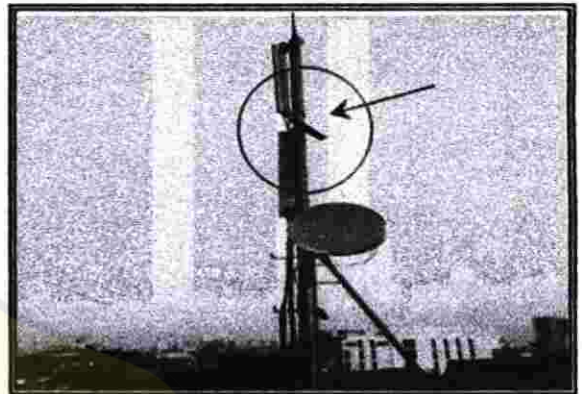
## LoS Report

Link ID:	095158A_090151A	Link Name:	RS Husada_Lautze
LoS Requested Date:	26-Jul-2009	LoS Date:	27-Jul-2009
LoS Requested by:	Hersa Indraprahasta	Report by:	Riko Indovina
<b>SITE A</b>		<b>SITE B</b>	
Site ID	095158A	Site ID	090151A
Latitude	S 06 08 49.30	Latitude	S 06 09 26.60
Longitude	E106 49 47.60	Longitude	E 106 50 08.90
Elevation (A.s.l)	8 m	Elevation (a.s.l)	8 m
Structure Type	Rooftop	Structure Type	Rooftop
Structure Height A.g.l	6 m	Structure Height A.g.l	6 m
Azimuth site A toward site B	150.25	Azimuth site B toward site A	330.25
Building height	21 m	Building height	17 m
Address to site A		Address to site B	
Jl. Mangga Besar Raya, Jakarta Pusat		Jl. Lautze No.9 A Rt 013/05, Pasar Baru, Sawah Besar Jakarta Pusat	
Link length (Km):		1.32	
LoS Result:		<input checked="" type="checkbox"/> Visible	
<b>SITE A</b>		<b>SITE B</b>	
Minimum LoS height A a.g.l. (m):	26	Minimum LoS height B a.g.l. (m)	22
Comments on Site A			
Comments on Site B			
Comments on LoS A => B			
LOS			
Comments on LoS B => A			
LOS			

Site RS Husada Propose antenna



Site Lautze Propose antenna



View from Site A to Site B



View from Site B to Site A



View from Site A to Site B (Zoom)



View from Site B to Site A (Zoom)



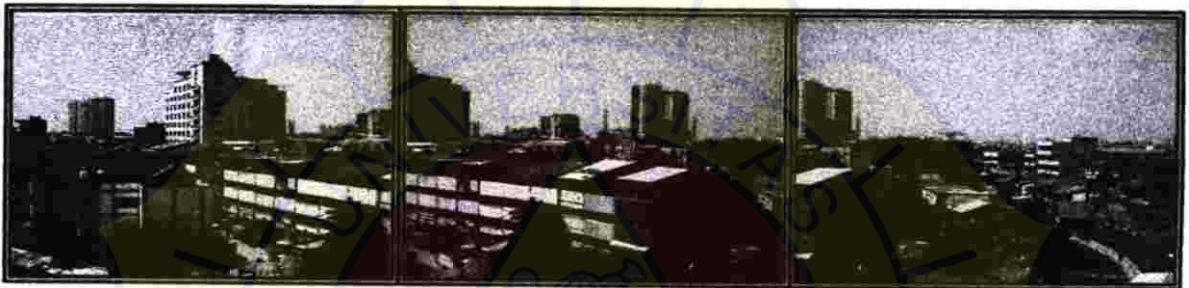
Panoramic



0

30

60



90

120

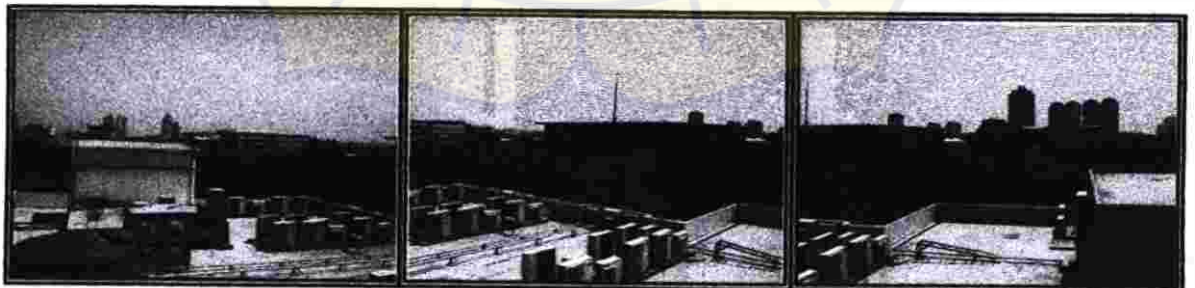
150



180

210

240



270

300

330





# TR/MW Planning Technical Site Survey Report



**095158A**  
site number

**RS Husada**  
site name

## 1. General information

Comm	orSiteLink:	Preferred	TR Site Rank	1
Cluster		Urban	Controller	

RP Latitude: 06° 08' 49.30" S	RP Longitude: 106° 49' 47.60"	Date of TSS: 27-Jul-2009
-------------------------------	-------------------------------	--------------------------

## 2. Microwave link information

MW link number	MW rank	Drawing Reference #	LOS required	LOS status	Azimuth	Antenna diameter	Antenna centerline
095158_090180	1		Yes <input type="checkbox"/> no <input type="checkbox"/>	NO LOS	289.22	0.3	-
095158_093194	2		Yes <input type="checkbox"/> no <input type="checkbox"/>	NO LOS	208.13	0.3	-
095158_090177	3		Yes <input type="checkbox"/> no <input type="checkbox"/>	NO LOS	90	0.3	-
095158_090158	4		Yes <input checked="" type="checkbox"/> no <input type="checkbox"/>	LOS	150.25	0.3	26

## 3. Fixed / Lease line information

LL Number	LL rank	Capacity	Equipment type	Equipment model	Configuration
095158_090151	1	4E1		SRALxD 23-4	1+0

## 4. Reasons for acceptance/rejection or RP comments:

--

The Transmission Planner is responsible for checking the Detailed Site Sketch (which is completed at the Technical Site Survey by Construction) for all required Transmission Planning Information. Any additions or changes to this configuration after the date on the Construction Technical Site Survey Document must be transmitted to all departments so that the information can be incorporation into the drawings.

## 5. Parties

Transmission/Microwave Planner

Network Planning Manager

Hersa Indraprahasta

Rusvanetti

Signature

Signature

Revision number: 01

1

Document title: 7.2. TP TSSR\_095158A

Date of issue: Juli 29, 2009

of

Document number: 2009

References: M4. TSS Approved

1

Release status: Released

# Lampiran

8

Tabel Frekuensi



Jl. Manggar Blok AE 5/ 4, Kav. DPRD  
Pondok Kelapa Permai, Jakarta Timur 13450  
Telp. (021) 99603869 Email : [gsmjkt@gmail.com](mailto:gsmjkt@gmail.com)

**SURAT KETERANGAN**  
NO : 015 / GSBM - HR / VIII - 2009

Yang bertanda tangan dibawah ini :

Nama : Reza Ardhy F, ST  
Jabatan : Manager Teknik  
Alamat : Jl. Manggar Blok AE 5/ 4, Kav. DPRD Pondok Kelapa Permai

Menerangkan bahwa mahasiswa aktif tersebut dibawah ini :

Nama : Riko Indovina  
NIM : 02210021  
Fakultas : Teknik  
Jurusan : Elektro Telekomunikasi  
Perguruan Tinggi : Universitas Darma Persada

Yang bersangkutan telah melaksanakan magang dan pengambilan data dibagian Transmission Network Planning periode 25 January s/d 24 Agustus 2009.

Demikian surat keterangan ini dibuat untuk dipergunakan seperlunya.

Jakarta, 25 Agustus 2009

PT. GLOBAL SEJAHTERA BINA MANDIRI

Reza Ardhy F, ST

Manager Teknik

# Lampiran

10

**Tabel Data *Link* BTS RS Husada**

***Far End* BTS Kebon Jeruk I Maphar**

### Tabel Data *Link RS Husada Far End Kebon Jeruk I Maphar*

NO.	PARAMETER	Site A	Site B
1	Site ID	095158A	090180B
2	Site Name	RS Husada	Kebon Jeruk I - Maphar
3	Coordinat	06 08 51.40 LS 106 49 45.10 BT	06 09 31.60 LS 106 49 25.00 BT
4	Azimuth	206,58	26,58
5	Path Length	1,38	1,38
6	Elevation	7	4
7	Tower Height	38	41
8	Antenna Height	37	25
9	Antenna Model	VHLP1-23	VHLP1-23
10	Antenna Code	VHLP1-23-7014	VHLP1-23-7014
11	Antenna Diameter	0,3	0,3
12	Antenna Gain (dBi)	35,3	35,3
13	Frequensi (GHz)	22011,5	23019,5
14	Polarization	V.	V
15	Radio Model	SRALxD 23-4 ND	SRALxD 23-4 ND
16	Transmitt Output Power (dBm)	18	18
17	EIRP (dBw)	18,8	18,8
18	Transmitt Line Loss (dB)	4,5	4,5
19	Receive Line Loss (dB)	0,5	0,5
20	Free Space Loss (dB)	122,49	122,49
21	Receive Signal Level (dBm)	-39,16	-39,16
22	Receiver Threshold (dBm)	-88	-88
23	Fade Margin (dB)	48,84	48,84