

Appendix A

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##### GUI for Dimensioning Process

h = figure;
hp = uipanel('Title','Dimensioning of LTE
Network','FontSize',27,'BackgroundColor','w',...
'ForegroundColor',[.2 0 0],'Position',[.10 .20 .79.60]);
    set(hp, 'FontWeight', 'bold')
hsp1 = uipanel('Parent',hp,'Title','Capacity
Planning','FontSize',20,...
'ForegroundColor','w','BackgroundColor',[.1 0 0], ...
'Position',[.52 .10 .41 .75]);
    set(hsp1, 'FontWeight', 'bold');
hsp2 = uipanel('Parent',hp,'Title','Coverage
Planning','FontSize',20,'ForegroundColor','w',...
'BackgroundColor',[.1 0 0],'Position',[.10 .10 .41 .75]);
    set(hsp2, 'FontWeight', 'bold');
hbsp2 = uicontrol('Parent',hsp2,'String','Push here',...
'ForegroundColor',[.2 0 0],'BackgroundColor','w', ...
'FontSize',16,'Position',[60 35 11 60],'Callback','cu');
    set(hbsp2, 'FontWeight', 'bold');
    whitebg([.1 0 0])

figure
    whitebg([.1 0 0])
h=uicontrol('Style','pushbutton','String', ...
'Coverage Planning Parameters', ...
'BackgroundColor','white','FontSize',20, ...
'ForegroundColor', 'k', ...
'Position',[470,550,480,70], 'Callback', 'cu1');
set(h, 'FontWeight', 'bold')

h1 = uicontrol('Style', 'edit', 'String', '',...
'FontSize',16,'Position',[800 450 100 50], ...
'Callback', 'cu2');
    set(h1, 'FontWeight', 'bold')
d1 = uicontrol('Style', 'text', 'String', ...
'Total Deployment Area (Km)',...
'FontSize',15,'Position', [500 450 275 50]);
    set(d1, 'FontWeight', 'bold')

    h89 = uicontrol('Style','text', 'String','Index ',...

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        'ForegroundColor','w', ...
        'BackgroundColor',[.1 0 0], ...
        'FontSize',16,'Position',[20 440 230 45],
'Callback', 'du3');
    set(h89, 'FontWeight', 'bold');
    h87 = uicontrol('Style','text', 'String', ...
'Km == Kilo Meter ', ...
'ForegroundColor','w','BackgroundColor',[.1 0 0], ...
'FontSize',16,'Position', ...
[20 370 230 60], 'Callback', 'du3');
    set(h87, 'FontWeight', 'bold');
    i=1;

h2 = uicontrol('Style', 'edit', 'String', '',...
'FontSize',16,'Position',[800 360 100 65], ...
'Callback', 'cu3');
    set(h2, 'FontWeight', 'bold')
d2 = uicontrol('Style', 'text', 'String', ...
'Deployed Frequency (150MHz <= f >= 1500MHz)',...
'FontSize',15,'Position', [500 360 275 65]);
    set(d2, 'FontWeight', 'bold')

    h89 = uicontrol('Style','text', ...
'String','MHz == Mega Hertz ',...
'ForegroundColor','w', ...
'BackgroundColor',[.1 0 0], ...
'FontSize',16,'Position',[20 300 230 60], ...
'Callback', 'du3');
    set(h89, 'FontWeight', 'bold');

deployed_frequency = str2double(get(h2,'string'));
f=deployed_frequency;

if f<150
    if i<3
        e2 = uicontrol('Style', 'pushbutton', 'String',...
'Invalid Value','FontSize',15, ...
'Position',[500 280 275 50],'Callback', 'cu2');
        set(e2, 'FontWeight', 'bold');
        i=i+1;
    else
        e2 = uicontrol('Style', 'text', 'String',...
'Your Choices is Over',...
'FontSize',15,'Position', [500 280 275 50]);
        set(e2, 'FontWeight', 'bold');
    end
end

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quit
end
elseif f>1500
    if i<3
        e2 = uicontrol('Style','pushbutton','String',...
            'Invalid Value','FontSize',15,...
            'Position',[500 280 275 50],'Callback','cu2');
        set(e2,'FontWeight','bold');
        i=i+1;
    else
        e2 = uicontrol('Style','text','String',...
            'Your Choices is Over',...
            'FontSize',15,'Position',[500 280 275 50]);
        set(e2,'FontWeight','bold');
        quit
    end
else
    hpop = uicontrol('Style','popup',...
        'String',{ '1.4' '3' '5' '10' '15' '20'},...
        'FontSize',16,'Position',[800 280 100 50],...
        'Callback','cu4');
    set(hpop,'FontWeight','bold')
    d = uicontrol('Style','text','String','Preferred
    Bandwidth (MHz)',...
        'FontSize',15,'Position',[500 280 275 50]);
    set(d,'FontWeight','bold')
    end

h3 = uicontrol('Style','text','String','20',...
    'FontSize',16,'Position',[800 190 100 50]);
set(h3,'FontWeight','bold')
d3 = uicontrol('Style','text','String',...
    'Planning Margin (db)',...
    'FontSize',15,'Position',[500 190 275 50]);
set(d3,'FontWeight','bold')

h4 = uicontrol('Style','pushbutton','String','3',...
    'FontSize',16,'Position',[800 90 100 50],
    'Callback','cu5');
set(h4,'FontWeight','bold')
d4 = uicontrol('Style','text','String','Diversity Gain
(db)',...
    'FontSize',15,'Position',[500 90 275 50]);
set(d4,'FontWeight','bold')

h89 = uicontrol('Style','text','String',...

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'db == Decibal ', ...
'ForegroundColor','w','BackgroundColor',[.1 0 0], ...
'FontSize',16,'Position',[20 230 230 60],
'Callback','du3');
set(h89, 'FontWeight', 'bold');

h79 = uicontrol('Style','text', 'String', ...
'm == Meter ',...
'ForegroundColor','w', ...
'BackgroundColor',[.1 0 0], ...
'FontSize',16,'Position', ...
[20 160 230 60], 'Callback', 'du3');
set(h79, 'FontWeight', 'bold');

figure
d80 = uicontrol('Style','text', ...
'String','Coverage Planning Design',...
'BackgroundColor','w',...
'ForegroundColor',[.2 0 0], ...
'FontSize',22,'Position',[440 585 570 50]);
set(d80, 'FontWeight', 'bold')
hp2 = uipanel('Title','Uplink Calculations','FontSize',...
18,'BackgroundColor','white',...
'ForegroundColor','k', ...
'Position',[.10 .50 .35 .30]);
set(hp2, 'FontWeight', 'bold')
hsp1 = uipanel('Parent',hp2,'Title',...
'UE to eNodeB','FontSize',16,...
'ForegroundColor','w', 'BackgroundColor',[.1 0 0],...
'Position',[.09 .25 .80 .70]);
set(hsp1, 'FontWeight', 'bold')
hpsp1 = uicontrol('Parent',hsp1, ...
'String','Push Here',...
'ForegroundColor',[.1 0 0],'BackgroundColor','w', ...
'FontSize',14,'Position',[20 10 110 50],'Callback','up');
set(hpsp1, 'FontWeight', 'bold')

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

hp3 = uipanel('Title', ...
'Downlink Calculations','FontSize',18,...
'BackgroundColor','white',...
'ForegroundColor','k', ...
'Position',[.60 .50 .35 .30]);
set(hp3, 'FontWeight', 'bold')
hsp2 = uipanel('Parent',hp3,'Title', ...
'eNodeB to UE','FontSize',16,...

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        'ForegroundColor','w','BackgroundColor',[.1 0 0],...
        'Position',[.12 .25 .80 .70]);
        set(hsp2, 'FontWeight', 'bold')
        %%%%%%%%%%

        h21 = uicontrol('Style','text', ...
        'String', 'Hata Model',...
        'FontSize',18,'Position', [200 250 170 50],
        'Callback', 'cu6');
        set(h21, 'FontWeight', 'bold')

hpop3 = uicontrol('Style', 'popup','String',...
{'1]Open' '2]Suburban' '3]Small city' '4]Large city'},...
    'FontSize',14, 'Position', [725 210 170 80],...
    'Callback', 'cu7');
set(hpop3, 'FontWeight', 'bold')
d23 = uicontrol('Style', 'text', 'String', ...
    'Natural Area Type ',...
    'FontSize',14,'Position', [500 240 170 55]);
set(d23, 'FontWeight', 'bold')

val = get(hpop3,'Value');
if val == 1
    h24 = uicontrol('Style','text', 'String', ...
    'eNodeB Hight (m)',...
    'FontSize',14,'Position',[500 150 170 60]);
    set(h24, 'FontWeight', 'bold')
    h22 = uicontrol('Style','edit', 'String', ' ',...
    'FontSize',16,'Position', ...
    [725 150 170 60],'Callback', 'im2');
    set(h22, 'FontWeight', 'bold')
elseif val == 4
    h24 = uicontrol('Style','text', 'String', ...
    'eNodeB Hight (m)',...
    'FontSize',14,'Position', [500 150 170 60]);
    set(h24, 'FontWeight', 'bold')
    h22 = uicontrol('Style','edit', 'String', ' ',...
    'FontSize',16,'Position', ...
    [725 150 170 60],'Callback', 'cul0');
    set(h22, 'FontWeight', 'bold')
end

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figure
d80 = uicontrol('Style','text','String', ...
    'Coverage Planning Design',...
    'BackgroundColor','w',...
    'ForegroundColor',[.2 0 0], ...
    'FontSize',22,'Position', [440 585 570 50]);
set(d80, 'FontWeight', 'bold')
hp2 = uipanel('Title', ...
    'Uplink Calculations','FontSize',18,...
    'BackgroundColor','white',...
    'ForegroundColor','k', ...
    'Position',[.10 .50 .35 .30]);
set(hp2, 'FontWeight', 'bold')
hsp1 = uipanel('Parent',hp2,'Title', ...
    'UE to eNodeB','FontSize',16,...
    'ForegroundColor','w','BackgroundColor',[.1 0 0],...
    'Position',[.09 .25 .80 .70]);
set(hsp1, 'FontWeight', 'bold')

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
hp3 = uipanel('Title','Downlink
Calculations','FontSize',18,...
    'BackgroundColor','white',...
    'ForegroundColor','k', ...
    'Position',[.60 .50 .35 .30]);
set(hp3, 'FontWeight', 'bold')
hsp1 = uipanel('Parent',hp3,'Title', ...
    'eNodeB to UE','FontSize',16,...
    'ForegroundColor','w','BackgroundColor',[.1 0 0],...
    'Position',[.12 .25 .80 .70]);
set(hsp1, 'FontWeight', 'bold')

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

h21 = uicontrol('Style','text', ...
    'String', 'Hata Model','FontSize',16, ...
    'Position', [200 250 170 50], 'Callback', 'cu6');
set(h21, 'FontWeight', 'bold')

figure
d80 = uicontrol('Style','text','String', ...
    'Coverage Planning Design',...
    'BackgroundColor','w',...
    'ForegroundColor',[.2 0 0], ...
    'FontSize',22,'Position',[440 585 570 50]);
set(d80, 'FontWeight', 'bold')

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hp2 = uipanel('Title', ...
'Uplink Calculations','FontSize',18,...
    'BackgroundColor','white',...
    'ForegroundColor','k', ...
    'Position',[.10 .50 .35 .30]);
set(hp2, 'FontWeight', 'bold')
hsp1 = uipanel('Parent',hp2,'Title', ...
'UE to eNodeB','FontSize',16,...
    'ForegroundColor','w','BackgroundColor',[.1 0 0],...
    'Position',[.09 .25 .80 .70]);
set(hsp1, 'FontWeight', 'bold')

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

hp3 = uipanel('Title','Downlink
Calculations','FontSize',18,...
    'BackgroundColor','white',...
    'ForegroundColor','k', ...
    'Position',[.60 .50 .35 .30]);
set(hp3, 'FontWeight', 'bold')
hsp1 = uipanel('Parent',hp3,'Title', ...
'eNodeB to UE','FontSize',16,...
    'ForegroundColor','w','BackgroundColor',[.1 0 0],...
    'Position',[.12 .25 .80 .70]);
set(hsp1, 'FontWeight', 'bold')

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

h21 = uicontrol('Style','pushbutton', ...
'String', 'Hata Model',...
    'ForegroundColor',[.2 0 0],'FontSize',16, ...
    'Position', [200 250 170 60], 'Callback', 'cu6');
set(h21, 'FontWeight', 'bold')
h25 = uicontrol('Style','text', 'String', ...
'UE Hight (m)',...
    'FontSize',14,'Position', [500 70 170 60]);
set(h25, 'FontWeight', 'bold')
h23 = uicontrol('Style','edit', 'String', ' ',...
'FontSize',16,'Position', [725 70 170 60], ...
'Callback', 'im2');
set(h23, 'FontWeight', 'bold')

h5 = uicontrol('Style', 'edit', 'String', '',...
    'FontSize',14, 'Position', ...
[320 470 80 60], 'Callback', 'c2');
set(h5, 'FontWeight', 'bold')
d5 = uicontrol('Style', 'text', 'String', ...

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        'Transmitter Power',...
        'FontSize',16,'Position', [160 470 140 60]);
        set(d5, 'FontWeight', 'bold')

h6 = uicontrol('Style', 'edit', 'String', '',...
        'FontSize',14,'Position', ...
        [320 380 80 60], 'Callback', 'c3');
        set(h6, 'FontWeight', 'bold')
d6 = uicontrol('Style', 'text', 'String', ...
        'Transmitter Gain',...
        'FontSize',16,'Position', [160 380 140 60]);
        set(d6, 'FontWeight', 'bold')
h7 = uicontrol('Style', 'edit', 'String', '',...
        'FontSize',14,'Position', ...
        [320 290 80 60], 'Callback', 'c4');
        set(h7, 'FontWeight', 'bold')
d7 = uicontrol('Style', 'text', 'String', ...
        'Transmitter Loss',...
        'FontSize',16,'Position', [160 290 140 60]);
        set(d7, 'FontWeight', 'bold')

h8 = uicontrol('Style', 'edit', 'String', '',...
        'FontSize',14,'Position', ...
        [320 200 80 60], 'Callback', 'c5');
        set(h8, 'FontWeight', 'bold')
d8 = uicontrol('Style', 'text', 'String', ...
        'Reciever Gain',...
        'FontSize',16,'Position', [160 200 140 60]);
        set(d8, 'FontWeight', 'bold')

h9 = uicontrol('Style', 'edit', 'String', '',...
        'FontSize',14,'Position', ...
        [1150 470 80 60], 'Callback', 'c6');
        set(h9, 'FontWeight', 'bold')
d9 = uicontrol('Style', 'text', 'String', ...
        'Reciever Loss ',...
        'FontSize',16,'Position', [975 470 140 60]);
        set(d9, 'FontWeight', 'bold')

h10 = uicontrol('Style', 'edit', 'String', '',...
        'FontSize',14, 'Position', ...
        [1150 380 80 60], 'Callback', 'c7');
        set(h10, 'FontWeight', 'bold')
d10 = uicontrol('Style', 'text', 'String', ...
        'Interference Margin',...

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        'FontSize',16,'Position', [975 380 140 60]);
set(d10, 'FontWeight', 'bold')

h11 = uicontrol('Style', 'edit', 'String', '',...
    'FontSize',14,'Position', ...
    [1150 290 80 60], 'Callback', 'c8');
set(h11, 'FontWeight', 'bold')
d11 = uicontrol('Style', 'text', ...
    'String','Noise Figure',...
    'FontSize',16,'Position', [975 290 140 60]);
set(d11, 'FontWeight', 'bold')

h12 = uicontrol('Style', 'edit', 'String', '',...
    'FontSize',14,'Position', ...
    [1150 180 80 97], 'Callback', 'cu8');
set(h12, 'FontWeight', 'bold')
d12 = uicontrol('Style', 'text', 'String', ...
    'Signal To Interference Ratio (SINR) ',...
    'FontSize',16,'Position', [975 180 140 97]);
set(d12, 'FontWeight', 'bold')

figure
h=uicontrol('Style','pushbutton','String', ...
    'Uplink Radio Link Budget Parameters (all in db)', ...
    'BackgroundColor','white','FontSize',20, ...
    'Position',[350,560,650,80], 'Callback', 'c1');
set(h, 'FontWeight', 'bold')

figure
h=uicontrol('Style','pushbutton','String', ...
    'Downlink Radio Link Budget Parameters (all in db)', ...
    'BackgroundColor','white','FontSize',20, ...
    'Position',[340,560,680,80], 'Callback', 'cc1');
set(h, 'FontWeight', 'bold')

figure

h=uicontrol('Style','pushbutton','String', ...
    'Capacity Planning Parameters', ...
    'BackgroundColor','white','FontSize',20,
    ...'ForegroundColor','k', ...
    'Position',[450,550,530,70], 'Callback', 'dul');
set(h, 'FontWeight', 'bold');

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hpop4 = uicontrol('Style', 'popup',...
    'String', ...
    {'0 - 500 ' '500 - 1000 ' '1000 - 2000 ' '2000 - 3000 '
    'enter your number: '},...
    'FontSize',14, 'Position', [755 450 215 60],...
    'Callback', 'du2');
set(hpop4, 'FontWeight', 'bold');
d26 = uicontrol('Style', 'text', 'String', ...
'Total Number Of Users',...
    'FontSize',16,'Position', [500 450 230 60]);
set(d26, 'FontWeight', 'bold');

hpop5 = uicontrol('Style', 'edit', 'String', ' ',...
    'FontSize',14, 'Position', [755 300 215 60],...
    'Callback', 'du4');
set(hpop5, 'FontWeight', 'bold');
d27 = uicontrol('Style', 'text', 'String', ...
'Downlink Peak Data Rate (Mbps)',...
    'FontSize',16,'Position', [500 300 230 60]);
set(d27, 'FontWeight', 'bold');

h87 = uicontrol('Style','text', 'String','Index ',...
    'ForegroundColor','w', ...
'BackgroundColor',[.1 0 0], ...
    'FontSize',16,'Position',[20 210 230 45],
'Callback', 'du3');
set(h87, 'FontWeight', 'bold');
h89 = uicontrol('Style','text', 'String', ...
'Mbps == Mega Bit Per Second ',...
    'ForegroundColor','w','BackgroundColor',[.1 0 0], ...
    'FontSize',16,'Position',[20 130 230 60],
'Callback', 'du3');
set(h89, 'FontWeight', 'bold');

hpop6 = uicontrol('Style','edit', 'String', ' ',...
    'FontSize',14, 'Position', [755 215 215 60],...
    'Callback', 'du5');
set(hpop6, 'FontWeight', 'bold');
d28 = uicontrol('Style', 'text', 'String', ...
'Uplink Peak Data Rate (Mbps)',...
    'FontSize',16,'Position', [500 215 230 60]);
set(d28, 'FontWeight', 'bold');

hpop7 = uicontrol('Style', 'popup', 'String', ...
    {'85 % ' '88 % ' '90 % ' '92 % ' '95 % ' '97 %'},...

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        'FontSize',14, 'Position', [755 128 215 60],...
        'Callback', 'du6');
set(hpop7, 'FontWeight', 'bold');
d29 = uicontrol('Style', 'text', 'String', ...
'Practical Percentage Of Peak Throughput',...
        'FontSize',16,'Position', [500 128 230 60]);
set(d29, 'FontWeight', 'bold');

hpop8 = uicontrol('Style', 'popup',...
        'String', {'20 ' 'enter your value '},...
        'FontSize',14, 'Position', [755 55 215 60],...
        'Callback', 'du7');
set(hpop8, 'FontWeight', 'bold');
d29 = uicontrol('Style', 'text', 'String', ...
'Over Booking Factor Value (<= 20)',...
        'FontSize',16,'Position', [500 55 230 60]);
set(d29, 'FontWeight', 'bold');

va = get(hpop8, 'Value');
if va == 1
    h27 = uicontrol('Style','pushbutton', 'String','20',...
        'FontSize',14,'Position', [755 22 215 40], ...
        'Callback', 'lte');
    set(h27, 'FontWeight', 'bold');
else va == 2

    h27 = uicontrol('Style','edit', 'String',' ',...
        'FontSize',14,'Position', [755 22 215 40], ...
        'Callback', 'lte');
    set(h27, 'FontWeight', 'bold');
end

h = figure;
hp = uipanel('Title', ...
'Dimensioning of LTE Network','FontSize',27,...
        'BackgroundColor','w',...
        'ForegroundColor',[.2 0 0], ...
        'Position',[.10 .20 .79 .60]);
set(hp, 'FontWeight', 'bold');
hsp1 = uipanel('Parent',hp,'Title', ...
'Capacity Planning','FontSize',20,...
        'ForegroundColor','w','BackgroundColor',[.1 0 0], ...
        'Position',[.52 .10 .41 .75]);
set(hsp1, 'FontWeight', 'bold')
hsp2 = uipanel('Parent',hp,'Title', ...
'Coverage Planning','FontSize',20,...
        'ForegroundColor','w','BackgroundColor',[.1 0 0], ...

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        'Position',[.10 .10 .41 .75]);
        set(hsp2, 'FontWeight', 'bold')
        hbsp1 = uicontrol('Parent', ...
hsp1, 'String', 'Push here', ...
        'ForegroundColor',[.2 0 0], 'BackgroundColor','w', ...
        'FontSize',16,'Position',[60 35 110 60],'Callback','du');
        set(hbsp1, 'FontWeight', 'bold')
        whitebg([.1 0 0])
deployment_area = str2double(get(h1,'string'));
if isnan(deployment_area)
    errordlg('You must enter a numeric value', ...
'Bad Input','modal')
    return
end
da=deployment_area;

deployed_frequency = str2double(get(h2,'string'));
if isnan(deployed_frequency)
    errordlg('You must enter a numeric value', ...
'Bad Input','modal')
    return
end
f=deployed_frequency;

bandwidth=str2double(get( hpop,'string'));

if isnan(bandwidth)
    errordlg('You must enter a numeric value', ...
'Bad Input','modal')
    return
end

planning_margin = str2double(get(h3,'string'));
if isnan(planning_margin)
    errordlg('You must enter a numeric value', ...
'Bad Input','modal')
    return
end
pm=planning_margin;

diversity_gain = str2double(get(h4,'string'));
if isnan(diversity_gain)
    errordlg('You must enter a numeric value', ...
'Bad Input','modal')
    return
end
gd=diversity_gain;

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UE_power = str2double(get(h5,'string'));
if isnan(UE_power)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
Ptx_U=UE_power;

UE_gain = str2double(get(h6,'string'));
if isnan(UE_gain)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
Gtx_U=UE_gain;

UE_loss = str2double(get(h7,'string'));
if isnan(UE_loss)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
Ltx_U=UE_loss;

eNodeB_gain = str2double(get(h8,'string'));
if isnan(eNodeB_gain)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
Grx_U=eNodeB_gain;

eNodeB_loss= str2double(get(h9,'string'));
if isnan(eNodeB_loss)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
Lrx_U=eNodeB_loss;

interference_margin= str2double(get(h10,'string'));
if isnan(interference_margin)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
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```
IM_U=interference_margin;

noise_figure= str2double(get(h11,'string'));
if isnan(noise_figure)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
NF_U=noise_figure;

SINR= str2double(get(h12,'string'));
if isnan(SINR)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
sinr_U=SINR;

eNodeB_power = str2double(get(h13,'string'));
if isnan(eNodeB_power)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
Ptx_D=eNodeB_power;

eNodeB_gain = str2double(get(h14,'string'));
if isnan(eNodeB_gain)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
Gtx_D=eNodeB_gain;

eNodeB_loss = str2double(get(h15,'string'));
if isnan(eNodeB_loss)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
Ltx_D=eNodeB_loss;

UE_gain = str2double(get(h16,'string'));
if isnan(UE_gain)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
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end
Grx_D=UE_gain;

UE_loss= str2double(get(h17,'string'));
if isnan(UE_loss)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
Lrx_D=UE_loss;
interferanc_margin= str2double(get(h18,'string'));
if isnan(interferanc_margin)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
IM_D=interferanc_margin;

noise_figur= str2double(get(h19,'string'));
if isnan(noise_figur)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
NF_D=noise_figur;

SINRa= str2double(get(h20,'string'));
if isnan(SINRa)
    errordlg('You must enter a numeric value', ...
    'Bad Input','modal')
    return
end
sinr_D=SINRa;

arty=str2double(get(hpop3,'string'));

ar = get(hpop3,'Value');
if ar == 1
    a=1;

hbt= str2double(get(h22,'string'));
hb=hbt;
hm=1;

elseif ar == 2
    a=2;
```

```

hbt= str2double(get(h22,'string'));
hb=hbt;
hm=1;
elseif ar == 3
    a=3;

hbt= str2double(get(h22,'string'));
hb=hbt;
hm=1;
elseif ar == 4
    a=4;

hbt= str2double(get(h22,'string'));
hb=hbt;
hms= str2double(get(h23,'string'));
hm=hms;
end

t = get(hpop7,'Value');
if t == 1
    pth=0.85;
elseif t == 2
    pth=0.88;
elseif t == 3
    pth=0.90;
elseif t == 4
    pth=0.92;
elseif t == 5
    pth=0.95;
    elseif t == 6
        pth=0.97;
end

OBF= str2double(get(h27,'string'));
obf=OBF;

disp('*****')
disp('          THE RESULTS')
disp('*****')
disp('          ')
disp('          COVERAGE PLANNING')
%%%%%% calling coverage function

[no_of_cells_basedon_coverage,R_distance]=coverg(da,f,bw,pm
,gd, ...
Ptx_U,Gtx_U,Ltx_U,Grx_U,Lrx_U,IM_U,NF_U,sinr_U, ...

```



```

Ptx_D,Gtx_D,Ltx_D,Grx_D,Lrx_D,IM_D,NF_D,sinr_D,a,hb,hm)

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% calling capacity function
disp('*****')
disp(' ')
disp('          CAPACITY PLANNING')
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
no_of_cells_basedon_capacity=capct(bw,u,dlp,ulp,pth,obf)

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
no_of_cells=no_of_cells_basedon_coverage;
% Approximation for No. of cell if necessary
if no_of_cells<1
    no_of_cells=ceil( no_of_cells);
else
    no_of_cells=round( no_of_cells);
end

disp('*****')
disp(' ')
disp('* no_of_cells ='),disp(no_of_cells)

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
disp('*****')
disp(' ')
fplan(no_of_cells_basedon_coverage,R_distance,da);
disp('*****')
disp(' ')
fplan2(no_of_cells_basedon_capacity,da);

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% coverage function

function[no_of_cells_basedon_coverage,R_distance]=
coverg(da,f,bw,pm,gd, ...
Ptx_U,Gtx_U,Ltx_U,Grx_U,Lrx_U,IM_U,NF_U,sinr_U, ...
Ptx_D,Gtx_D,Ltx_D,Grx_D,Lrx_D,IM_D,NF_D,sinr_D,a,hb,hm)

%environmental characteristics

    %a(hm)
    if a==4
        h=(3.2*(log10(11.75*(hm))^2)-4.97);
    end

```

```

    if a==1
        h=((1.1*log10(f))-0.7)-((1.56*log10(f))-0.8);
    end

%k
    if a==1
        k=(4.78*(log10(f)^2))-((18.33*(log10(f)))+40.94);
    elseif a==2
        k=(2*((log10(f/28))^2))+5.4;
    else
        k=0;
    end

    %calling Thermal Noise Level(KTB) function
    ktb=kn(bw);

    %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% uplink %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

    %Reference Sensitivity (REFSENS)is a minimum received power
    REFSENS_U=ktb+NF_U+sinr_U+IM_U-gd;
    Prx_U=REFSENS_U;

    %pathloss equation
    PL_U=Ptx_U-Prx_U+Gtx_U+Grx_U-Ltx_U-Lrx_U+pm;
    PL=PL_U;

    %radius distance in Km
    R_distance= 10^((PL-69.55-(26.16*(log10(f))))+h+k)/(44.9-
    (6.55*(log10(hb))));

    D_U=R_distance;

    %site area
    cell_area_U=2.6*(D_U^2);

    no_of_sites_basedon_coverge_U=da/cell_area_U

    %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% downlink %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

    %Reference Sensitivity (REFSENS)is a minimum received power
    REFSENS_D=ktb+NF_D+sinr_D+IM_D-gd;
    Prx_D=REFSENS_D;

    %pathloss equation
    PL_D=Ptx_D-Prx_D+Gtx_D+Grx_D-Ltx_D-Lrx_D+pm;
    PL=PL_D;

```

```

%radius distance in Km
R_distance= 10^((PL-69.55-
(26.16*(log10(f)))+(13.82*(log10(hb)))+h+k)/(44.9-
(6.55*(log10(hb)))));
D_D=R_distance;

%site area
cell_area_D=2.6*(D_D^2);

no_of_sites_basedon_coverge_D=da/cell_area_D

% % %final
no_of_cells_basedon_coverage=no_of_sites_basedon_coverge_U
% Approximation for No. of cell if necessary
if no_of_cells_basedon_coverage<1
    no_of_cells_basedon_coverage=
ceil(no_of_cells_basedon_coverage);
else
    no_of_cells_basedon_coverage=
round(no_of_cells_basedon_coverage);
end

R_distance=D_U

% function to calculate Terminal noise

function ktb=kn(bw)

% array of channel bandwidth and their resource blocks
bw1=[1.4 3 5 10 15 20;6 15 25 50 75 100];

for i=1:6
    if bw1(1,i)== bw
        Nrb=bw1(2,i);
    end
end

% ktb in db
ktb=-174+(10*log10(180000*Nrb));

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% capacity function
function
no_of_cells_basedon_capacity=capct(bw,u,dlp,ulp,pth,obf)

%total capacity of downlink

```

```

DL_total_capacity=u*obf*dlp;

%total capacity of ulinkp
UL_total_capacity=u*obf*ulp;

%site capacity
% calling throughput function to get the maximum throughput
[DL_throughput,UL_throughput]= thg(bw);

%no of cells based on uplink
UL_site_capacity= (UL_throughput*pth);
no_of_capacity_cells_perUL=UL_total_capacity/UL_site_capacity

no_of_cells_basedon_capacity=no_of_capacity_cells_perDL
% Approximation for No. of cell if necessary
if no_of_cells_basedon_capacity<1

no_of_cells_basedon_capacity=ceil(no_of_cells_basedon_capacity);
else

no_of_cells_basedon_capacity=round(no_of_cells_basedon_capacity);
end

%function to return maximum throughput based on 3GPP
standard

function [DL_throughput,UL_throughput]= thg(bw)
%the bandwidth in mega hertz and the throughput in mega bit
per second

%thesis options for downlink and uplink are :
%Downlink MIMO (4*4)
DL_peak_throughput= [1.4 3 5 10 15 20;17.52 44150.752
220.272 299.552];

%Uplink SIMO (64 QAM)
UL_peak_throughput=[1.4 3 5 10 15 20;4.392 36.696 55.0560
75.376];

for i=1:6
    if DL_peak_throughput(1,i)== bw
        DL_throughput=DL_peak_throughput(2,i);
    end
end

```

```

        if UL_peak_throughput(1,i) == bw
            UL_throughput=UL_peak_throughput(2,i);
        end
    end
end

%%%%%%%%%%%%%%

function fplan2(no_of_cells_basedon_capacity,da)

% calculation of cell radius

% cell area
tc=da/no_of_cells_basedon_capacity

% cell radius
r=sqrt(tc/2.5981);

% Calculation the Coordinates for each BTS
c=no_of_cells_basedon_capacity;
no=c;

s=sqrt(da);

if r>s
    w=r+5;
else
    w=s;
end

he=w;

ct=2.6*(r^2)
k=1;
s=.86*r;
m=0;
e=0;
g=0;
% Calculation the Coordinates for each BTS
for i=r:1.5*r:w;
    e=e+1;
    n=rem(m,2);
    if n==1;
        for j=0:2*s:he;
            if j>he;
                break
            else

```

```

        if k>no;
            break
        else
            m=m+1;
        end
    g=g+1;
        if k>no;
            break
        else
            m=m+1;
        end
    g=g+1;
    end
end

% BTS Table
n=length(bt)
for j=1:n;
    bts(j,1)=j          ;           %BTS   ID
    bts(j,2)=bt(j)      ;           %X-
    Coordinate for BTS(j)
    bts(j,3)=bs(j);           %Y-
end

% Another Figure Explain The Distribution of Cells In
Expanded Area

figure;
whitebg('k');

%hold on;
plot(bts(:,2),bts(:,3),'d','LineWidth',1,...
      'MarkerEdgeColor','k',...
      'MarkerFaceColor','g',...
      'MarkerSize',9);
    xlabel('Width (Km)');
    ylabel('length (Km)');
    title([' Distribution of BTSS Based on Capacity Planning
'],'FontSize',18);
    set(title, 'FontWeight', 'bold','FontSize',18);

% Determine The Cells In The Area
for i=1:n;
    p1(i)=bt(i)-r;
    p2(i)=bt(i)-0.5*r;

```

```
p3(i)=bt(i)-0.5*r;  
p4(i)=bt(i)+0.5*r;  
p5(i)=bt(i)+0.5*r;  
p6(i)=bt(i)+r;  
p7(i)=bs(i);  
p8(i)=bs(i)+s;  
p9(i)=bs(i)-s;  
p10(i)=bs(i)+s;  
p11(i)=bs(i)-s;  
p12(i)=bs(i);  
  
    line([p1(i) p2(i)], [p7(i)  
p8(i)], 'LineWidth', 2, 'Color', 'r');  
    line([p2(i) p4(i)], [p8(i)  
p10(i)], 'LineWidth', 2, 'Color', 'r');  
    line([p4(i) p6(i)], [p10(i)  
p11(i)], 'LineWidth', 2, 'Color', 'r');  
    line([p5(i) p3(i)], [p11(i)  
p9(i)], 'LineWidth', 2, 'Color', 'r');  
    line([p3(i) p1(i)], [p9(i)  
p7(i)], 'LineWidth', 2, 'Color', 'r');  
end
```