

LAMPIRAN A
PERHITUNGAN *LINK BUDGET*, PROBABILITAS
LUASAN SEL DAN TEPI SEL

A. PERHITUNGAN *LINK BUDGET*

1. Site Monginsidi-Kalidoni Sektor 1

a. Sisi *uplink*

- ERP_{MS}

$$ERP_{MS} [dBm] = P_{TX-MS} + G_{MS} - L_{MS}$$

dengan :

$$P_{TX-MS} = 24 \text{ dBm}$$

$$G_{MS} = 0 \text{ dBi}$$

$$L_{MS} = 0 \text{ dB}$$

$$ERP_{MS} = 24 \text{ dBm} + 0 \text{ dBi} - 0 \text{ dB}$$

$$ERP_{MS} = 24 \text{ dBm}$$

- PL_{up}

$$PL_{up} [dB] = ERP_{MS} + G_{BS} - L_f - BS_{sensitivity} + G_{div} - F_m - I_{m-up} + G_{SHO}$$

dengan :

$$ERP_{MS} = 24 \text{ dBm}$$

$$G_{BS} = 15,85 \text{ dBi}$$

$$L_f = 3 \text{ dB}$$

$$BS_{sensitivity} = -120 \text{ dBm}$$

$$G_{div} = 0 \text{ dB}$$

$$F_m = 8,5 \text{ dB}$$

$$I_m = 3 \text{ dB}$$

$$G_{SHO} = 0 \text{ dB}$$

$$PL_{up} = 24 \text{ dBm} + 15,85 \text{ dBi} - 3 \text{ dB} + 102 \text{ dBm} + 0 \text{ dB} - 8,5 \text{ dB} - 3 \text{ dB} + 0 \text{ dB}$$

$$PL_{up} = 145,35 \text{ dB}$$

- $PL_{COST-231}$

$$PL_{\text{COST-231}}[\text{dB}] = 46,3 + 33,6 \log f_{\text{c-up}} - 13,82 \log h_{\text{BS}} - ((1,1 \log f_{\text{c-up}} - 0,7) \\ h_{\text{MS}} - (1,56 \log f_{\text{c-up}} - 0,8)) + (44,9 - 6,55 \log h_{\text{BS}}) \log d \\ + C_{\text{M}}$$

dengan :

$$f_{\text{c-up}} = 1725,22 \text{ MHz}$$

$$h_{\text{BS}} = 35 \text{ m}$$

$$h_{\text{MS}} = 1,5 \text{ m}$$

$$C_{\text{M}} = 3 \text{ dB}$$

$$PL_{\text{COST-231}}[\text{dB}] = 46,3 + 33,6 \log 1725,22 - 13,82 \log 35 - ((1,1 \log 1725, \\ 22 - 0,7) 1,5 - (1,56 \log 1725,22 - 0,8)) + (44,9 - 6,55 \log 35) \log d + 3 \text{ dB}$$

- Perkiraan radius sel (d)

$$PL_{\text{up}} = PL_{\text{COST-231}}$$

$$145,35 \text{ dB} = 46,3 + 33,6 \log 1725,22 - 13,82 \log 35 - ((1,1 \log 1725,22 - \\ 0,7) 1,5 - (1,56 \log 1725,22 - 0,8)) + (44,9 - 6,55 \log 35) \log d + 3$$

$$d = 1,77 \text{ Km}$$

b. Sisi *downlink*

- ERP_{BS}

$$ERP_{\text{BS}}[\text{dBm}] = P_{\text{TX-BS}} + G_{\text{BS}} - L_{\text{f}}$$

dengan :

$$P_{\text{TX-BS}} = 47,6 \text{ dBm}$$

$$G_{\text{BS}} = 15,85 \text{ dBi}$$

$$L_{\text{f}} = 3 \text{ dB}$$

$$ERP_{\text{BS}} = 47,6 \text{ dBm} + 15,85 \text{ dBi} - 3 \text{ dB}$$

$$ERP_{\text{BS}} = 60,45 \text{ dBm}$$

- PL_{down}

$$PL_{\text{down}}[\text{dB}] = ERP_{\text{BS}} + G_{\text{MS}} - MS_{\text{sensitivity}} - F_{\text{m}} - I_{\text{m}}$$

dengan :

$$ERP_{MS} = 60,45 \text{ dBm}$$

$$G_{MS} = 0 \text{ dBi}$$

$$MS_{\text{sensitivity}} = -100 \text{ dBm}$$

$$F_m = 8,5 \text{ dB}$$

$$I_m = 3 \text{ dB}$$

$$PL_{\text{down}} = 60,45 \text{ dBm} + 0 \text{ dBi} + 100 \text{ dBm} - 8,5 \text{ dB} - 3 \text{ dB}$$

$$PL_{\text{down}} = 148,95 \text{ dB}$$

- $PL_{\text{COST-231}}$

$$PL_{\text{COST-231}}[\text{dB}] = 46,3 + 33,6 \log f_{\text{c-down}} - 13,82 \log h_{\text{BS}} - ((1,1 \log f_{\text{c-down}} - 0,7) h_{\text{MS}} - (1,56 \log f_{\text{c-down}} - 0,8)) + (44,9 - 6,55 \log h_{\text{BS}}) \log d + C_M$$

dengan :

$$f_{\text{c-down}} = 1820,22 \text{ MHz}$$

$$h_{\text{BS}} = 35 \text{ m}$$

$$h_{\text{MS}} = 1,5 \text{ m}$$

$$C_M = 3 \text{ dB}$$

$$PL_{\text{COST-231}}[\text{dB}] = 46,3 + 33,6 \log 1820,22 - 13,82 \log 35 - ((1,1 \log 1820,22 - 0,7) 1,5 - (1,56 \log 1820,22 - 0,8)) + (44,9 - 6,55 \log 35) \log d + 3 \text{ dB}$$

- Perkiraan radius sel (d)

$$PL_{\text{down}} = PL_{\text{COST-231}}$$

$$148,95 \text{ dB} = 46,3 + 33,6 \log 1820,22 - 13,82 \log 35 - ((1,1 \log 1820,22 - 0,7) 1,5 - (1,56 \log 1820,22 - 0,8)) + (44,9 - 6,55 \log 35) \log d + 3$$

$$d = 2,14 \text{ Km}$$

c. Probabilitas Luasan Sel dan Tepi Sel

- $\text{slope} (\text{dB/dec}) = 44,9 - 6,55 \log h_{\text{BS}}$

dengan :

$$h_{BS} = 35 \text{ m}$$

$$slope = 34,7864 \text{ dB/dec}$$

- $a = \frac{F_m}{\tau\sqrt{2}}$

dengan :

$$F_m = 8,5 \text{ dB}$$

$$\tau = 8 \text{ dB}$$

$$a = \frac{8,5}{8\sqrt{2}}$$

$$a = 0,7510$$

- $b = \frac{10\alpha \log e}{\tau\sqrt{2}}$

dengan :

$$\alpha = 3,47864$$

$$\tau = 8 \text{ dB}$$

$$b = \frac{10 \cdot 3,47864 \log e}{8\sqrt{2}}$$

$$b = 1,335$$

- $\text{erf}(a) = 1 - 2Q(a\sqrt{2})$

$$\text{erf}(a) = 1 - 2Q(0,7510\sqrt{2})$$

$$\text{erf}(a) = 0,7060$$

- $\text{erf}(a, b) = \text{erf}\left(\frac{a \cdot b + 1}{b}\right)$

$$\text{erf}(a, b) = \text{erf}\left(\frac{0,7510 \cdot 1,335 + 1}{1,335}\right)$$

$$\text{erf}(a, b) = 0,9640$$

- $\exp(a, b) = \exp\left(\frac{2 \cdot a \cdot b + 1}{b^2}\right)$

$$\exp(a, b) = \exp\left(\frac{2 \cdot 0,7510 \cdot 1,335 + 1}{1,335^2}\right)$$

$$\exp(a, b) = 5,339$$

- probabilitas *coverage* sel

$$\mu = 0,5 \left(1 + \operatorname{erf}(a) + \exp\left(\frac{2 \cdot a \cdot b + 1}{b^2}\right) \cdot \left(1 - \operatorname{erf}\left(\frac{a \cdot b + 1}{b}\right)\right) \right)$$

$$\mu = 0,5 (1 + 0,7060 + 5,339(1 - 0,9640))$$

$$\mu = 95,02\%$$

- probabilitas tepi sel

$$\beta = 0,5 + 0,5 \cdot \operatorname{erf}(a)$$

$$\beta = 0,5 + 0,5 \cdot 0,7060$$

$$\beta = 85,30\%$$

2. Site Mata Merah-Sungai Selinca Sektor 3

a. Sisi *uplink*

- ERP_{MS}

$$\text{ERP}_{\text{MS}} [\text{dBm}] = P_{\text{TX-MS}} + G_{\text{MS}} - L_{\text{MS}}$$

dengan :

$$P_{\text{TX-MS}} = 24 \text{ dBm}$$

$$G_{\text{MS}} = 0 \text{ dBi}$$

$$L_{\text{MS}} = 0 \text{ dB}$$

$$\text{ERP}_{\text{MS}} = 24 \text{ dBm} + 0 \text{ dBi} - 0 \text{ dB}$$

$$\text{ERP}_{\text{MS}} = 24 \text{ dBm}$$

- PL_{up}

$$\text{PL}_{\text{up}} [\text{dB}] = \text{ERP}_{\text{MS}} + G_{\text{BS}} - L_{\text{f}} - \text{BS}_{\text{sensitivity}} + G_{\text{div}} - F_{\text{m}} - I_{\text{m-up}} + G_{\text{SHO}}$$

dengan :

$$\text{ERP}_{\text{MS}} = 24 \text{ dBm}$$

$$G_{\text{BS}} = 15,85 \text{ dBi}$$

$$L_{\text{f}} = 3,59 \text{ dB}$$

$$\text{BS}_{\text{sensitivity}} = -120 \text{ dBm}$$

$$G_{\text{div}} = 0 \text{ dB}$$

$$F_m = 10,5 \text{ dB}$$

$$I_m = 3 \text{ dB}$$

$$G_{\text{SHO}} = 0 \text{ dB}$$

$$PL_{\text{up}} = 24 \text{ dBm} + 15,85 \text{ dBi} - 3 \text{ dB} + 120 \text{ dBm} + 0 \text{ dB} - 10,5 \text{ dB} - 3 \text{ dB} + 0 \text{ dB}$$

$$PL_{\text{up}} = 142,76 \text{ dB}$$

- $PL_{\text{COST-231}}$

$$PL_{\text{COST-231}}[\text{dB}] = 46,3 + 33,6 \log f_{\text{c-up}} - 13,82 \log h_{\text{BS}} - ((1,1 \log f_{\text{c-up}} - 0,7) h_{\text{MS}} - (1,56 \log f_{\text{c-up}} - 0,8)) + (44,9 - 6,55 \log h_{\text{BS}}) \log d + C_M$$

dengan :

$$f_{\text{c-up}} = 1730,15 \text{ MHz}$$

$$h_{\text{BS}} = 45 \text{ m}$$

$$h_{\text{MS}} = 1,5 \text{ m}$$

$$C_M = 0 \text{ dB}$$

$$PL_{\text{COST-231}}[\text{dB}] = 46,3 + 33,6 \log 1730,15 - 13,82 \log 45 - ((1,1 \log 1730,15 - 0,7) 1,5 - (1,56 \log 1730,15 - 0,8)) + (44,9 - 6,55 \log 45) \log d + 0 \text{ dB}$$

- Perkiraan radius sel (d)

$$PL_{\text{up}} = PL_{\text{COST-231}}$$

$$145,35 \text{ dB} = 46,3 + 33,6 \log 1730,15 - 13,82 \log 45 - ((1,1 \log 1730,15 - 0,7) 1,5 - (1,56 \log 1730,15 - 0,8)) + (44,9 - 6,55 \log 45) \log d + 0 \text{ dB}$$

$$d = 2,04 \text{ Km}$$

b. Sisi *downlink*

- ERP_{BS}

$$ERP_{\text{BS}}[\text{dBm}] = P_{\text{TX-BS}} + G_{\text{BS}} - L_f$$

dengan :

$$P_{TX-BS} = 47,6 \text{ dBm}$$

$$G_{BS} = 15,85 \text{ dBi}$$

$$L_f = 3,59 \text{ dB}$$

$$ERP_{BS} = 47,6 \text{ dBm} + 15,85 \text{ dBi} - 3,59 \text{ dB}$$

$$ERP_{BS} = 59,86 \text{ dBm}$$

- PL_{down}

$$PL_{down} [\text{dB}] = ERP_{BS} + G_{MS} - MS_{sensitivity} - F_m - I_m$$

dengan :

$$ERP_{BS} = 59,86 \text{ dBm}$$

$$G_{MS} = 0 \text{ dBi}$$

$$MS_{sensitivity} = -100 \text{ dBm}$$

$$F_m = 10,5 \text{ dB}$$

$$I_m = 3 \text{ dB}$$

$$PL_{down} = 59,86 \text{ dBm} + 0 \text{ dBi} + 100 \text{ dBm} - 10,5 \text{ dB} - 3 \text{ dB}$$

$$PL_{down} = 146,36 \text{ dB}$$

- $PL_{COST-231}$

$$PL_{COST-231} [\text{dB}] = 46,3 + 33,6 \log f_{c-down} - 13,82 \log h_{BS} - ((1,1 \log f_{c-down} - 0,7) h_{MS} - (1,56 \log f_{c-down} - 0,8)) + (44,9 - 6,55 \log h_{BS}) \log d + C_M$$

dengan :

$$f_{c-down} = 1825,15 \text{ MHz}$$

$$h_{BS} = 45 \text{ m}$$

$$h_{MS} = 1,5 \text{ m}$$

$$C_M = 0 \text{ dB}$$

$$PL_{COST-231} [\text{dB}] = 46,3 + 33,6 \log 1825,15 - 13,82 \log 45 - ((1,1 \log 1825,15 - 0,7) 1,5 - (1,56 \log 1825,15 - 0,8)) + (44,9 - 6,55 \log 45) \log d + 0 \text{ dB}$$

- Perkiraan radius sel (d)

$$PL_{\text{down}} = PL_{\text{COST-231}}$$

$$146,36 \text{ dB} = 46,3 + 33,6 \log 1825,15 - 13,82 \log 45 - ((1,1 \log 1825,15 - 0,7)1,5 - (1,56 \log 1825,15 - 0,8)) + (44,9 - 6,55 \log 45) \log d + 0 \text{ dB}$$

$$d = 2,47 \text{ Km}$$

c. Probabilitas Luasan Sel dan Tepi Sel

- $\text{slope (dB/dec)} = 44,9 - 6,55 \log h_{\text{BS}}$

dengan :

$$h_{\text{BS}} = 45 \text{ m}$$

$$\text{slope} = 34,0715 \text{ dB/dec}$$

- $a = \frac{F_m}{\tau \sqrt{2}}$

dengan :

$$F_m = 10,5 \text{ dB}$$

$$\tau = 8 \text{ dB}$$

$$a = \frac{10,5}{8\sqrt{2}}$$

$$a = 0,9281$$

- $b = \frac{10\alpha \log e}{\tau \sqrt{2}}$

dengan :

$$\alpha = 3,40715$$

$$\tau = 8 \text{ dB}$$

$$b = \frac{10 \cdot 3,40715 \log e}{8\sqrt{2}}$$

$$b = 1,3079$$

- $\text{erf}(a) = 1 - 2Q(a\sqrt{2})$

$$\text{erf}(a) = 1 - 2Q(0,9281\sqrt{2})$$

$$\text{erf}(a) = 0,8064$$

- $\text{erf}(a, b) = \text{erf}\left(\frac{a \cdot b + 1}{b}\right)$
 $\text{erf}(a, b) = \text{erf}\left(\frac{0,9281 \cdot 1,3079 + 1}{1,3079}\right)$
 $\text{erf}(a, b) = 0,9836$
- $\exp(a, b) = \exp\left(\frac{2 \cdot a \cdot b + 1}{b^2}\right)$
 $\exp(a, b) = \exp\left(\frac{2 \cdot 0,9281 \cdot 1,3079 + 1}{1,3079^2}\right)$
 $\exp(a, b) = 7,4173$
- probabilitas *coverage* sel
 $\mu = 0,5 \left(1 + \text{erf}(a) + \exp\left(\frac{2 \cdot a \cdot b + 1}{b^2}\right) \cdot \left(1 - \text{erf}\left(\frac{a \cdot b + 1}{b}\right)\right) \right)$
 $\mu = 0,5 (1 + 0,8064 + 7,4173(1 - 0,9836))$
 $\mu = 96,40\%$
- probabilitas tepi sel
 $\beta = 0,5 + 0,5 \cdot \text{erf}(a)$
 $\beta = 0,5 + 0,5 \cdot 0,8064$
 $\beta = 90,32\%$

3. Site Inspektur Marzuki/Siring Agung Sektor 3

a. Sisi *uplink*

- ERP_{MS}
 $\text{ERP}_{\text{MS}}[\text{dBm}] = P_{\text{TX-MS}} + G_{\text{MS}} - L_{\text{MS}}$
dengan :
 $P_{\text{TX-MS}} = 24 \text{ dBm}$
 $G_{\text{MS}} = 0 \text{ dBi}$
 $L_{\text{MS}} = 0 \text{ dB}$
 $\text{ERP}_{\text{MS}} = 24 \text{ dBm} + 0 \text{ dBi} - 0 \text{ dB}$
 $\text{ERP}_{\text{MS}} = 24 \text{ dBm}$

- PL_{up}

$$PL_{up}[dB] = ERP_{MS} + G_{BS} - L_f - BS_{sensitivity} + G_{div} - F_m - I_{m-up} + G_{SHO}$$

dengan :

$$ERP_{MS} = 24 \text{ dBm}$$

$$G_{BS} = 15,85 \text{ dBi}$$

$$L_f = 2,62 \text{ dB}$$

$$BS_{sensitivity} = -120 \text{ dBm}$$

$$G_{div} = 0 \text{ dB}$$

$$F_m = 8 \text{ dB}$$

$$I_m = 3 \text{ dB}$$

$$G_{SHO} = 0 \text{ dB}$$

$$PL_{up} = 24 \text{ dBm} + 15,85 \text{ dBi} - 2,62 \text{ dB} + 120 \text{ dBm} + 0 \text{ dB} - 8 \text{ dB} - 3 \text{ dB} + 0 \text{ dB}$$

$$PL_{up} = 146,23 \text{ dB}$$

- $PL_{COST-231}$

$$PL_{COST-231}[dB] = 46,3 + 33,6 \log f_{c-up} - 13,82 \log h_{BS} - ((1,1 \log f_{c-up} - 0,7) h_{MS} - (1,56 \log f_{c-up} - 0,8)) + (44,9 - 6,55 \log h_{BS}) \log d + C_M$$

dengan :

$$f_{c-up} = 1728,05 \text{ MHz}$$

$$h_{BS} = 30 \text{ m}$$

$$h_{MS} = 1,5 \text{ m}$$

$$C_M = 3 \text{ dB}$$

$$PL_{COST-231}[dB] = 46,3 + 33,6 \log 1728,05 - 13,82 \log 30 - ((1,1 \log 1728,05 - 0,7) 1,5 - (1,56 \log 1728,05 - 0,8)) + (44,9 - 6,55 \log 30) \log d + 3 \text{ dB}$$

- Perkiraan radius sel (d)

$$PL_{up} = PL_{COST-231}$$

$$146,23 \text{ dB} = 46,3 + 33,6 \log 1728,05 - 13,82 \log 30 - ((1,1 \log 1728,05 - 0,7) 1,5 - (1,56 \log 1728,05 - 0,8)) + (44,9 - 6,55 \log 30) \log d + 3 \text{ dB}$$

$$d = 1,75 \text{ Km}$$

b. Sisi *downlink*

- ERP_{BS}

$$ERP_{BS} [\text{dBm}] = P_{TX-BS} + G_{BS} - L_f$$

dengan :

$$P_{TX-BS} = 47,6 \text{ dBm}$$

$$G_{BS} = 15,85 \text{ dBi}$$

$$L_f = 2,62 \text{ dB}$$

$$ERP_{BS} = 47,6 \text{ dBm} + 15,85 \text{ dBi} - 2,62 \text{ dB}$$

$$ERP_{BS} = 60,85 \text{ dBm}$$

- PL_{down}

$$PL_{down} [\text{dB}] = ERP_{BS} + G_{MS} - MS_{sensitivity} - F_m - I_m$$

dengan :

$$ERP_{BS} = 60,85 \text{ dBm}$$

$$G_{MS} = 0 \text{ dBi}$$

$$MS_{sensitivity} = -100 \text{ dBm}$$

$$F_m = 8 \text{ dB}$$

$$I_m = 3 \text{ dB}$$

$$PL_{down} = 60,85 \text{ dBm} + 0 \text{ dBi} + 100 \text{ dBm} - 8 \text{ dB} - 3 \text{ dB}$$

$$PL_{down} = 149,85 \text{ dB}$$

- $PL_{COST-231}$

$$PL_{COST-231} [\text{dB}] = 46,3 + 33,6 \log f_{c-down} - 13,82 \log h_{BS} - ((1,1 \log f_{c-down} - 0,7) h_{MS} - (1,56 \log f_{c-down} - 0,8)) + (44,9 - 6,55 \log h_{BS}) \log d + C_M$$

dengan :

$$f_{c\text{-down}} = 1823,05 \text{ MHz}$$

$$h_{BS} = 30 \text{ m}$$

$$h_{MS} = 1,5 \text{ m}$$

$$C_M = 3 \text{ dB}$$

$$PL_{\text{COST-231}}[\text{dB}] = 46,3 + 33,6 \log 1823,05 - 13,82 \log 30 - ((1,1 \log 1823,05 - 0,7)1,5 - (1,56 \log 1823,05 - 0,8)) + (44,9 - 6,55 \log 30) \log d + 3 \text{ dB}$$

- Perkiraan radius sel (d)

$$PL_{\text{down}} = PL_{\text{COST-231}}$$

$$149,85 \text{ dB} = 46,3 + 33,6 \log 1823,05 - 13,82 \log 30 - ((1,1 \log 1823,05 - 0,7)1,5 - (1,56 \log 1823,05 - 0,8)) + (44,9 - 6,55 \log 30) \log d + 3 \text{ dB}$$

$$d = 2,11 \text{ Km}$$

c. Probabilitas Luasan Sel dan Tepi Sel

- $slope(\text{dB/dec}) = 44,9 - 6,55 \log h_{BS}$

dengan :

$$h_{BS} = 30 \text{ m}$$

$$slope = 35,2249 \text{ dB/dec}$$

- $a = \frac{F_m}{\tau\sqrt{2}}$

dengan :

$$F_m = 8 \text{ dB}$$

$$\tau = 8 \text{ dB}$$

$$a = \frac{8}{8\sqrt{2}}$$

$$a = 0,7071$$

- $b = \frac{10\alpha \log e}{\tau\sqrt{2}}$

dengan :

$$\alpha = 3,52249$$

$$\tau = 8 \text{ dB}$$

$$b = \frac{10.3,522495 \log e}{8\sqrt{2}}$$

$$b = 1,3522$$

- $\text{erf}(a) = 1 - 2Q(a\sqrt{2})$

$$\text{erf}(a) = 1 - 2Q(0,7071\sqrt{2})$$

$$\text{erf}(a) = 0,6826$$

- $\text{erf}(a, b) = \text{erf}\left(\frac{a.b + 1}{b}\right)$

$$\text{erf}(a, b) = \text{erf}\left(\frac{0,7071.1,3522 + 1}{1,3522}\right)$$

$$\text{erf}(a, b) = 0,9593$$

- $\exp(a, b) = \exp\left(\frac{2.a.b + 1}{b^2}\right)$

$$\exp(a, b) = \exp\left(\frac{2.0,7071.1,3522 + 1}{1,3522^2}\right)$$

$$\exp(a, b) = 4,9173$$

- probabilitas *coverage* sel

$$\mu = 0,5 \left(1 + \text{erf}(a) + \exp\left(\frac{2.a.b + 1}{b^2}\right) \cdot (1 - \text{erf}\left(\frac{a.b + 1}{b}\right)) \right)$$

$$\mu = 0,5 (1 + 0,6826 + 4,9173(1 - 0,9593))$$

$$\mu = 94,14\%$$

- probabilitas tepi sel

$$\beta = 0,5 + 0,5.\text{erf}(a)$$

$$\beta = 0,5 + 0,5.0,6826$$

$$\beta = 84,13\%$$

4. Site Sei Talo/Siring Agung Sektor 2

a. Sisi *uplink*

- ERP_{MS}

$$ERP_{MS}[\text{dBm}] = P_{TX-MS} + G_{MS} - L_{MS}$$

dengan :

$$P_{TX-MS} = 24 \text{ dBm}$$

$$G_{MS} = 0 \text{ dBi}$$

$$L_{MS} = 0 \text{ dB}$$

$$ERP_{MS} = 24 \text{ dBm} + 0\text{dBi} - 0\text{dB}$$

$$ERP_{MS} = 24 \text{ dBm}$$

- PL_{up}

$$PL_{up}[\text{dB}] = ERP_{MS} + G_{BS} - L_f - BS_{sensitivity} + G_{div} - F_m - I_{m-up} + G_{SHO}$$

dengan :

$$ERP_{MS} = 24 \text{ dBm}$$

$$G_{BS} = 15,85 \text{ dBi}$$

$$L_f = 3 \text{ dB}$$

$$BS_{sensitivity} = -120 \text{ dBm}$$

$$G_{div} = 0 \text{ dB}$$

$$F_m = 9 \text{ dB}$$

$$I_m = 3 \text{ dB}$$

$$G_{SHO} = 0 \text{ dB}$$

$$PL_{up} = 24 \text{ dBm} + 15,85 \text{ dBi} - 3 \text{ dB} + 120 \text{ dBm} + 0 \text{ dB} - 9 \text{ dB} - 3 \text{ dB} + 0 \text{ dB}$$

$$PL_{up} = 144,85 \text{ dB}$$

- $PL_{COST-231}$

$$PL_{COST-231}[\text{dB}] = 46,3 + 33,6 \log f_{c-up} - 13,82 \log h_{BS} - ((1,1 \log f_{c-up} - 0,7) h_{MS} - (1,56 \log f_{c-up} - 0,8)) + (44,9 - 6,55 \log h_{BS}) \log d + C_M$$

dengan :

$$f_{c-up} = 1735,30 \text{ MHz}$$

$$h_{BS} = 35 \text{ m}$$

$$h_{MS} = 1,5 \text{ m}$$

$$C_M = 3 \text{ dB}$$

$$PL_{\text{COST-231}}[\text{dB}] = 46,3 + 33,6 \log 1735,30 - 13,82 \log 35 - ((1,1 \log 1735,30 - 0,7) 1,5 - (1,56 \log 1735,30 - 0,8)) + (44,9 - 6,55 \log 35) \log d + 3 \text{ dB}$$

- Perkiraan radius sel (d)

$$PL_{\text{up}} = PL_{\text{COST-231}}$$

$$144,85 \text{ dB} = 46,3 + 33,6 \log 1735,30 - 13,82 \log 35 - ((1,1 \log 1735,30 - 0,7) 1,5 - (1,56 \log 1735,30 - 0,8)) + (44,9 - 6,55 \log 35) \log d + 3 \text{ dB}$$

$$d = 1,71 \text{ Km}$$

b. Sisi *downlink*

- ERP_{BS}

$$ERP_{BS}[\text{dBm}] = P_{\text{TX-BS}} + G_{BS} - L_f$$

dengan :

$$P_{\text{TX-BS}} = 47,6 \text{ dBm}$$

$$G_{BS} = 15,85 \text{ dBi}$$

$$L_f = 3 \text{ dB}$$

$$ERP_{BS} = 47,6 \text{ dBm} + 15,85 \text{ dBi} - 3 \text{ dB}$$

$$ERP_{BS} = 60,45 \text{ dBm}$$

- PL_{down}

$$PL_{\text{down}}[\text{dB}] = ERP_{BS} + G_{MS} - MS_{\text{sensitivity}} - F_m - I_m$$

dengan :

$$ERP_{BS} = 60,45 \text{ dBm}$$

$$G_{MS} = 0 \text{ dBi}$$

$$MS_{\text{sensitivity}} = -100 \text{ dBm}$$

$$F_m = 9 \text{ dB}$$

$$I_m = 3 \text{ dB}$$

$$PL_{\text{down}} = 60,45 \text{ dBm} + 0 \text{ dBi} + 100 \text{ dBm} - 9 \text{ dB} - 3 \text{ dB}$$

$$PL_{\text{down}} = 148,45 \text{ dB}$$

- $PL_{\text{COST-231}}$

$$PL_{\text{COST-231}}[\text{dB}] = 46,3 + 33,6 \log f_{\text{c-down}} - 13,82 \log h_{\text{BS}} - ((1,1 \log f_{\text{c-down}} - 0,7) h_{\text{MS}} - (1,56 \log f_{\text{c-down}} - 0,8)) + (44,9 - 6,55 \log h_{\text{BS}}) \log d + C_M$$

dengan :

$$f_{\text{c-down}} = 1830,30 \text{ MHz}$$

$$h_{\text{BS}} = 35 \text{ m}$$

$$h_{\text{MS}} = 1,5 \text{ m}$$

$$C_M = 3 \text{ dB}$$

$$PL_{\text{COST-231}}[\text{dB}] = 46,3 + 33,6 \log 1830,30 - 13,82 \log 35 - ((1,1 \log 1830,30 - 0,7) 1,5 - (1,56 \log 1830,30 - 0,8)) + (44,9 - 6,55 \log 35) \log d + 3 \text{ dB}$$

- Perkiraan radius sel (d)

$$PL_{\text{down}} = PL_{\text{COST-231}}$$

$$148,45 \text{ dB} = 46,3 + 33,6 \log 1830,30 - 13,82 \log 35 - ((1,1 \log 1830,30 - 0,7) 1,5 - (1,56 \log 1830,30 - 0,8)) + (44,9 - 6,55 \log 35) \log d + 3 \text{ dB}$$

$$d = 2,06 \text{ Km}$$

c. Probabilitas Luasan Sel dan Tepi Sel

- $slope \text{ (dB/dec)} = 44,9 - 6,55 \log h_{\text{BS}}$

dengan :

$$h_{\text{BS}} = 35 \text{ m}$$

$$slope = 34,7864 \text{ dB/dec}$$

- $a = \frac{F_m}{\tau \sqrt{2}}$

dengan :

$$F_m = 9 \text{ dB}$$

$$\tau = 8 \text{ dB}$$

$$a = \frac{9}{8\sqrt{2}}$$

$$a = 0,7955$$

- $b = \frac{10\alpha \log e}{\tau\sqrt{2}}$

dengan :

$$\alpha = 3,47864$$

$$\tau = 8 \text{ dB}$$

$$b = \frac{10 \cdot 3,47864 \log e}{8\sqrt{2}}$$

$$b = 1,3353$$

- $\text{erf}(a) = 1 - 2Q(a\sqrt{2})$

$$\text{erf}(a) = 1 - 2Q(0,7955\sqrt{2})$$

$$\text{erf}(a) = 0,7498$$

- $\text{erf}(a, b) = \text{erf}\left(\frac{a \cdot b + 1}{b}\right)$

$$\text{erf}(a, b) = \text{erf}\left(\frac{0,7955 \cdot 1,3353 + 1}{1,3353}\right)$$

$$\text{erf}(a, b) = 0,9722$$

- $\exp(a, b) = \exp\left(\frac{2 \cdot a \cdot b + 1}{b^2}\right)$

$$\exp(a, b) = \exp\left(\frac{2 \cdot 0,7955 \cdot 1,3353 + 1}{1,3353^2}\right)$$

$$\exp(a, b) = 5,7681$$

- probabilitas *coverage* sel

$$\mu = 0,5 \left(1 + \text{erf}(a) + \exp\left(\frac{2 \cdot a \cdot b + 1}{b^2}\right) \cdot (1 - \text{erf}\left(\frac{a \cdot b + 1}{b}\right)) \right)$$

$$\mu = 0,5(1 + 0,7498 + 5,7681(1 - 0,9722))$$

$$\mu = 95,51\%$$

- probabilitas tepi sel

$$\beta = 0,5 + 0,5 \cdot \text{erf}(a)$$

$$\beta = 0,5 + 0,5 \cdot 0,7498$$

$$\beta = 87,49\%$$

B. PERHITUNGAN PROBABILITAS LUASAN SEL DAN TEPI SEL UNTUK RADIUS BARU

1. Site Monginsidi-Kalidoni

Probabilitas Luasan Sel dan Tepi Sel

- $\text{slope (dB/dec)} = 44,9 - 6,55 \log h_{\text{BS}}$

dengan :

$$h_{\text{BS}} = 35 \text{ m}$$

$$\text{slope} = 34,7864 \text{ dB/dec}$$

- $a = \frac{F_m}{\tau\sqrt{2}}$

dengan :

$$F_m = 8,5 \text{ dB}$$

$$\tau = 8 \text{ dB}$$

$$a = \frac{8,5}{8\sqrt{2}}$$

$$a = 0,7510$$

- $b = \frac{10\alpha \log e}{\tau\sqrt{2}}$

dengan :

$$\alpha = 3,47864$$

$$\tau = 8 \text{ dB}$$

$$b = \frac{10 \cdot 3,47864 \log e}{8\sqrt{2}}$$

$$b = 1,335$$

- $\text{erf}(a) = 1 - 2Q(a\sqrt{2})$
 $\text{erf}(a) = 1 - 2Q(0,7510\sqrt{2})$
 $\text{erf}(a) = 0,7060$
- $\text{erf}(a, b) = \text{erf}\left(\frac{a \cdot b + 1}{b}\right)$
 $\text{erf}(a, b) = \text{erf}\left(\frac{0,7510 \cdot 1,335 + 1}{1,335}\right)$
 $\text{erf}(a, b) = 0,9640$
- $\exp(a, b) = \exp\left(\frac{2 \cdot a \cdot b + 1}{b^2}\right)$
 $\exp(a, b) = \exp\left(\frac{2 \cdot 0,7510 \cdot 1,335 + 1}{1,335^2}\right)$
 $\exp(a, b) = 5,339$
- probabilitas luasan sel

$$\mu = 0,5 \left(1 + \text{erf}(a) + \exp\left(\frac{2 \cdot a \cdot b + 1}{b^2}\right) \cdot (1 - \text{erf}\left(\frac{a \cdot b + 1}{b}\right)) \right)$$

$$\mu = 0,5 (1 + 0,7060 + 5,339(1 - 0,9640))$$

$$\mu = 95,02\%$$
- probabilitas tepi sel

$$\beta = 0,5 + 0,5 \cdot \text{erf}(a)$$

$$\beta = 0,5 + 0,5 \cdot 0,7060$$

$$\beta = 85,30\%$$

LAMPIRAN B
TABEL GAUSSIAN

TABEL GAUSSIAN

y	Q(y)	y	Q(y)	y	Q(y)
0.05	0.4801	1.05	0.1469	2.1	0.0179
0.1	0.4602	0.1	0.1357	2.2	0.0139
0.15	0.4405	1.15	0.1251	2.3	0.0107
0.2	0.4207	1.2	0.1151	2.4	0.0082
0.25	0.4013	1.25	0.0156	2.5	0.0062
0.3	0.3821	1.3	0.0968	2.6	0.0047
0.35	0.3632	1.35	0.0885	2.7	0.0035
0.4	0.3446	1.4	0.0808	2.8	0.0026
0.45	0.3264	1.45	0.0735	2.9	0.0019
0.5	0.3085	1.5	0.0668	3	0.0013
0.55	0.2912	1.55	0.0606	3.1	0.001
0.6	0.2743	1.6	0.0548	3.2	0.00069
0.65	0.2578	1.65	0.0495	3.3	0.00048
0.7	0.242	1.7	0.0446	3.4	0.00034
0.75	0.2266	1.75	0.0401	3.5	0.00023
0.8	0.2119	1.8	0.0359	3.6	0.00016
0.85	0.1977	1.85	0.0322	3.7	0.0001
0.9	0.1841	1.9	0.0287	3.8	0.00007
0.95	0.1711	1.95	0.0256	3.9	0.00005
1	0.1587	2	0.0228	4	0.00003
10^{-3}	3.1	10^{-4}	3.7	10^{-5}	4.27
$5 \cdot 10^{-4}$	3.28	$5 \cdot 10^{-5}$	3.9	10^{-6}	4.78