LTE PLANNING
Coverage Planning

Wireless Access Communication

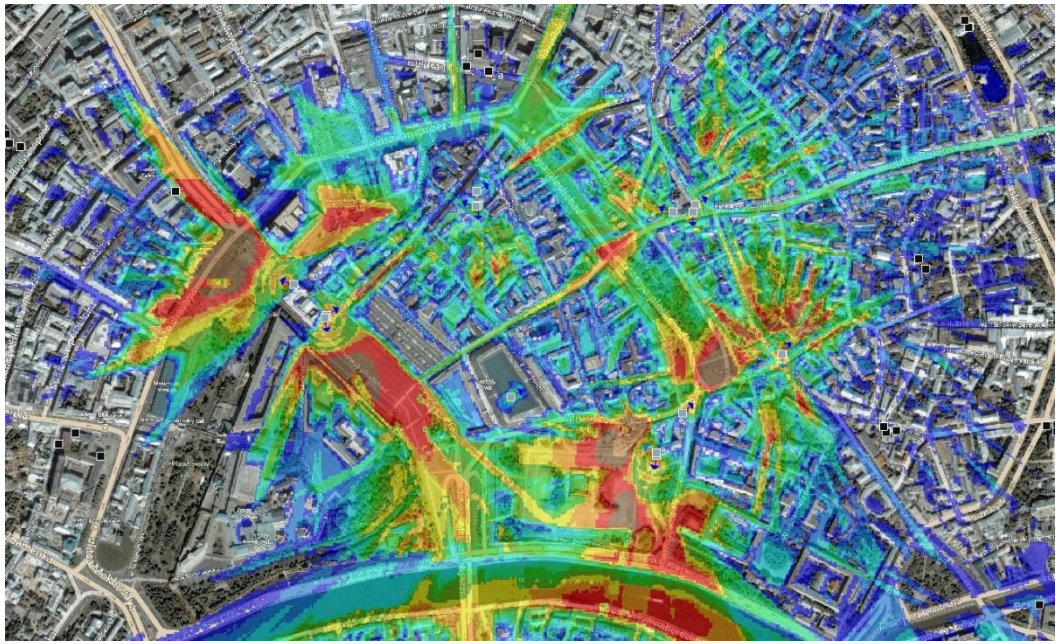
Telkom Engineering School

Faculty of Electrical Engineering

Bandung – 2020

Coverage Planning

Coverage Planning gives an estimation of the resources needed to provide service in the deployment area with the given system parameters.



Downlink Link Budget

Downlink Link Budget		
Transmitter	Value	Calculation
Max eNB Tx Power (dBm)	46	A
RB to Distribute Power	100	C
Subcarriers to Distribute Power	1200	D = 12*C
Subcarrier Power (dBm)	15.21	E = A-10*log(D)
Tx Antenna Gain (dBi)	18	G
Feeder Loss (dB)	0.5	H
EIRP (dBm)	32.71	J = E+G-H
Receiver	Value	Calculation
SINR (dB)	-3.5	K
Rx Noise Figure (dB)	7	L
Receiver Sensitivity (dBm)	-128.74	M = K+L-174+10*log(15000)
Rx Body Loss (dB)	0	P
Interference Margin (dB)	3.67	Q
Min. Signal Reception Strength (dBm)	-125.07	R = M+P+Q
Path Loss & Shadow Fading Margin	Value	Formula
Penetration Loss (dB)	15	S
Shadow Fading Margin (dB)	8	T
MAPL (dB)	134.78	U = J-R-S-T

Uplink Link Budget

Uplink Link Budget		
Transmitter	Value	Calculation
Max Total Tx Power (dBm)	23	A
RB to Distribute Power	8	C
Subcarriers to Distribute Power	96	D = 12*C
Subcarrier Power (dBm)	3.18	E = A-10*log(D)
Tx Body Loss (dBi)	0	I
EIRP (dBm)	3.18	J = E-I
Receiver	Value	Calculation
SINR (dB)	-2.5	K
Rx Noise Figure (dB)	2.3	L
Receiver Sensitivity (dBm)	-132.44	M = K+L-174+10*log(15000)
Rx Antenna Gain (dBi)	18	N
Rx Cable Loss (dB)	0	O
Interference Margin (dB)	0.87	Q
Min. Signal Reception Strength (dBm)	-149.57	R = M-N+O+Q
Path Loss & Shadow Fading Margin	Value	Formula
Penetration Loss (dB)	15	S
Shadow Fading Margin (dB)	8	T
MAPL (dB)	129.75	U = J-R-S-T

Outdoor Propagation Models

- COST 231 Hata Model

The COST231-Hata model extends Hata's model for use in the 1500 - 2000 MHz frequency range, where it is known to estimate path loss.

$$PL = Lu - a(h_{Rx})$$

Calculation COST 231 Propagation

$$Lu = 49,3+ 33,9 \log_{10} (fc) – 13,82 \log_{10} (h_{tx}) + (44,9 – 6,55 \log (h_{tx})) \log d$$
$$Lu = 49,3+ 33,9 \log_{10} (1800) – 13,82 \log_{10} (30) + (44,9 – 6,55 \log (30))\log d$$
$$Lu = 49,3+ 110,3537379 – 20,41381574+ (35,224855)\log d$$

$$PL = 49,3+ 110,35373 – 20,41381574+ (35,224855)\log d – a(hr)$$

(Jika hr = 1,5 maka a(hr) = 0)

Calculation COST 231 Propagation

129,75 = 139,2399143 + (35,224855)logd

-9,48991426 = (35,224855)logd

Logd = $\frac{-9,48991426}{35,224855}$

Logd = -0,2694096047

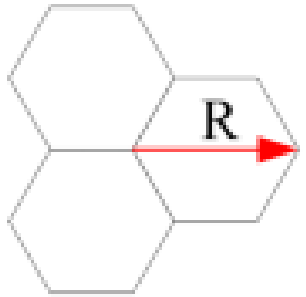
D= $10^{-0,2694096047}$

D= 0,538 km

Site Calculation

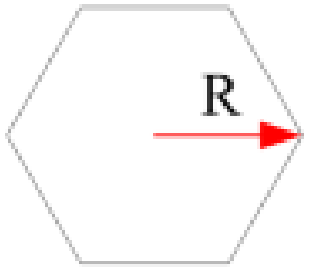
Bandung Area Wide = 168.23 km^2

Calculation	Formula	Result
Cell Coverage (Tri-Sectoral)	1,95 x d^2	0.564
Total Cell	$\frac{area\ wide}{cell\ coverage}$	299



3-sector site

$$Area = \frac{9}{8}\sqrt{3}R^2$$



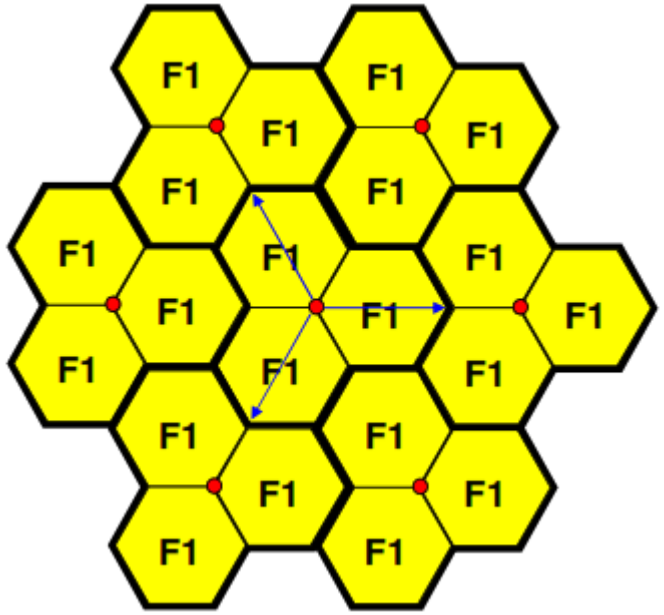
Omni site

$$Area = \frac{3}{2}\sqrt{3}R^2$$

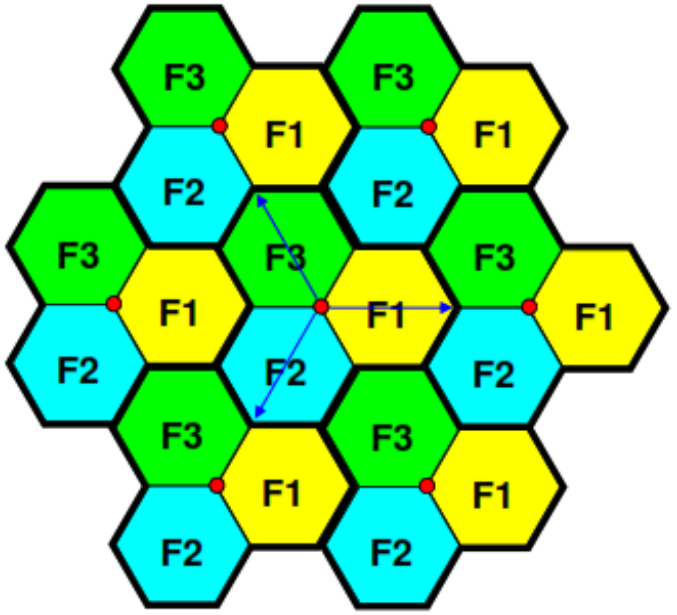
LTE CELL PLANNING

Frequency Planning

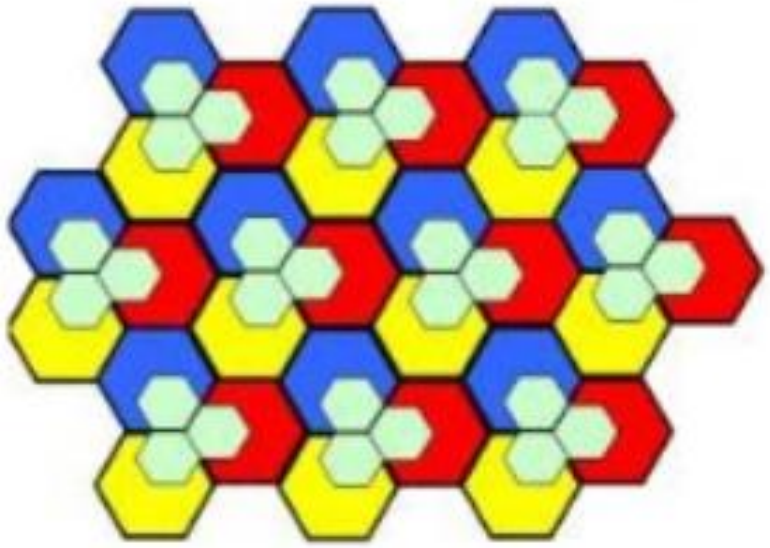
"Frequency Planning needs when the frequency of LTE system works on the same frequency band and the resources of the spectrum frequency is limited"



Frequency Reuse
1x3x1

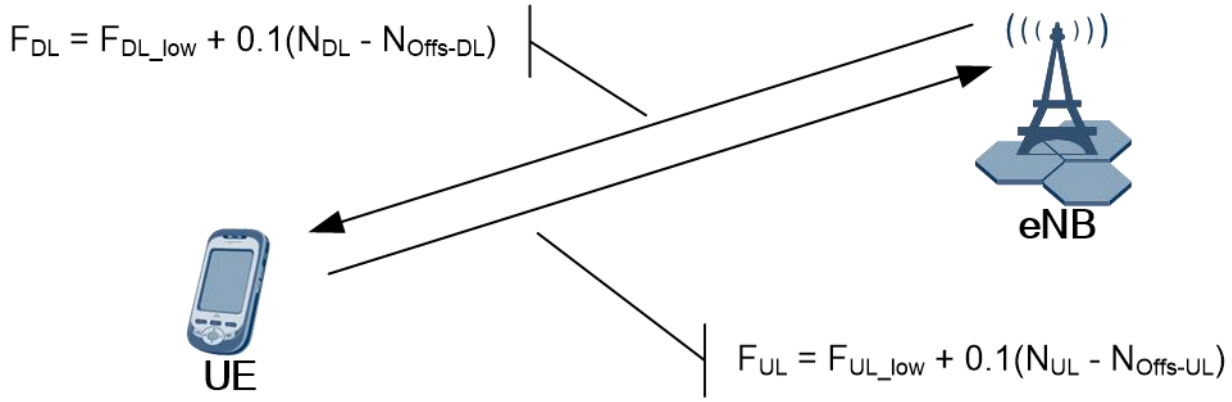


Frequency Reuse
1x3x3



Soft Frequency Reuse
1x3x1

Frequency Planning (EARFCN)



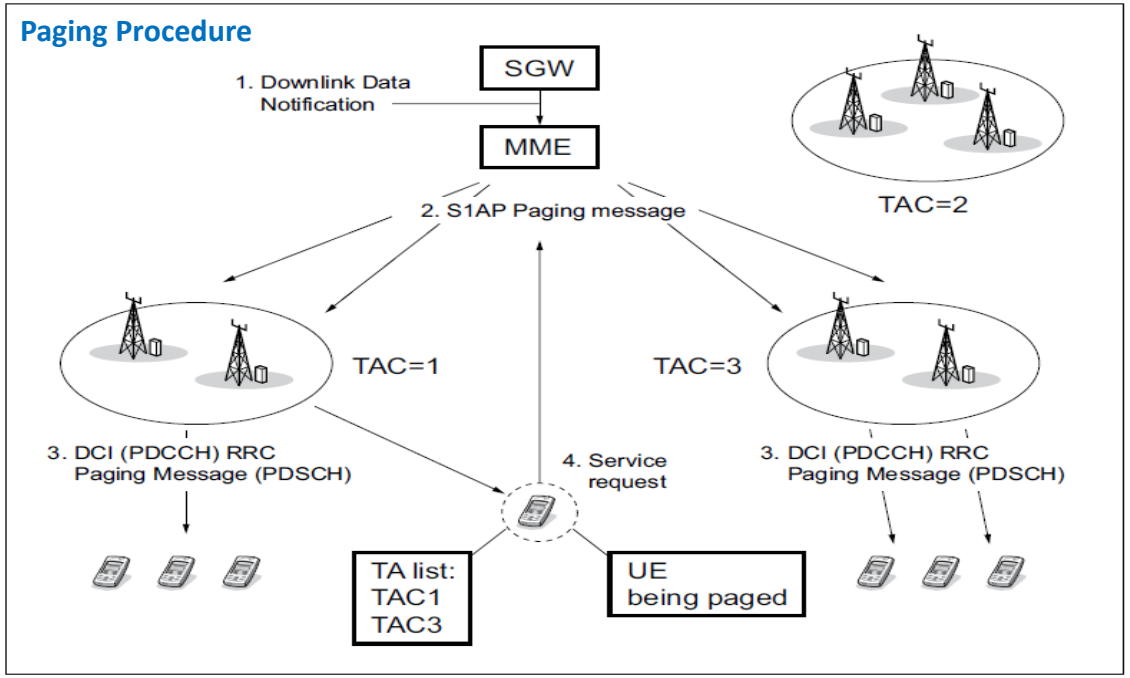
Band	Downlink			Uplink		
	F_{DL_low} (Mhz)	N_{OFF_DL}	Range of N_{DL}	F_{UL_low} (Mhz)	N_{OFF_UL}	Range of N_{UL}
1	2110	0	0 – 599	1920	18000	18000 – 18599
3	1805	1200	1200 – 1949	1710	19200	19200 – 19949
5	869	2400	2400 – 2649	824	20400	20400 – 20649
8	925	3450	3450 – 3799	880	21450	21450 – 21799
40	2300	38650	38650 – 39649	2300	38650	38650 – 39649

$F_{DL/UL}$: DL/UL Frequency center
F_{DL/UL_low} : The lowest frequency of the DL/UL operating band

$N_{Offs_{DL/UL}}$: Offset used for calculating DL/UL EARFCN
$N_{DL/UL}$: Downlink/Uplink EARFCN

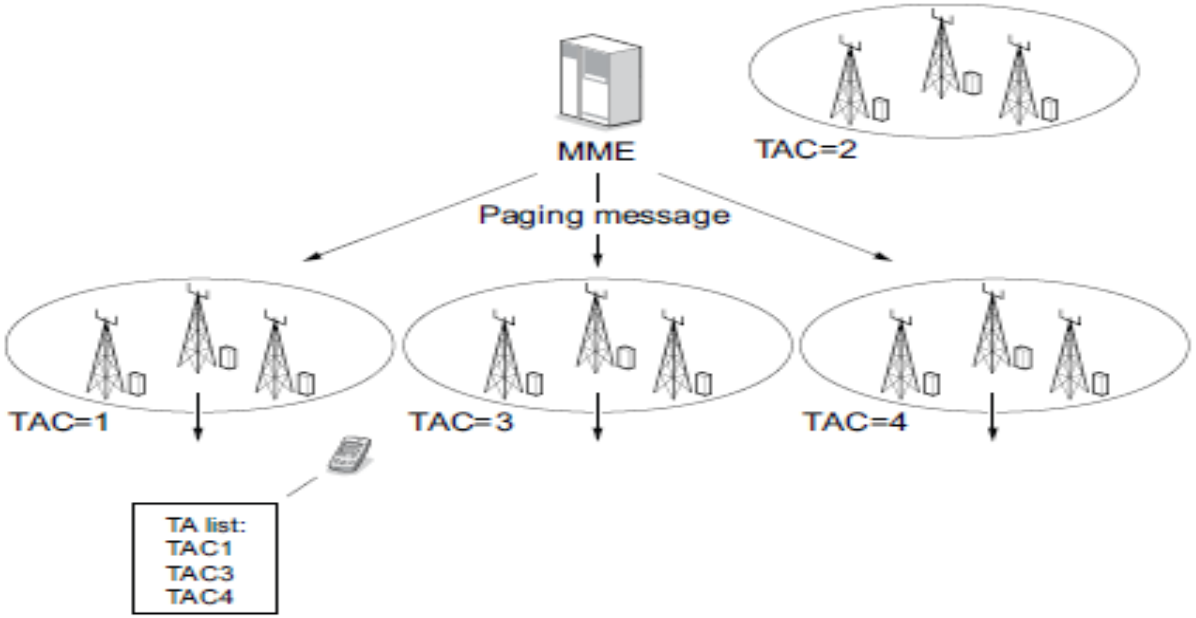
Tracking Area Concept

- TA have similar function as RA in UMTS/GSM to track UE location while Idle Mode
- TA Information is used by the MME when paging idle UE to notify them of incoming data connections
- A TA contains cells using the same TAC. Cells in the network coverage area are divided into multiple TAs by TAC
- TA aims to reduce location update signaling caused by location changes in the LTE System



Tracking Area Planning Principles

- TAs and TALs are configured for specific areas, preventing unnecessary TAU signaling overhead
- Maximum value of a TAC is determined by maximum paging capacity of MME.
- According to the some product specification, One TAL support up to 16 TAs, each TA supports maximum 100 eNodeB in one MME



TAC = Tracking Area Code (1~65533, and 65535)

TAI = Tracking Area ID = MCC + MNC + TAC

TAL = Tracking Area List

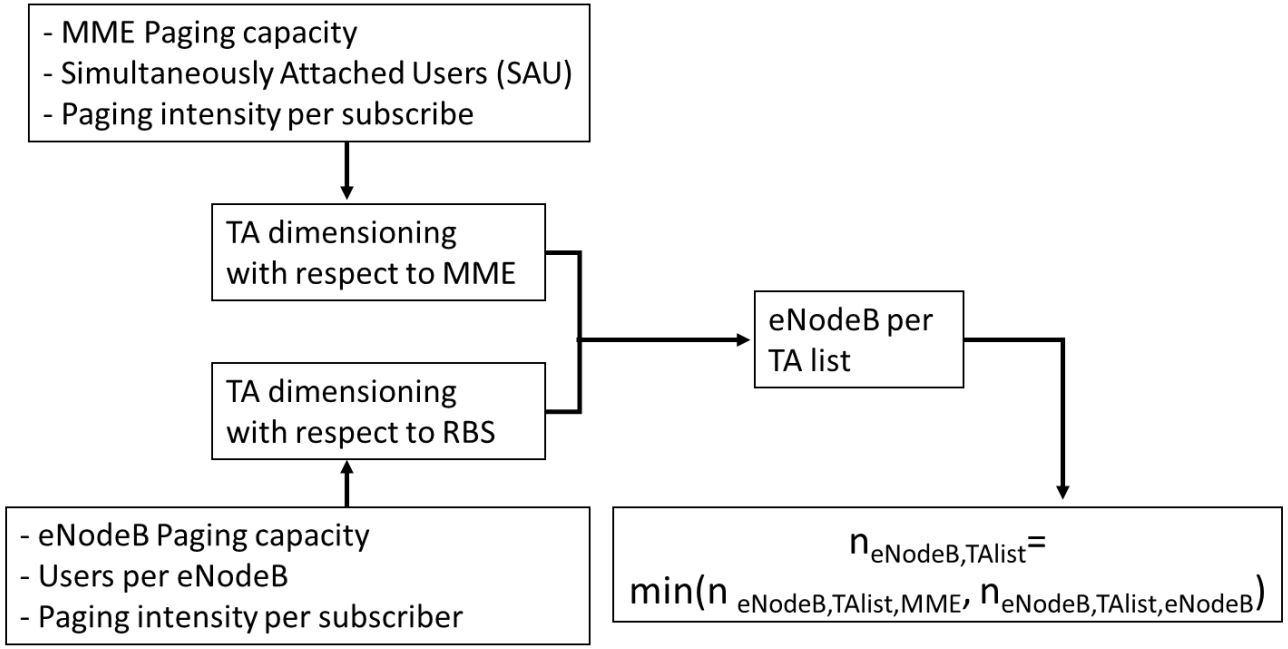
1 TAL = up to 16 TAC

TAL value range: 0~ 65534

MCC	MNC	TAC
510	10	1000

→ TAI: 510 – 10 – 1000

Tracking Area Planning & Dimensioning



When planning borders between TAs and TA lists, the following general rules apply:

- TA and TA lists should be planned so that areas with frequent TA update signaling are located in low mobility areas. This makes it easier for the eNodeB to cope with the additional signaling caused by the TAL update procedure.
- TA and TA list should be planned so that the need for TA updates (TAL border) is minimized. This is accomplished by considering how users travel within the network. Busy roads, railways, and so on, should cross as few TA list borders as possible.

PCI Planning Concept

In LTE System, Physical Cell Identity is used to differentiate radio signals of different cells. That is, the PCI is unique in the coverage of cells.

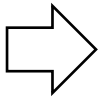
PCI		SSS ID								
		0	1	2	…	163	164	165	166	167
PSS ID	0	0	3	6	…	489	492	495	498	501
	1	1	4	7	…	490	493	496	499	502
	2	2	5	8	….	491	494	497	500	503

PCI ID = (3 x SSS ID) + PSS ID

Total PCI = 3 x 168 = 504 PCI

Primary Synchronization Signal (PSS):

- Detection of carrier frequency
- Detection of SCH symbol timing
- Identification of Cell ID (0-2)

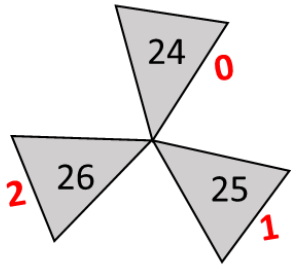


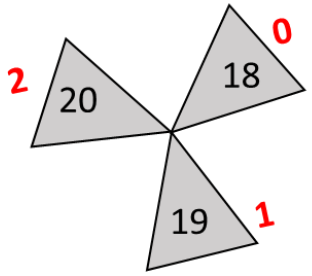
Secondary Synchronization Signal (SSS):

- Detection of radio frame timing
- Detection of cell ID group (0-167)
- Detection of MIMO & CP configuration

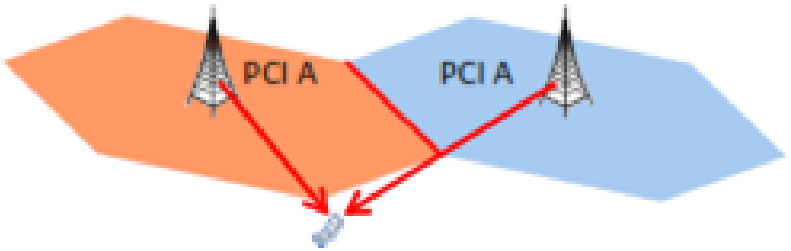
PCI Allocation

PCI can be allocated manually using Modulo 3 concept. The result of mod 3 assigned on each sector cannot be face-to-face.

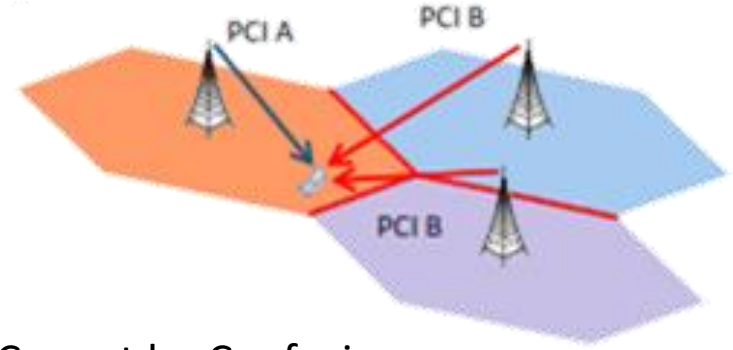




Terms of Allocating PCI:



Cannot be Collision
→ PCI code must be unique in an area where a cell is covered



Cannot be Confusion
→ A cell is not allowed to have the same neighboring cells with adjacent PCI

PRACH Planning Backgrounds & Principles

"PRACH is the UL channel that is used by the UE for initial cell and scheduling requests"

- There are 64 PRACH preambles in each LTE cell for Random Access used for users randomly selects a preamble sequence to establish initial connection.
- Preambles are generated from root sequence (Zadoff-Chu sequence) and its cyclic shift 838 root sequences are defined by 3GPP with length 839

  For example: for Cyclic Shift step 76, so-call Ncs = 76

  →Each root sequence can generate Rounddown(839/76) = 11 sequences

  →To Generate 64 sequences, number of root sequences needed = Roundup(64/11) = 6

  →So available root sequences = Rounddown (838/6) = 139 (Index 0, 6, 12, 18, …)
- Root sequence needs to be reuse in the network

Cell Range Given Ncs

Zero Correlation Zone High Speed Flag= false		Preamble sequences per Root Sequence	Root Sequences Required per Cell	Root Sequence reuse pattern	Cell Range (km)
Index	Cyclic shift				
1	13	64	1	838	0.76
2	15	55	2	419	1.04
3	18	46	2	419	1.47
4	22	38	2	419	2.04
5	26	32	2	419	2.62
6	32	26	3	279	3.47
7	38	22	3	279	4.33
8	46	18	4	209	5.48
9	59	14	5	167	7.34
10	76	11	6	139	9.77
11	93	9	8	104	12.20
12	119	7	10	83	15.92
13	167	5	13	64	22.78
14	279	3	22	38	38.80
15	419	2	32	26	58.83
0	838	1	64	13	118.8

Defining Ncs Value

- $Ncs * Ts > T_{RTD} + T_{MDS} + T_{dev}$
  [Ncs * (800/839) > (6.67*R) + 5 + 2]
  - Ncs is mainly decided by Cell radius.
  - $T_{RTD} = 2*R/C = 2*R / (3*10^8)$ seconds = 6.67 * R (us)
    - T_{RTD} is round trip delay, decided by cell radius R
    - C is light speed = $3*10^8$ m/s
  - T_{MDS} is Maximum time delay spread, 5us for Dense Urban and Urban
  - T_{dev} is UE timing deviation due to un-ideal synchronization to the downlink
    - Typically, assume T_{MDS} = 5us, UE timing deviation = 2us
  - Ts is PRACH sampling period, and Ts = 800/839 [us]
- If planned cell radius = 8Km, then Ncs = 76 (Dense Urban, Urban)
- If planned cell radius = 12Km, then Ncs = 93 (Suburban, Rural, long distance coverage)

N_{CS} Configuration	N_{CS} Value	
	Unrestricted Set for Low-Speed Cells	Restricted Set for High-Speed Cells
0	0	15
1	13	18
2	15	22
3	18	26
4	22	32
5	26	38
6	32	46
7	38	55
8	46	68
9	59	82
10	76	100
11	93	128
12	119	158
13	167	202
14	279	237
15	429	-

PRACH Planning Procedures

- Step 1: Determine Ncs value by the cell radius. (E.g. Assume the cell radius is 9.8 km, take Ncs value 76)
- Step 2: The value of 839/76 is rounded down to 11, that is, each index should generate 11 preamble sequences. In this case, 6 (64/11) root sequence indexes are required to generate 64 preamble sequences.
- Step 3: The number of available root sequence indexes is 839/6=139 (0, 6, 12,…,6*n,…, 828)
- Step 4: The available root sequence indexes are assigned to cells. The reuse distance shall be as far as possible

Atoll Simulation

Atoll Overview

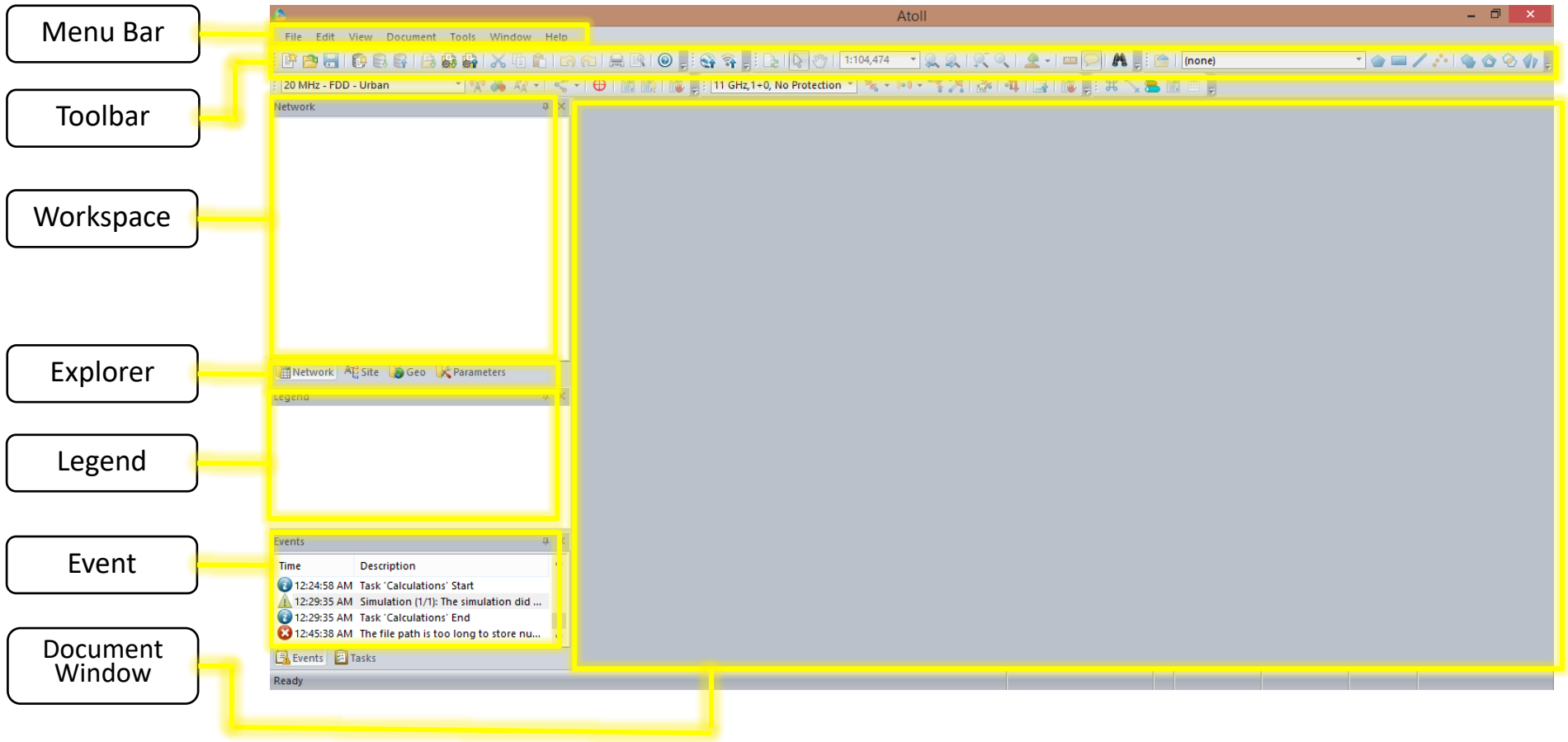
Forsk is an independent company providing radio planning and optimisation software solutions to the wireless industry since 1987.

Atoll is a 64-bit multi-technology wireless network design and optimisation platform that supports wireless operators throughout the network lifecycle, from initial design to densification and optimisation.

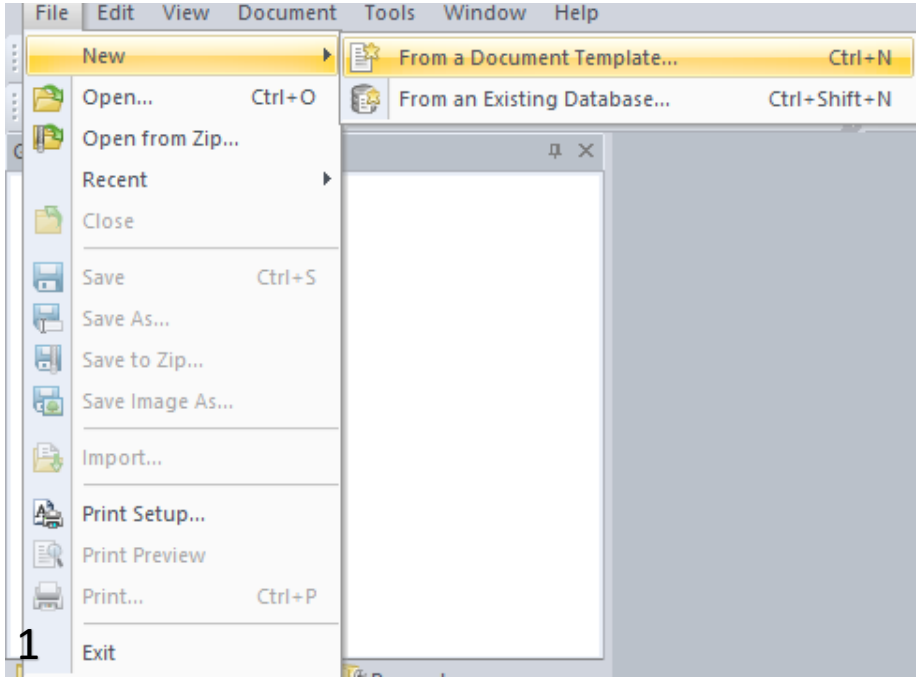
Atoll Supported Technology:

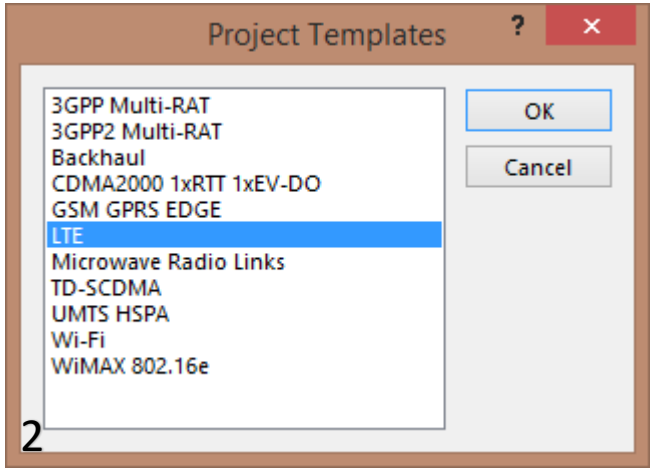
- ✓ GSM/GPRS/EDGE
- ✓ WIMAX/BWA
- ✓ UMTS/HSPA
- ✓ Wi-Fi
- ✓ LTE/LTE-A
- ✓ Microwave Links
- ✓ TD-SCDMA
- ✓ CDMA2000

Atoll User Interface



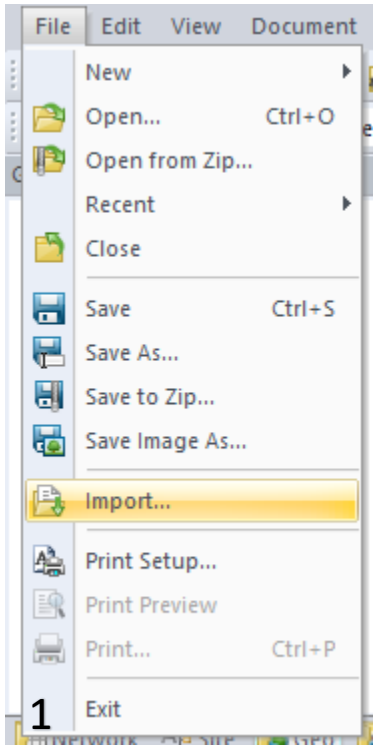
Create New Project

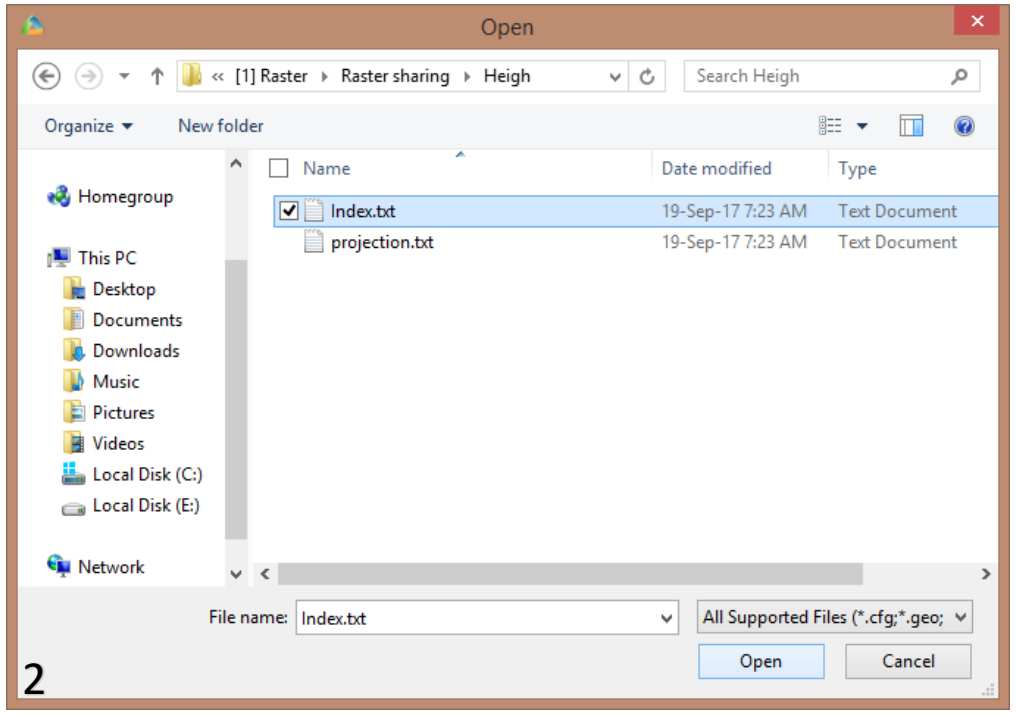


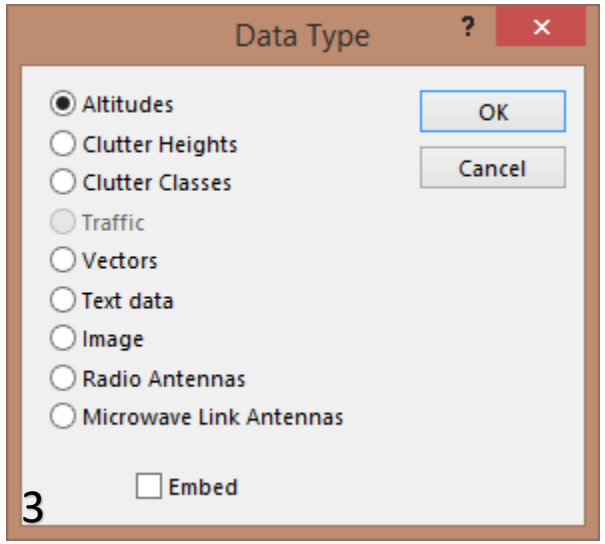


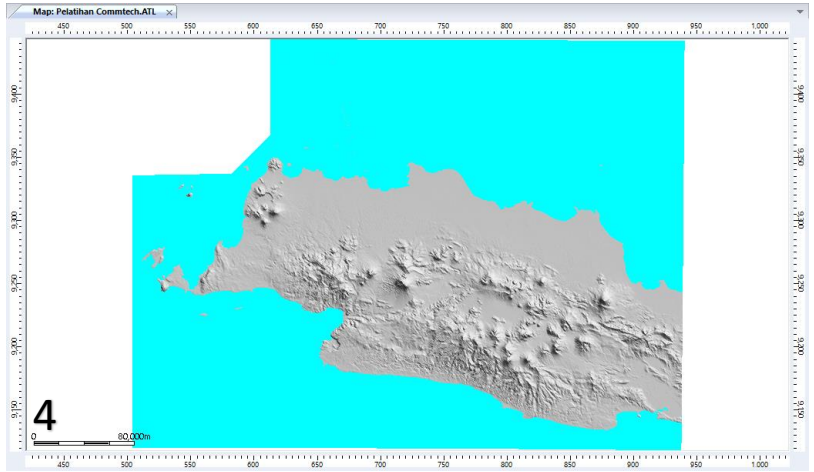
1. File → New → From a Document Template
2. Choose your project templates → LTE → OK
3. Result

Importing Maps [1]









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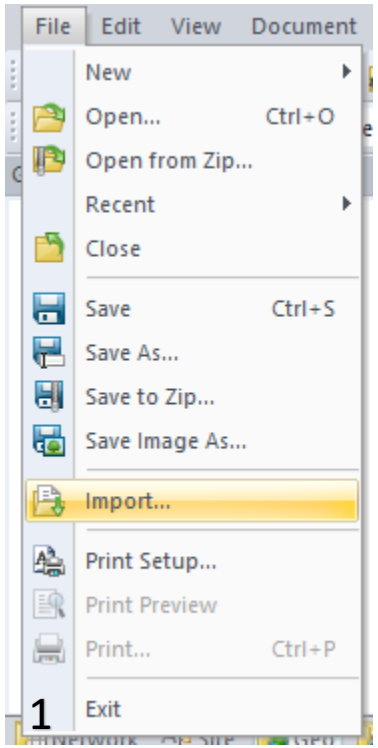
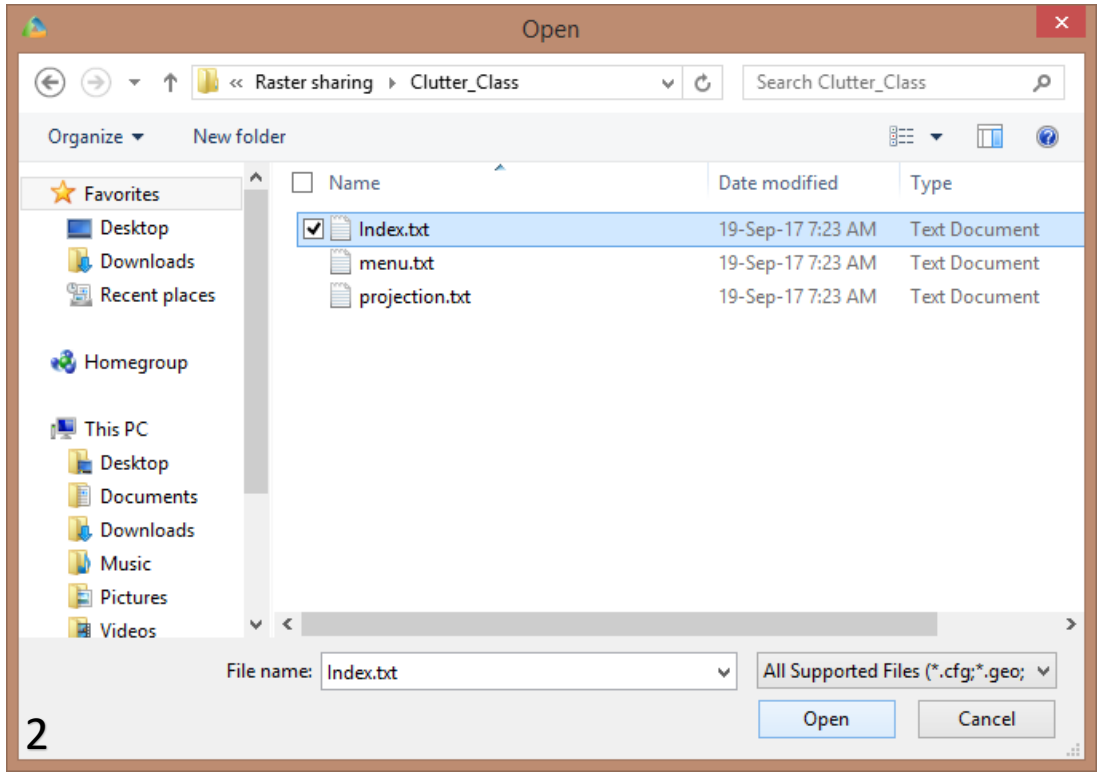
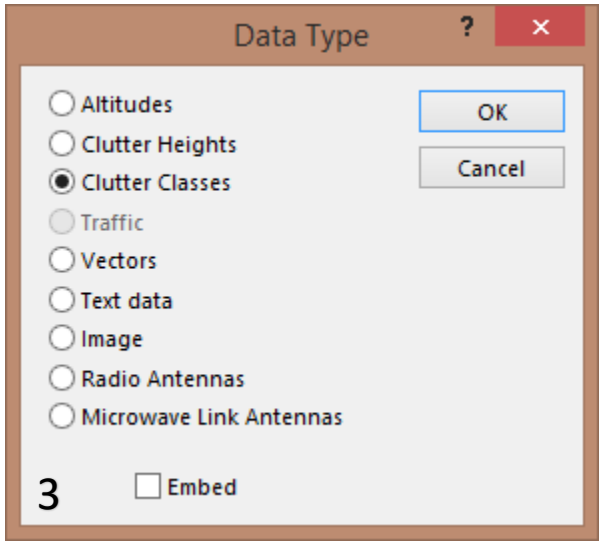
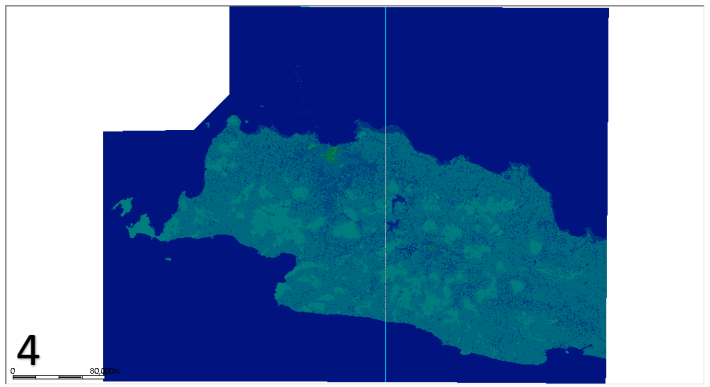
3. Choose Altitudes
4. Result will be shown in document window

Importing Maps [2]









1. Select File then Import
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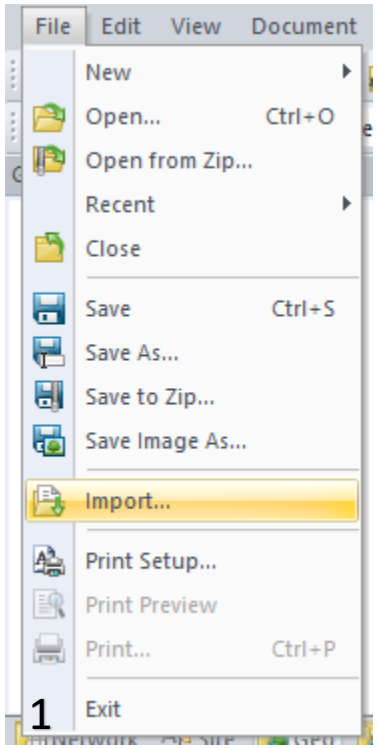
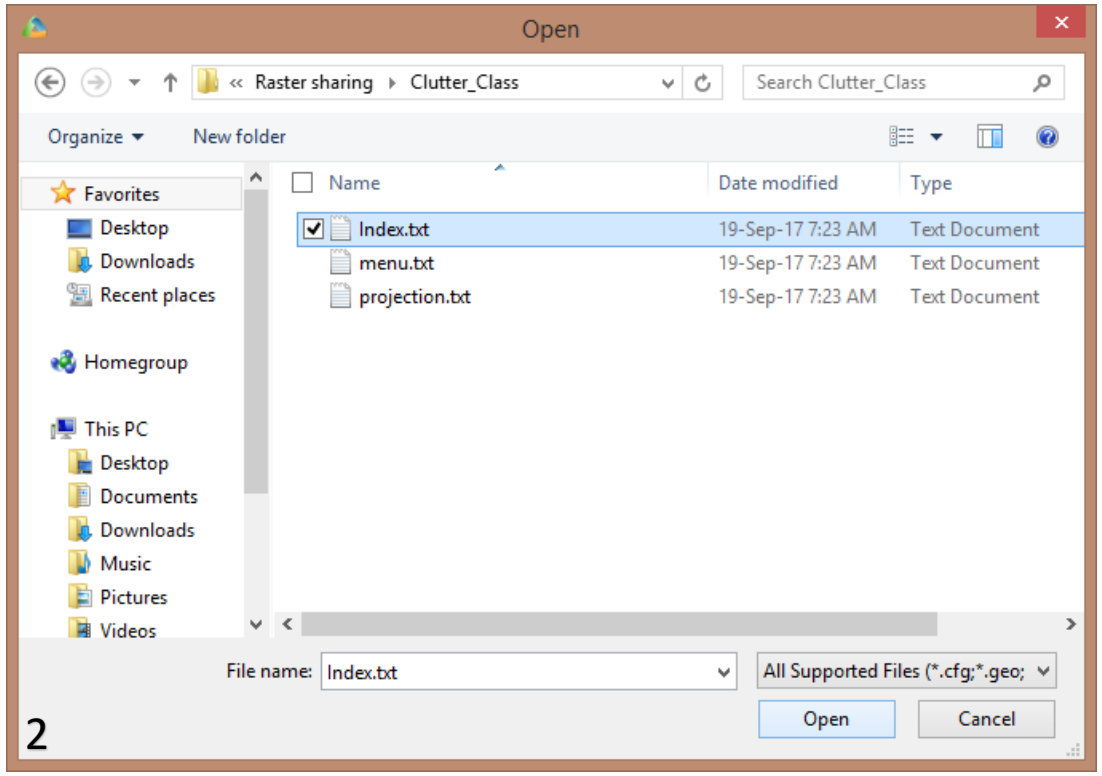
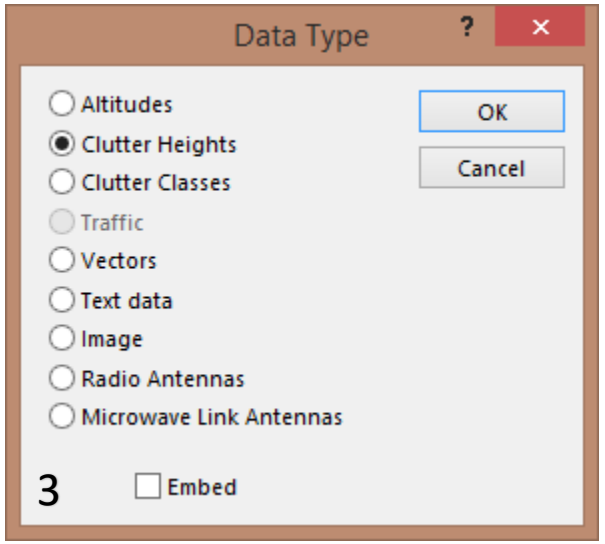
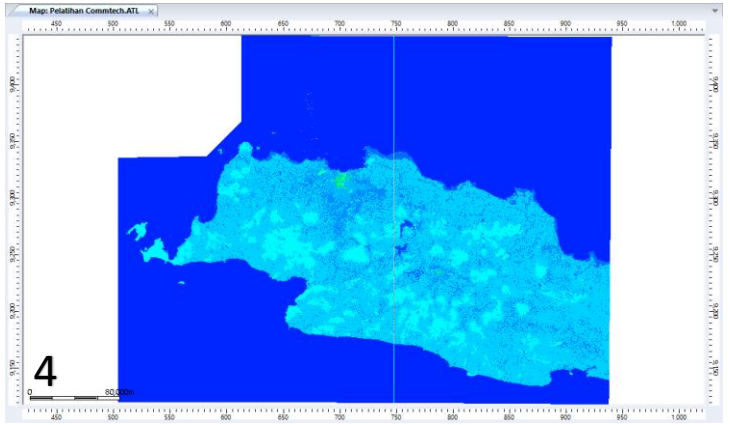
3. Choose Clutter Classes
4. Result will be shown in document window

Importing Maps [3]









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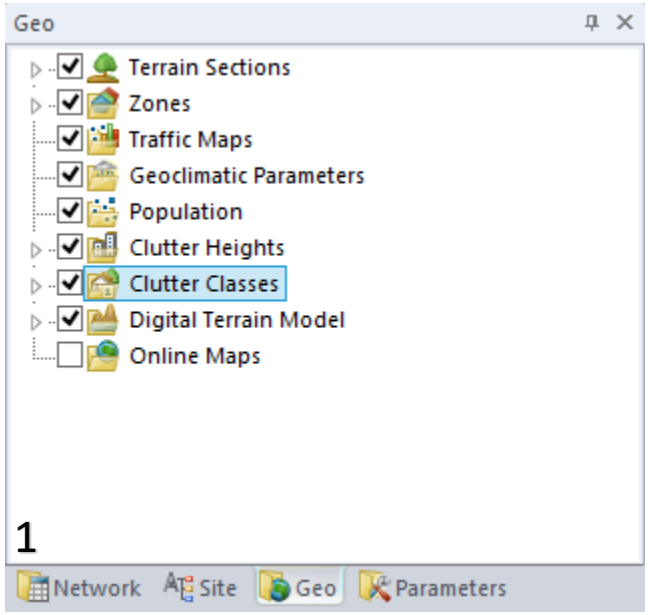
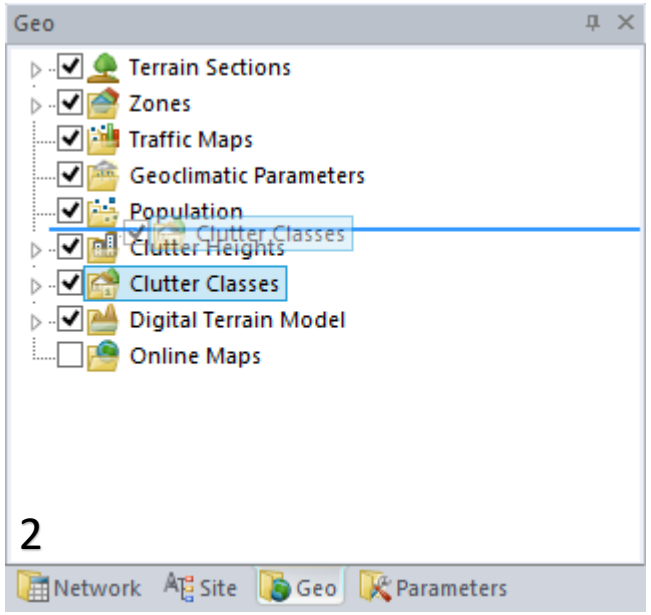
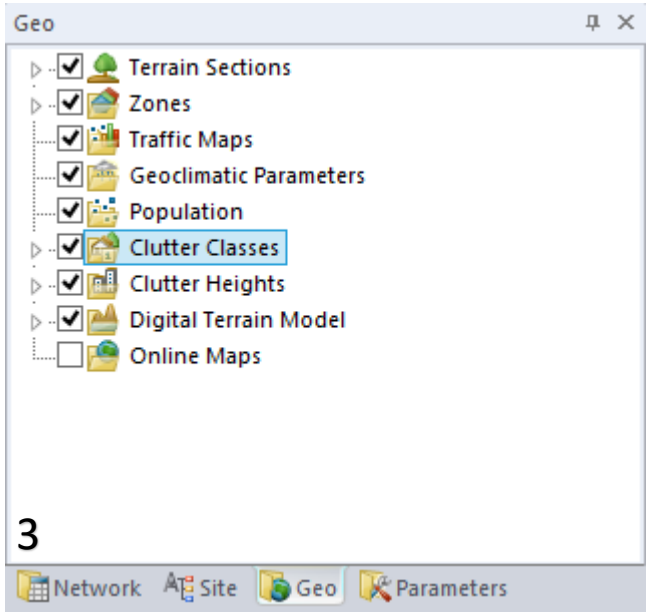
3. Choose Clutter Heights
4. Result will be shown in document window

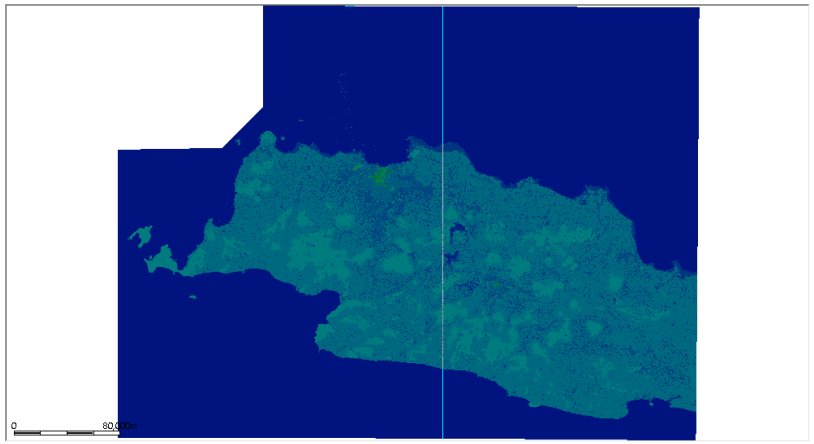
Setting Clutter Classes Legend [1]



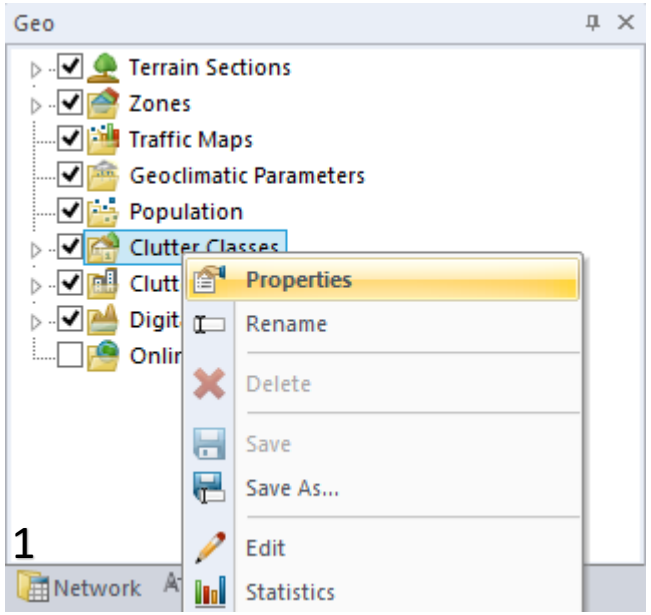


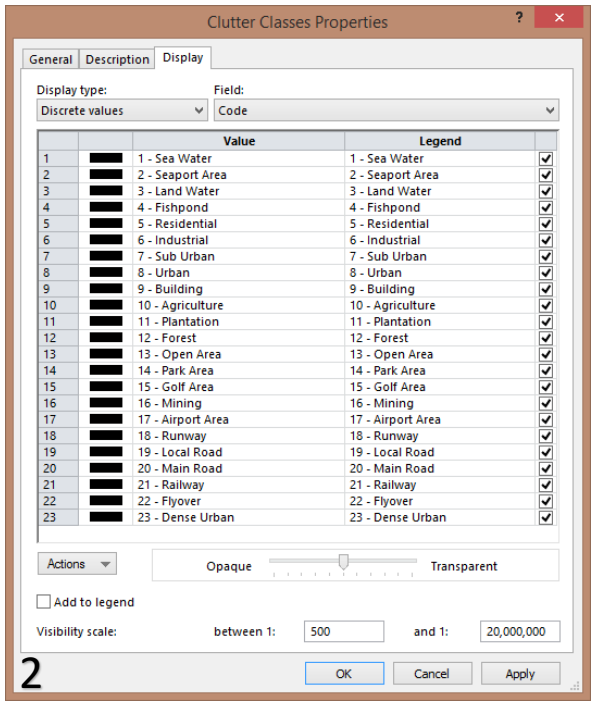


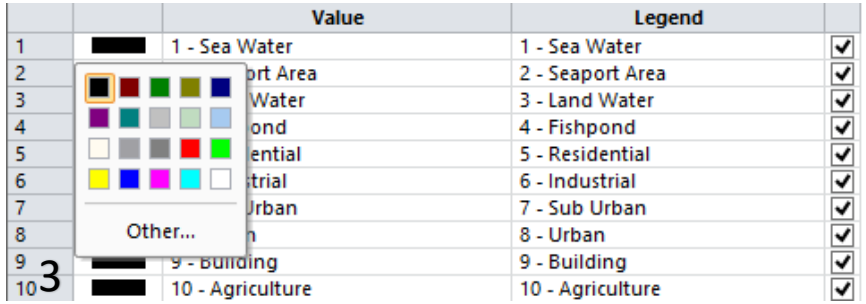
1. Open Geo tab
2. Click Clutter Classes and drag above Clutter Heights
3. Clutter Class already above Clutter Heights
4. Result in document window



Setting Clutter Classes Legend [2]

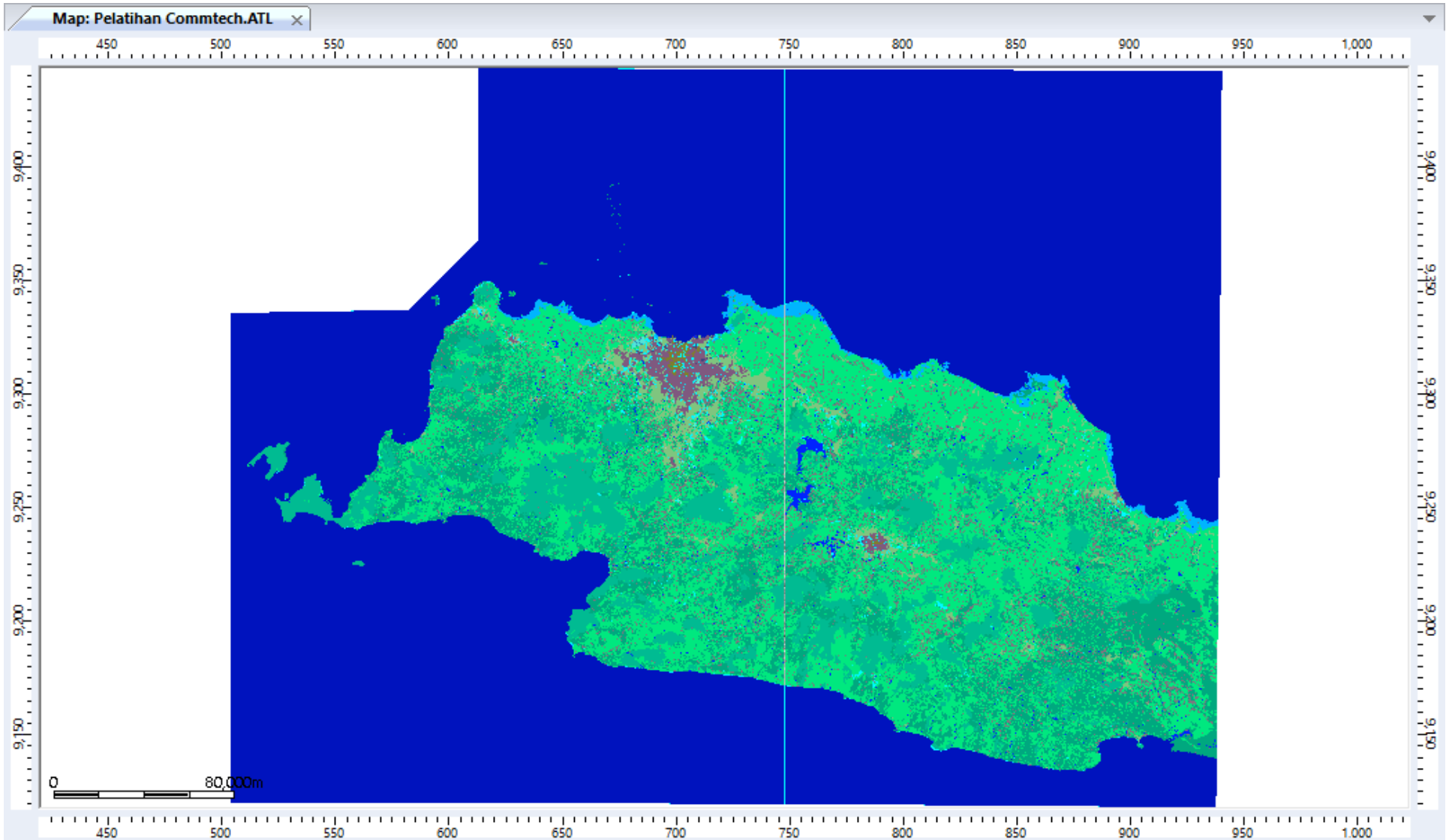




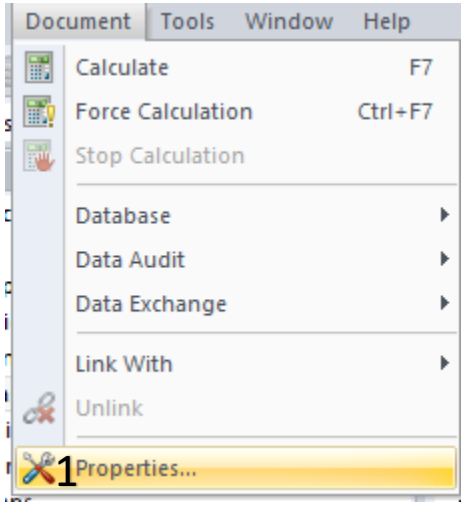


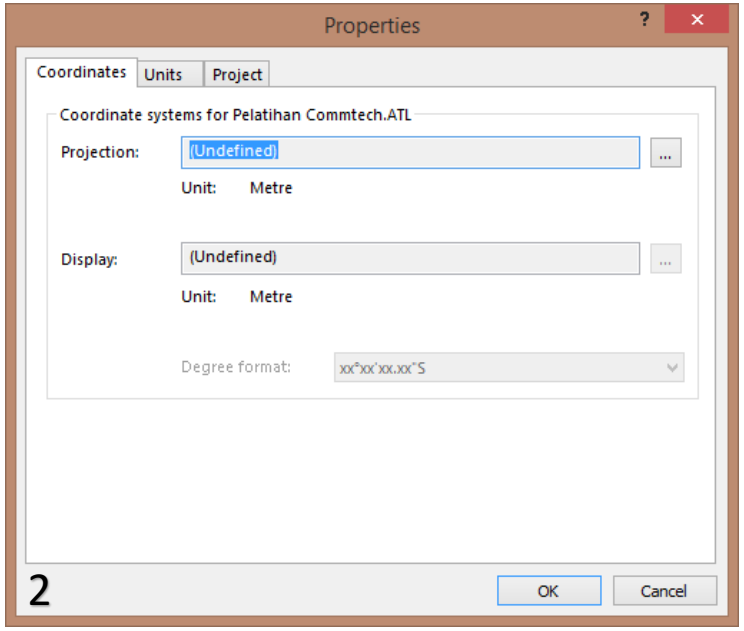
1. Right click Clutter Class → Properties
2. Clutter Class has not colored yet
3. Select the colour you want
4. Result

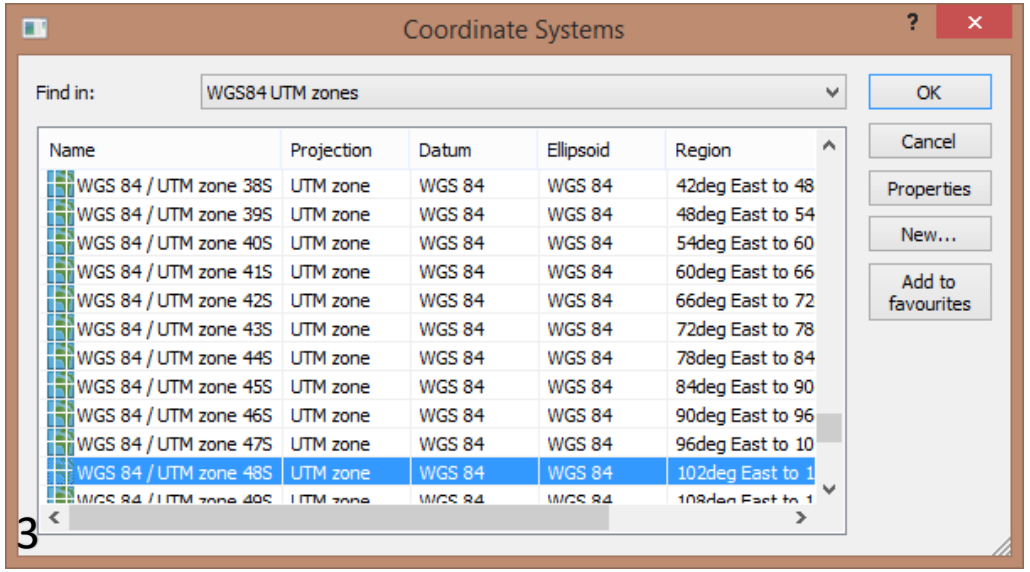
Map Result


Map: Pelatihan Commtech.ATL
450
500
550
600
650
700
750
800
850
900
950
1,000
9,400
9,350
9,300
9,250
9,200
9,150
0
80,000m

Selecting Projection Map [1]

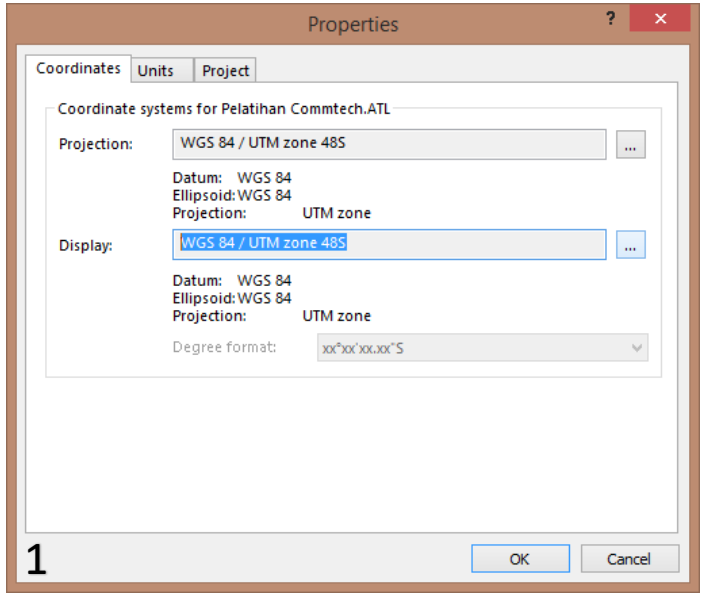


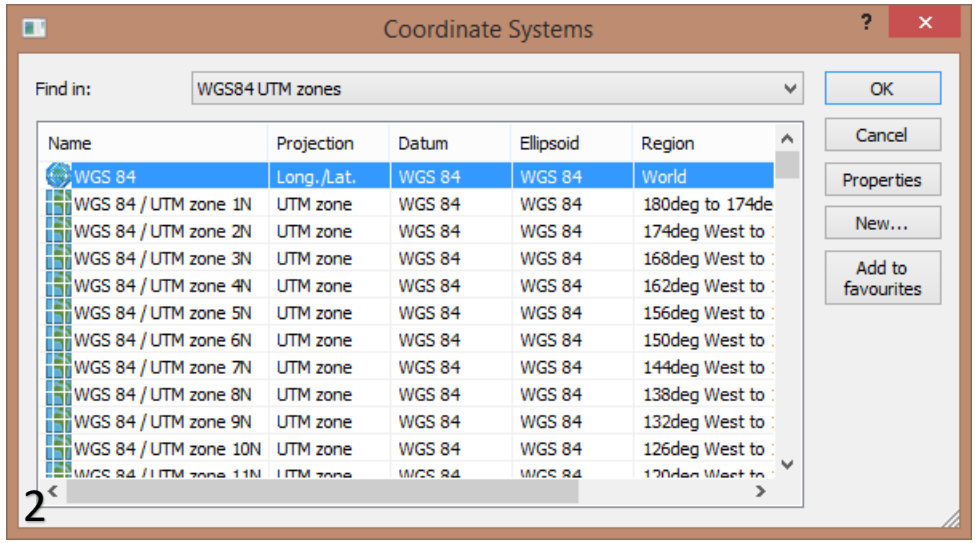


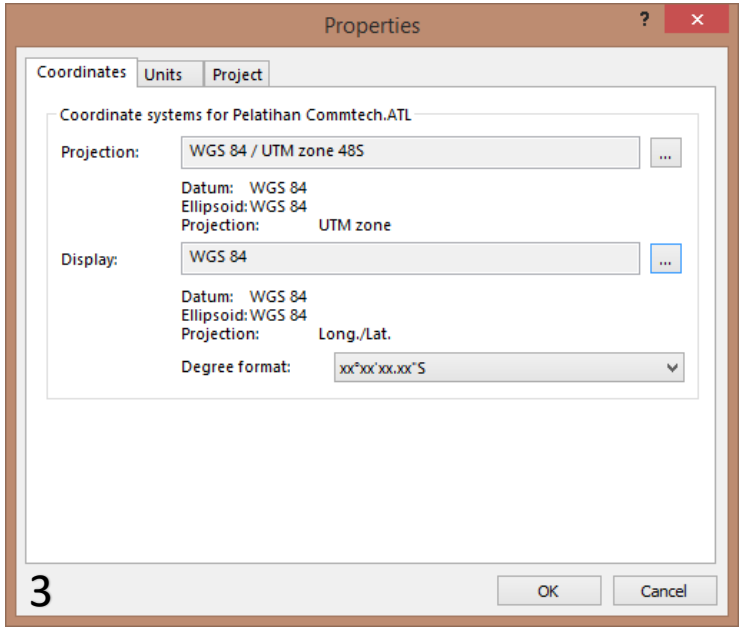


1. Select Document then Properties
2. Projection Map has not selected yet → select "…"
3. On Find In, choose WGS84 UTM zones → UTM zone 48S → OK

Selecting Projection Map [2]

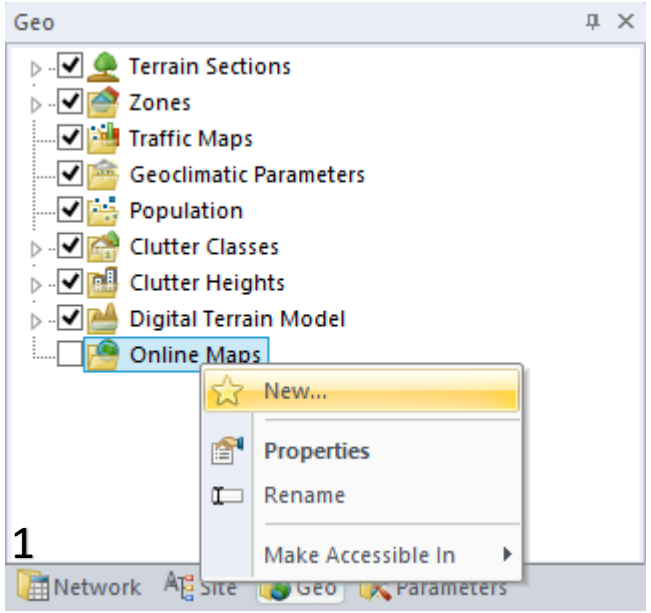


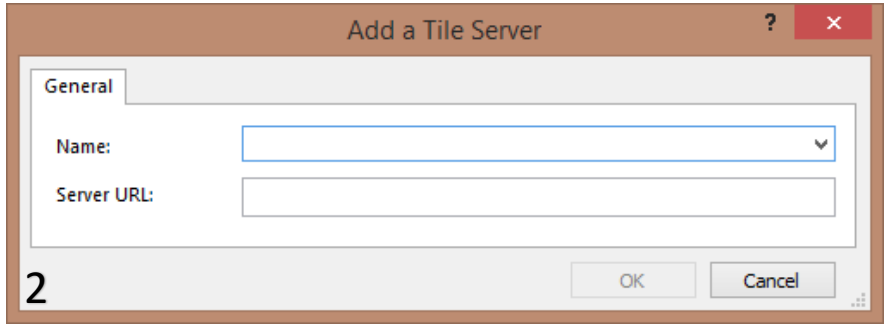


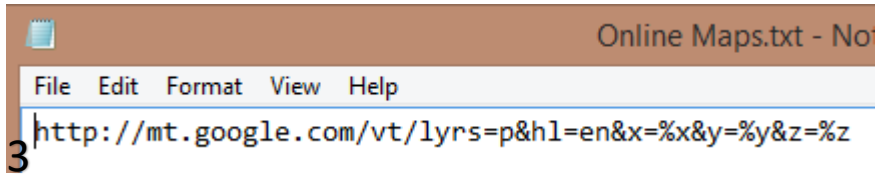


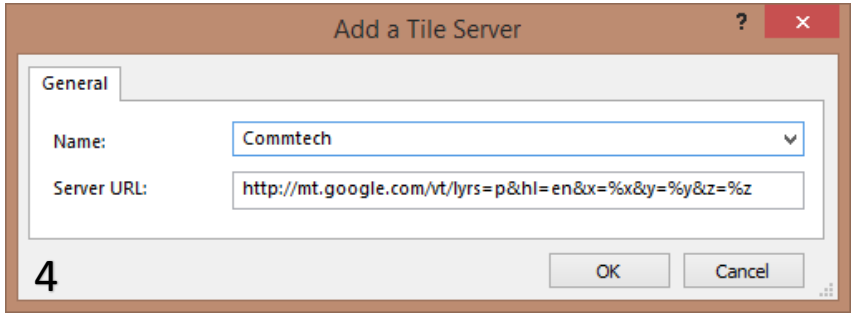
1. On Display → select "…"
2. Choose WGS 48 → OK
3. Projection Map already set

Online Maps [1]



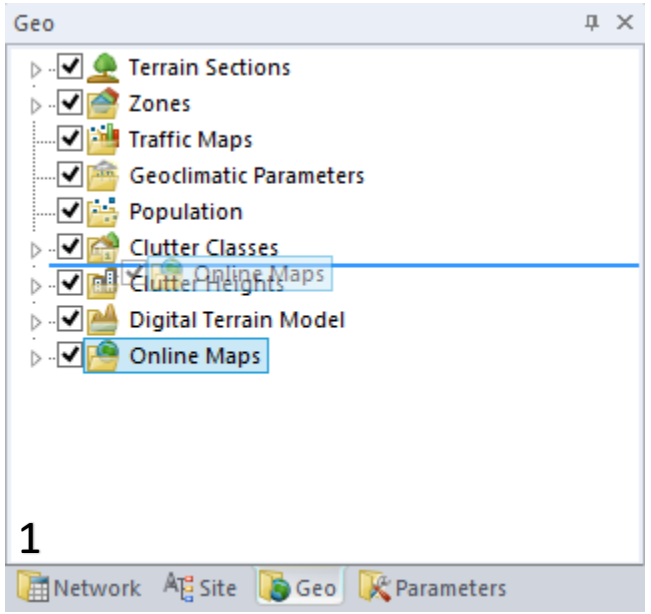


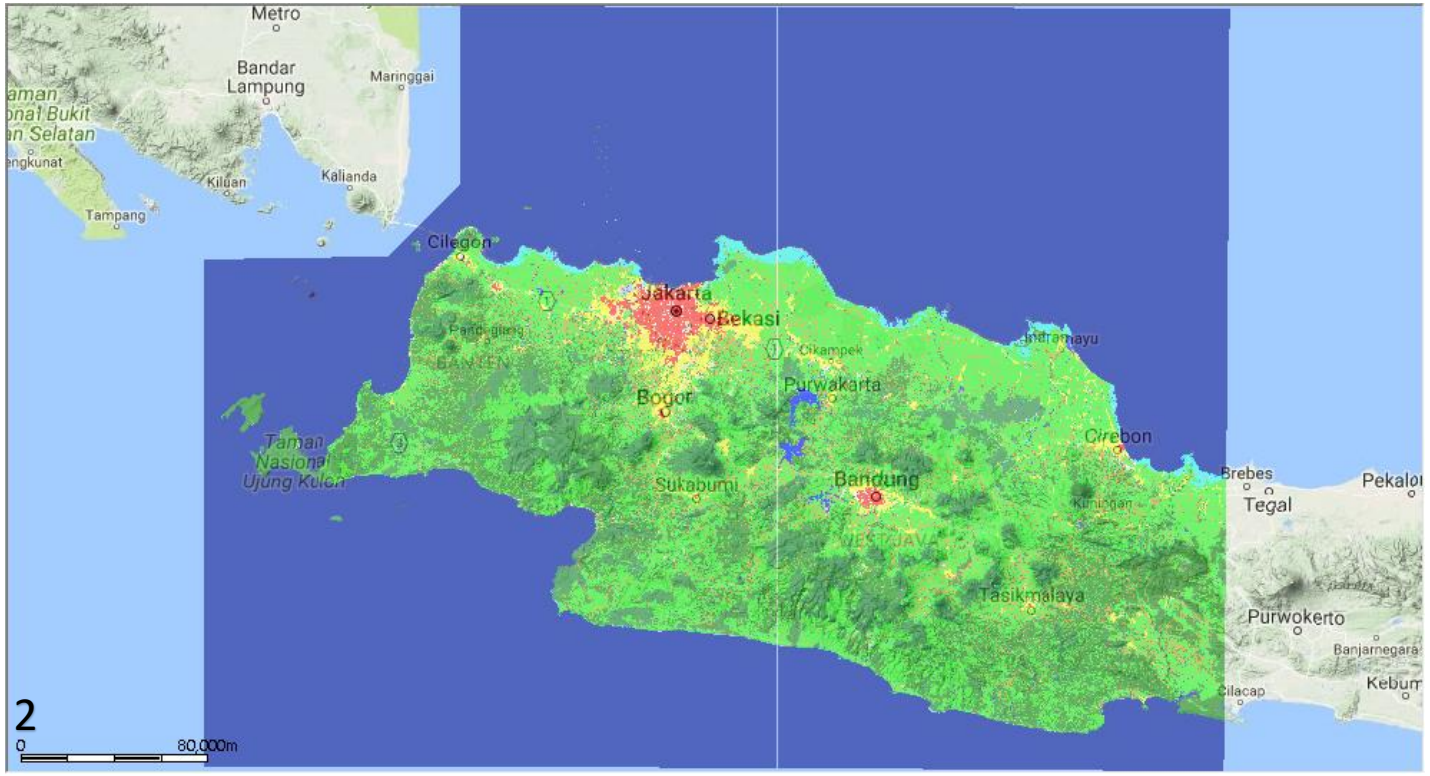




1. Open Geo Tab → right click Online Maps → New
2. Online Maps still blank
3. Minimize Atoll → open your training data → Open Online Maps.txt → Copy the URL
4. Online Maps already filled

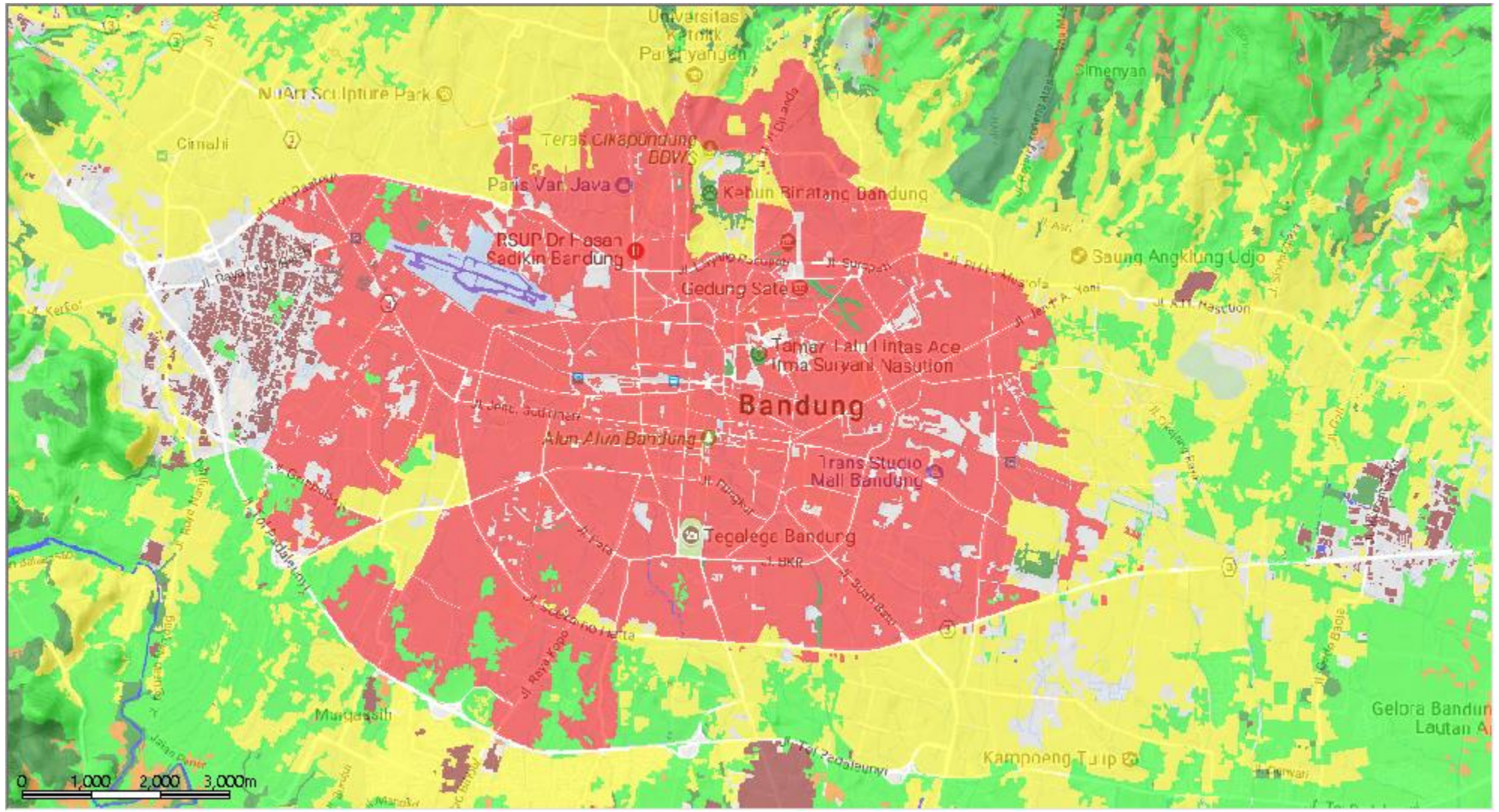
Online Maps [2]



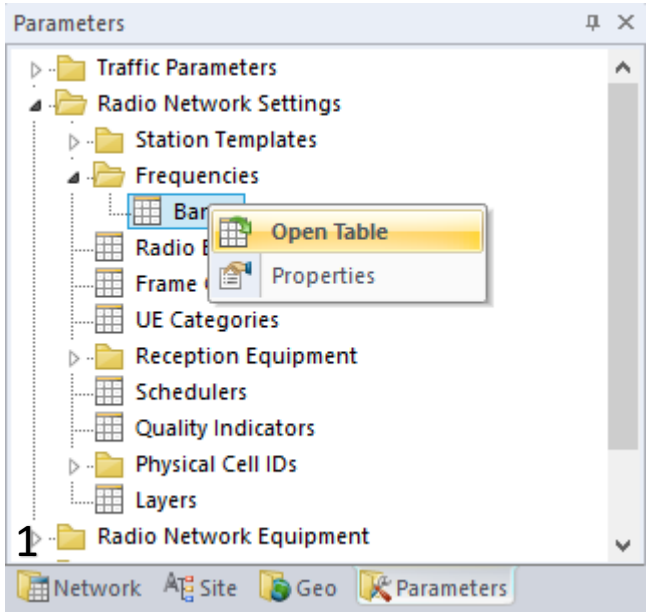


1. Open Geo Tab → click and drag Online Maps above Clutter Heights
2. Result In Map
3. You can zoom the map by using Zoom tool ()

Map Result


Universitas
Parahyangan
Dimenyan
Teras Cikapundung
BBWS
Paris Van Java
Kebun Binatang Bandung
RSUP Dr Hasan
Sadikin Bandung
Gedung Sate
Saung Angklung Udjo
Taman Lalu Lintas Ace
Ima Suryani Nasution
Bandung
Alun Alun Bandung
Trans Studio
Mall Bandung
Tegalega Bandung
Gelora Bandun
Lautan A
Kampoeng Tulip
0 1,000 2,000 3,000m

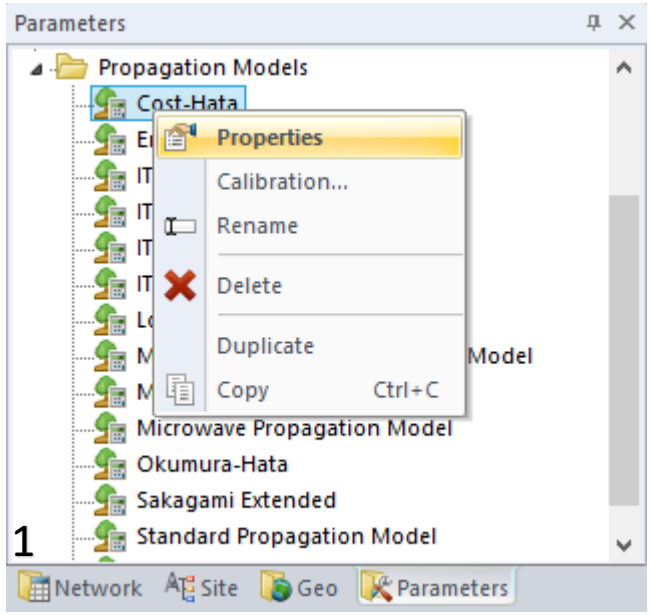
Selecting Frequency Band

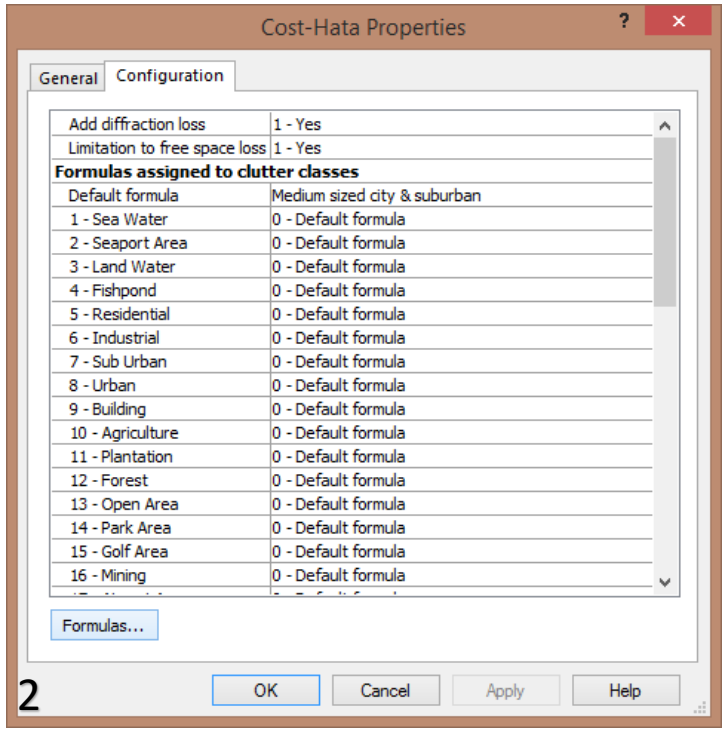


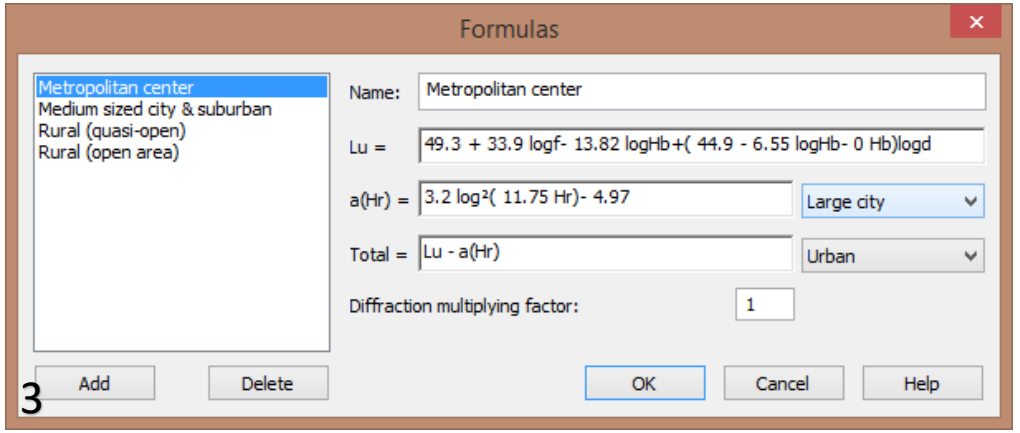
	Name	Duplexing Method	TDD: Start Frequency, FDD: DL Start Frequency (MHz)	FDD: UL Start Frequency (MHz)	Channel Width (MHz)	Inter-channel spacing (MHz)	Number of Frequency Blocks	Sampling Frequency (MHz)	First channel	Last channel
	E-UTRA Band 13 - 10MHz	FDD	746	777	10	0	50	15.36	5,230	5,230
	E-UTRA Band 13 - 5MHz	FDD	746	777	5	0	25	7.68	5,205	5,255
	E-UTRA Band 17 - 10MHz	FDD	734	704	10	0	50	15.36	5,780	5,780
	E-UTRA Band 17 - 5MHz	FDD	734	704	5	0	25	7.68	5,755	5,805
	E-UTRA Band 2 - 10MHz	FDD	1,930	1,850	10	0	50	15.36	650	1,150
	E-UTRA Band 2 - 15MHz	FDD	1,930	1,850	15	0	75	23.04	675	1,125
	E-UTRA Band 2 - 20MHz	FDD	1,930	1,850	20	0	100	30.72	700	1,100
	E-UTRA Band 2 - 5MHz	FDD	1,930	1,850	5	0	25	7.68	625	1,175
	E-UTRA Band 20 - 10MHz	FDD	791	832	10	0	50	15.36	6,200	6,400
	E-UTRA Band 20 - 15MHz	FDD	791	832	15	0	75	23.04	6,225	6,375
	E-UTRA Band 20 - 20MHz	FDD	791	832	20	0	100	30.72	6,250	6,250
	E-UTRA Band 20 - 5MHz	FDD	791	832	5	0	25	7.68	6,175	6,425
	E-UTRA Band 3 - 10MHz	FDD	1,805	1,710	10	0	50	15.36	1,250	1,850
	E-UTRA Band 3 - 15MHz	FDD	1,805	1,710	15	0	75	23.04	1,275	1,875
▶	E-UTRA Band 3 - 20MHz	FDD	1,805	1,710	20	0	100	30.72	1,300	1,700
	E-UTRA Band 3 - 5MHz	FDD	1,805	1,710	5	0	25	7.68	1,225	1,925
2	E-UTRA Band 34 - 10MHz	TDD	2,010	2,010	10	0	50	15.36	36,250	36,250
	E-UTRA Band 34 - 15MHz	TDD	2,010	2,010	15	0	75	23.04	36,275	36,275

1. Go to Parameters Tab→ Expand Radio Network Settings→ Expand Frequencies→ Right Click Bands→ Open Table
2. Check your frequency band

Selecting Propagation Models

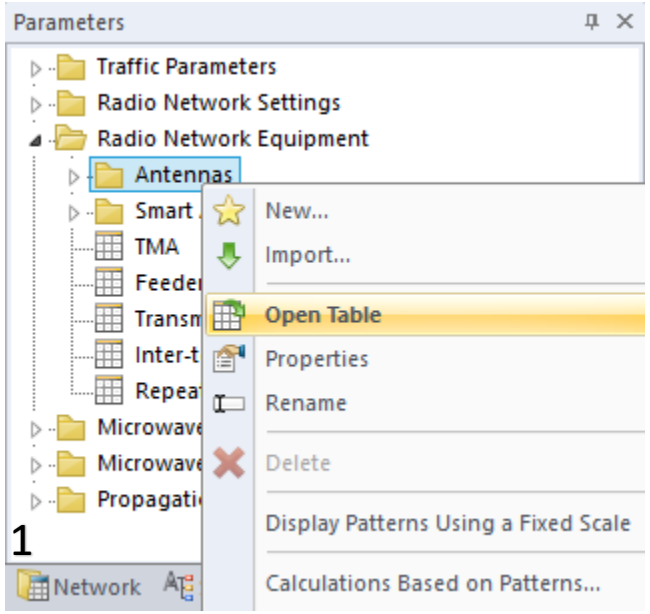


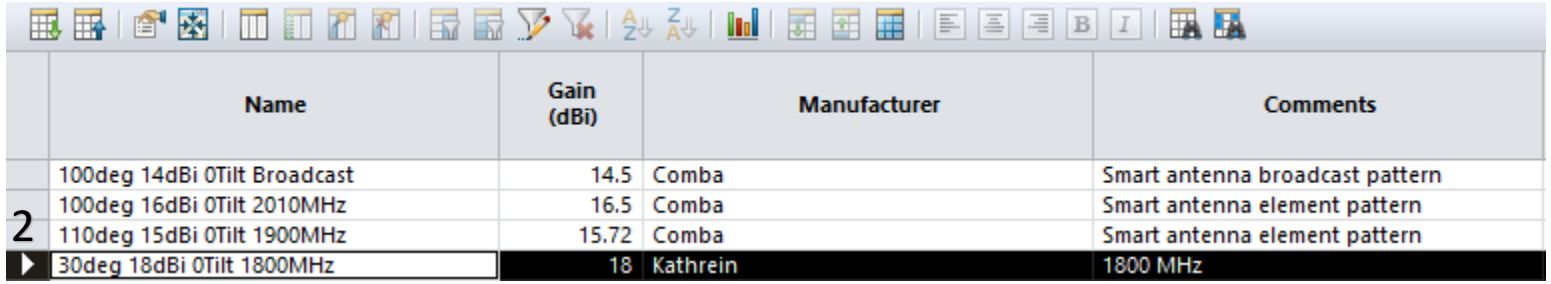




1. In Parameters tab → Expand Propagation Models → Right click your Propagation Models → Properties
2. Select Formulas
3. Set your formulas

Selecting Antenna

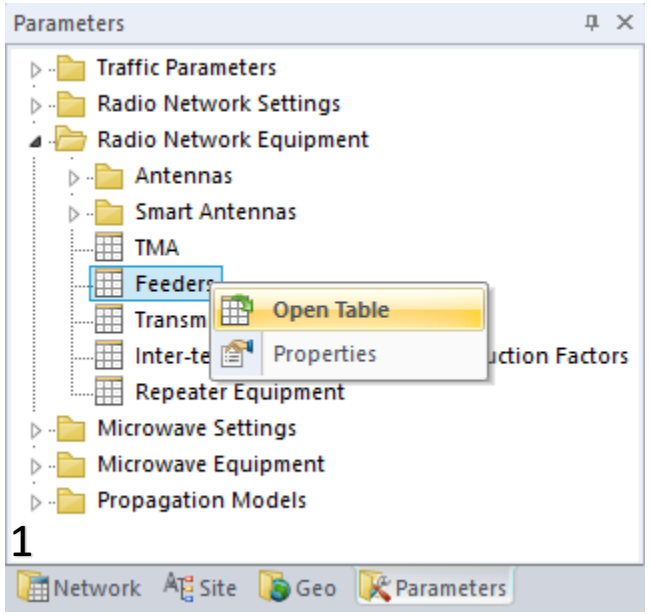




	Name	Gain (dBi)	Manufacturer	Comments
	100deg 14dBi 0Tilt Broadcast	14.5	Comba	Smart antenna broadcast pattern
2	100deg 16dBi 0Tilt 2010MHz	16.5	Comba	Smart antenna element pattern
	110deg 15dBi 0Tilt 1900MHz	15.72	Comba	Smart antenna element pattern
▶	30deg 18dBi 0Tilt 1800MHz	18	Kathrein	1800 MHz

1. Go to Parameters Tab→ Expand Radio Network Equipment → Right Click Antennas→ Open Table
2. Check your Antenna

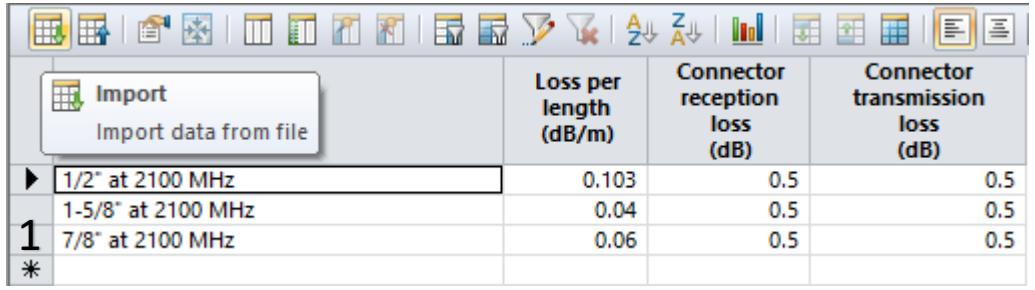
Selecting Feeder



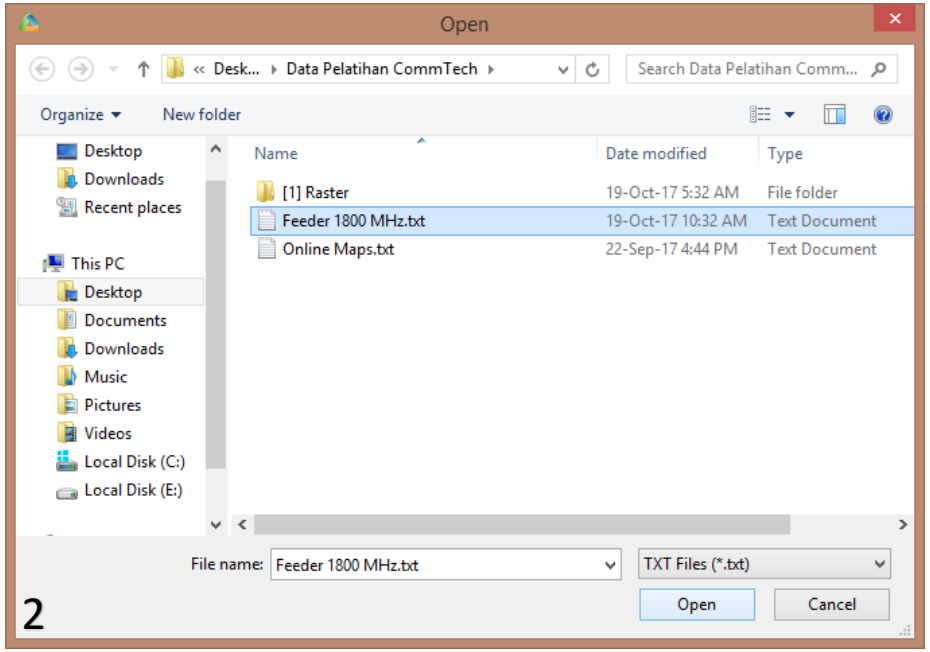
	Name	Loss per length (dB/m)	Connector reception loss (dB)	Connector transmission loss (dB)
▶	1/2" at 2100 MHz	0.103	0.5	0.5
	1-5/8" at 2100 MHz	0.04	0.5	0.5
2	7/8" at 2100 MHz	0.06	0.5	0.5
*				

1. Go to Parameters Tab→ Expand Radio Network Equipment → Right Click Feeders→ Open Table
2. Check your Feeder

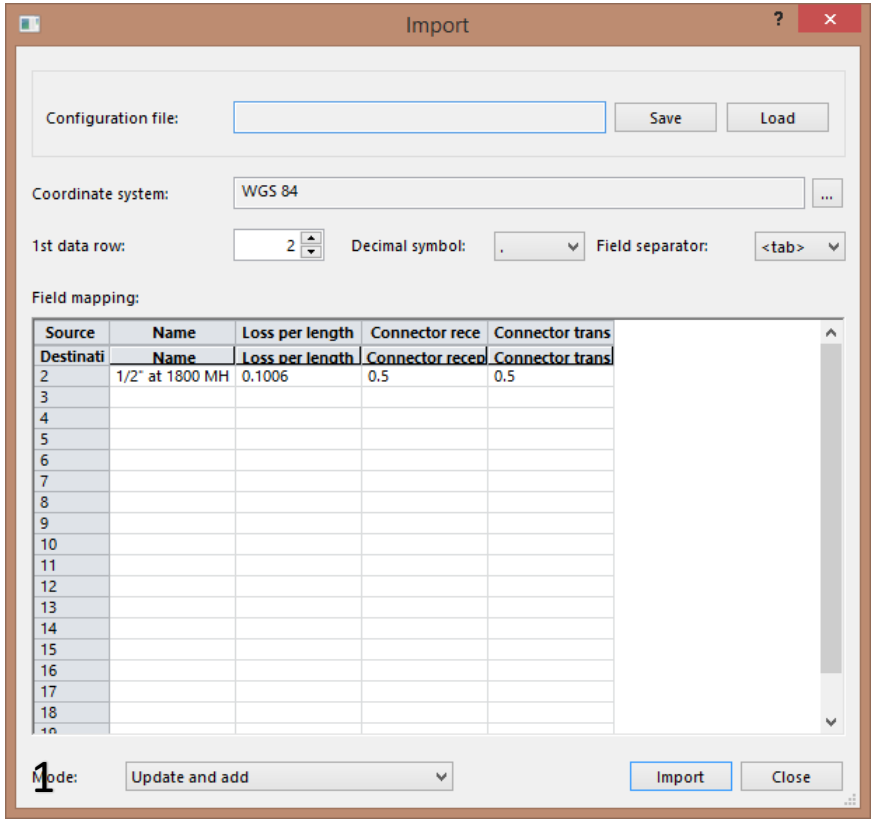
Importing Feeders [1]



1. Select Import
2. Find your data → Open



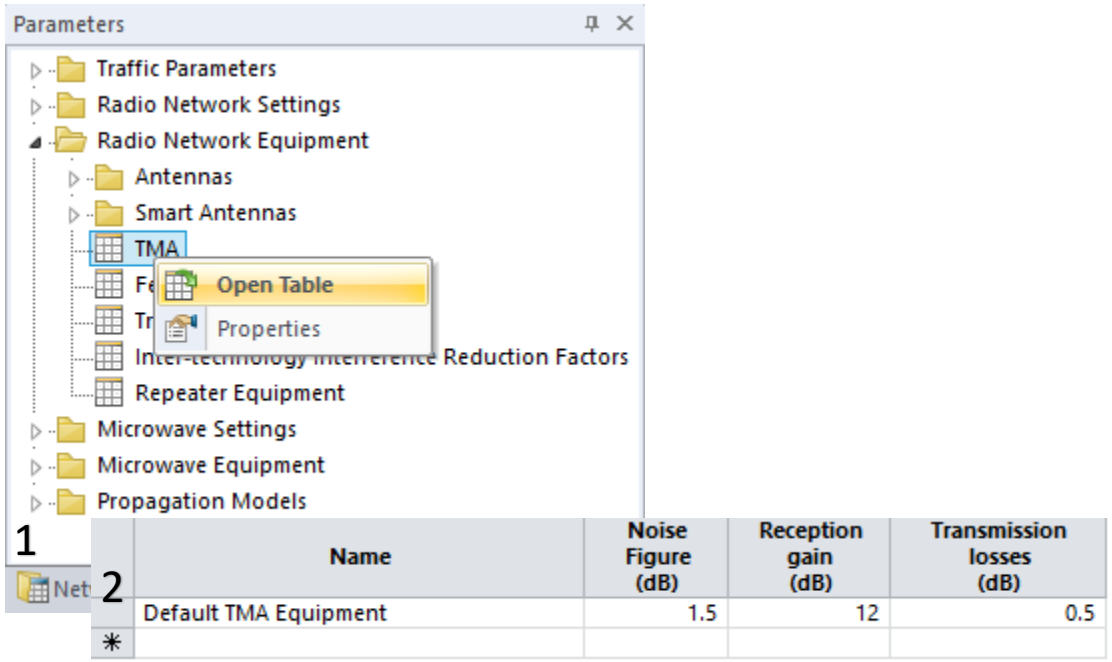
Importing Feeders [2]

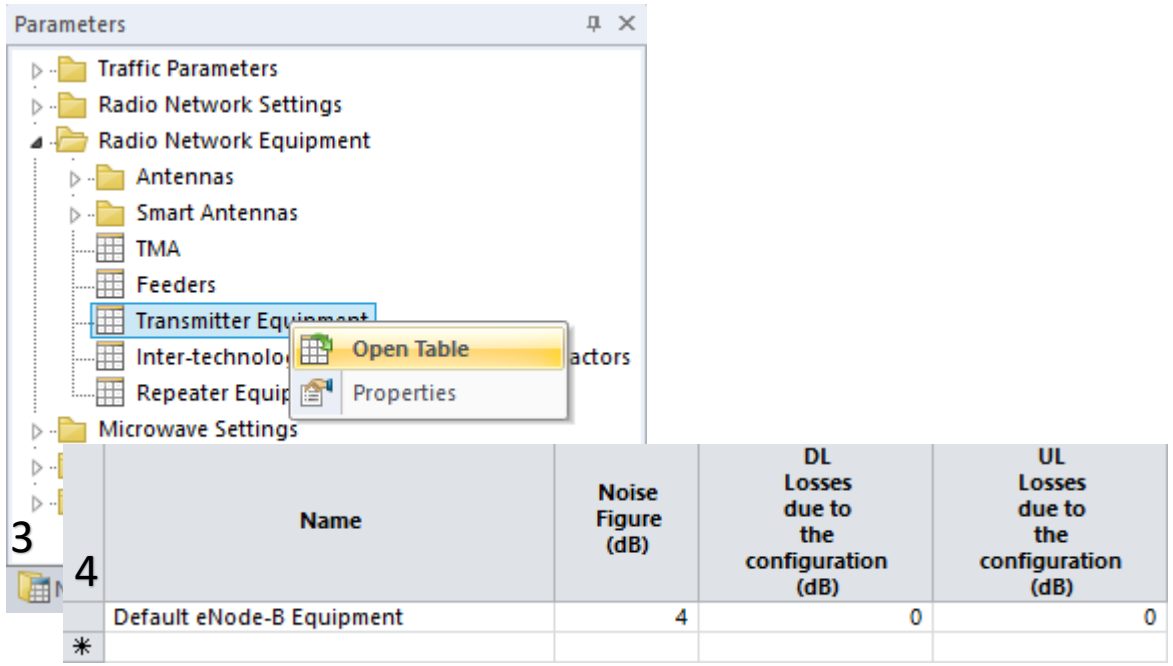


	Name	Loss per length (dB/m)	Connector reception loss (dB)	Connector transmission loss (dB)
▶	1/2" at 1800 MHz	0.1006	0.5	0.5
	1/2" at 2100 MHz	0.103	0.5	0.5
2	1-5/8" at 2100 MHz	0.04	0.5	0.5
	7/8" at 2100 MHz	0.06	0.5	0.5
*				

1. Select Import
2. Your new afeeder already set

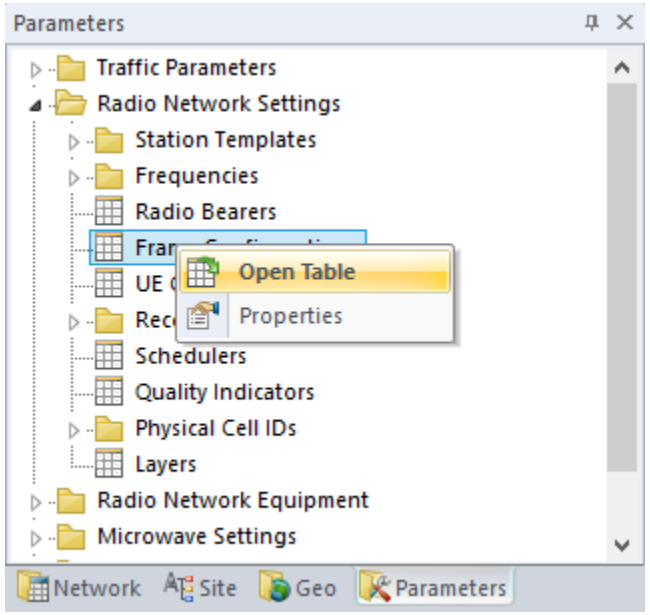
Selecting TMA & Transmitter Epuipment

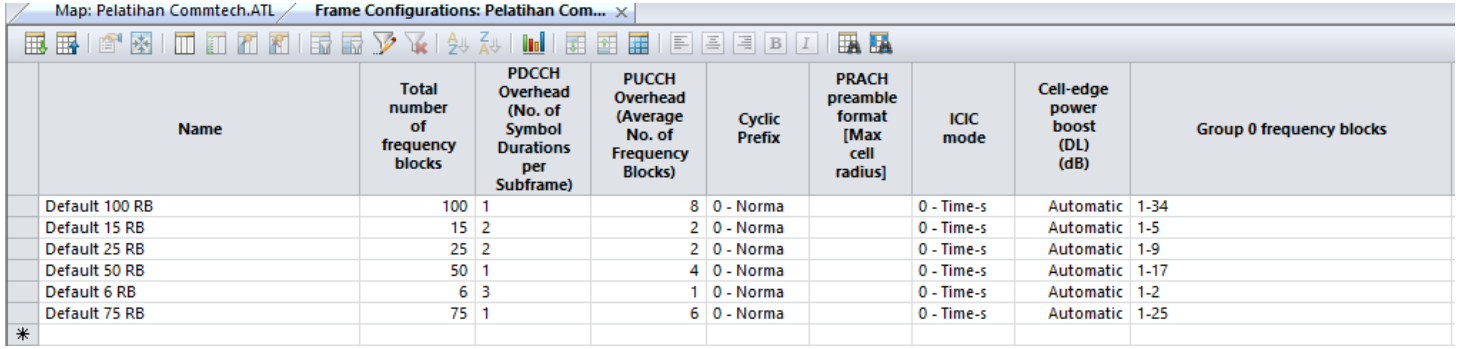




1. In Parameters Tab→ Radio Network Equipment → TMA → Open Table
2. Set the value of TMA equipment
3. Right click Transmitter equipment→ Open Table
4. Set the value of Transmitter equipment

Frame Configuration

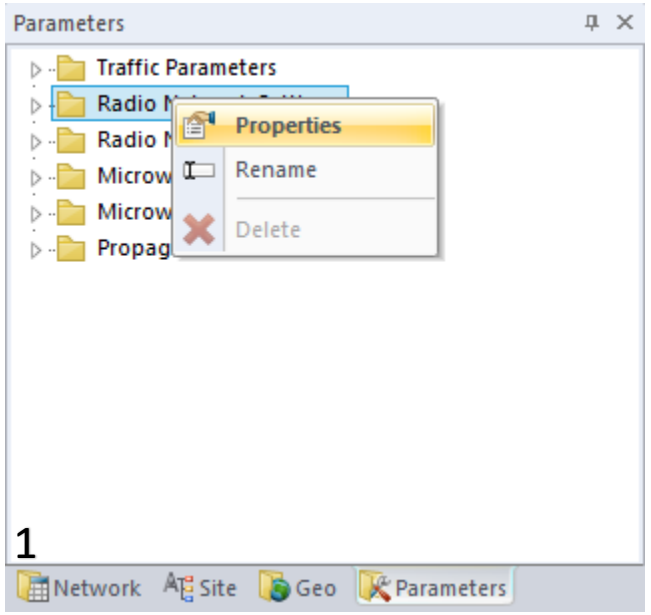


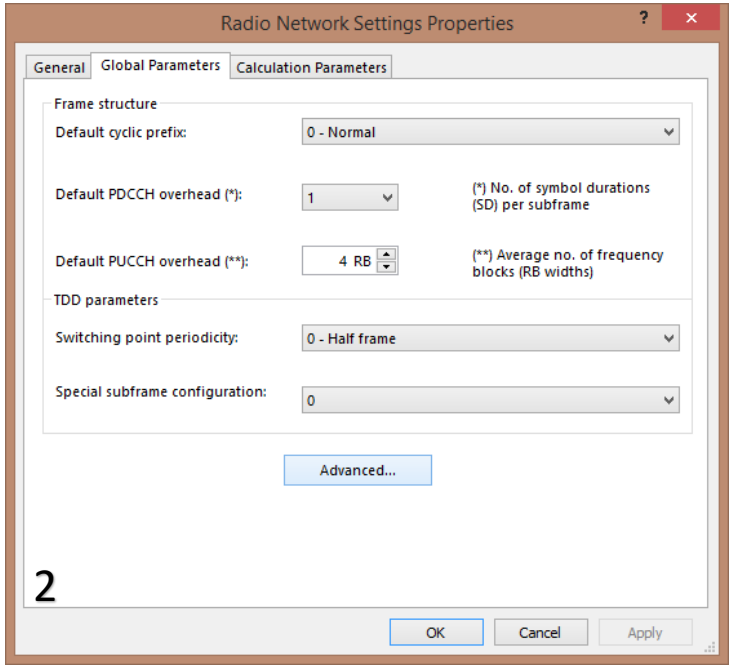


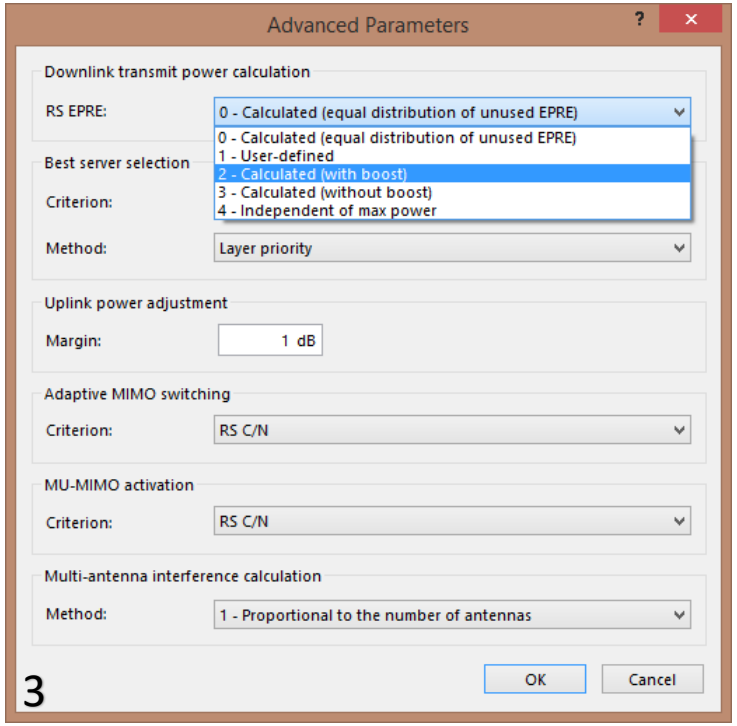
Name	Total number of frequency blocks	PDCCH Overhead (No. of Symbol Durations per Subframe)	PUCCH Overhead (Average No. of Frequency Blocks)	Cyclic Prefix	PRACH preamble format [Max cell radius]	ICIC mode	Cell-edge power boost (DL) (dB)	Group 0 frequency blocks
Default 100 RB	100	1	8	0 - Norma		0 - Time-s	Automatic	1-34
Default 15 RB	15	2	2	0 - Norma		0 - Time-s	Automatic	1-5
Default 25 RB	25	2	2	0 - Norma		0 - Time-s	Automatic	1-9
Default 50 RB	50	1	4	0 - Norma		0 - Time-s	Automatic	1-17
Default 6 RB	6	3	1	0 - Norma		0 - Time-s	Automatic	1-2
Default 75 RB	75	1	6	0 - Norma		0 - Time-s	Automatic	1-25

1. In Parameter tab →Radio Network Settings→ Right click Frame Configuration → Open Table
2. Configure your Frame

RS EPRE Configuration

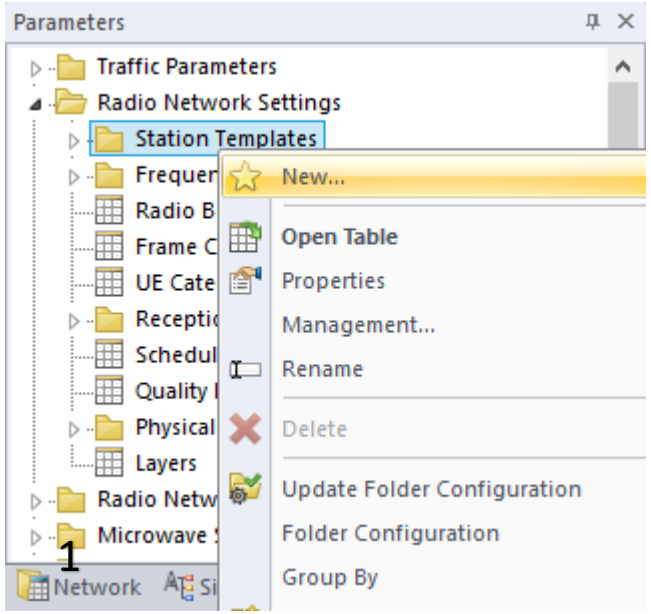




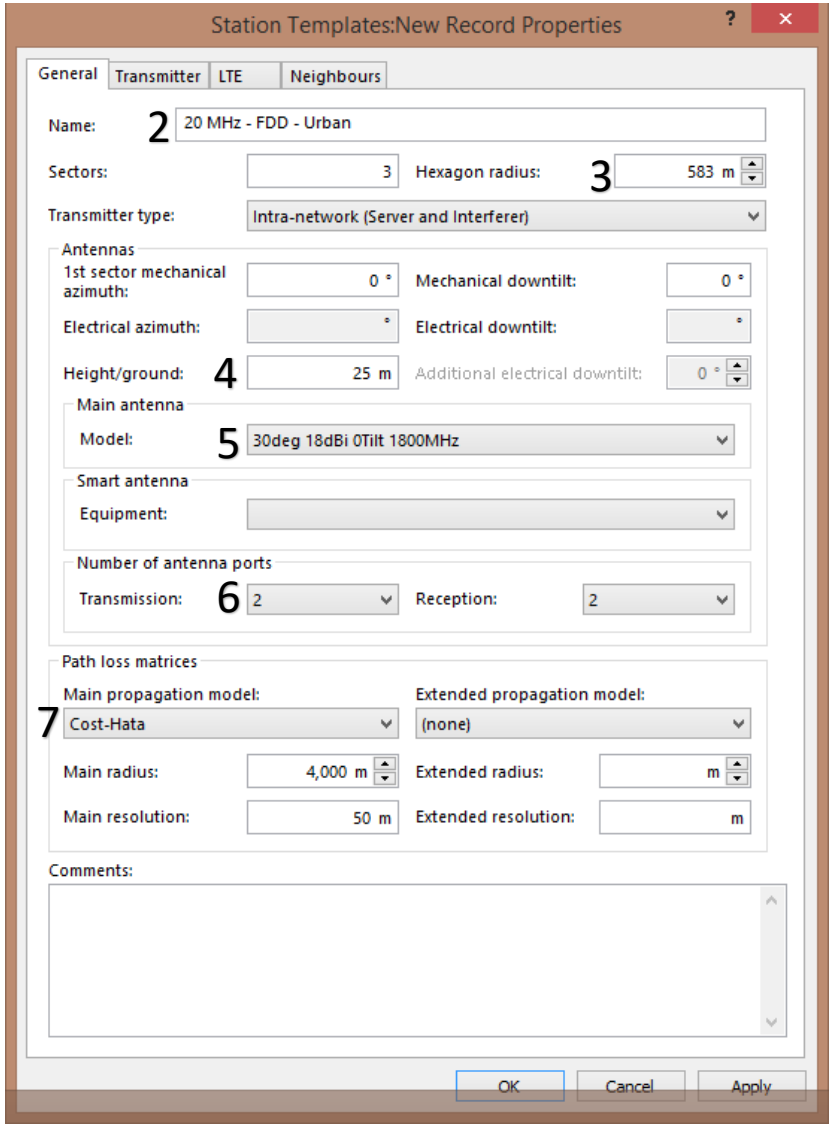


1. Right click Radio Network Setting → Properties
2. Choose Global Parameter Tab → Advanced
3. RS EPRE → Calculated (With Boost) → OK

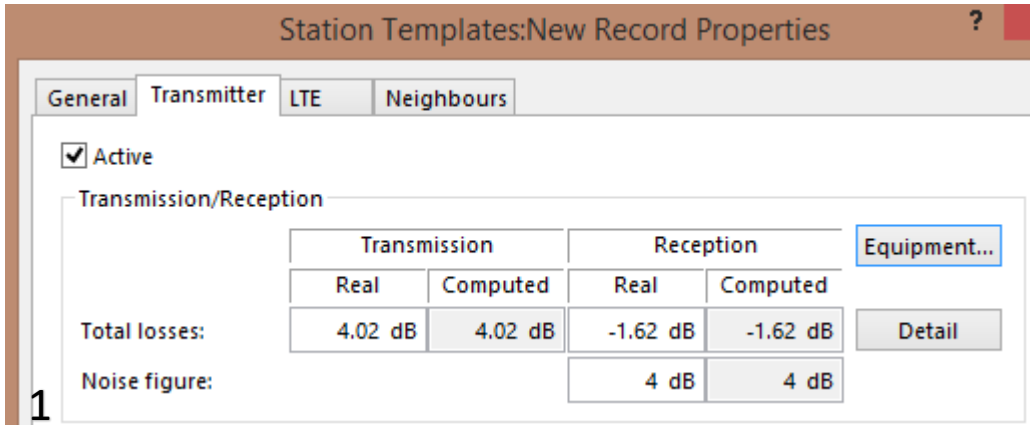
Station Template Configuration [1]

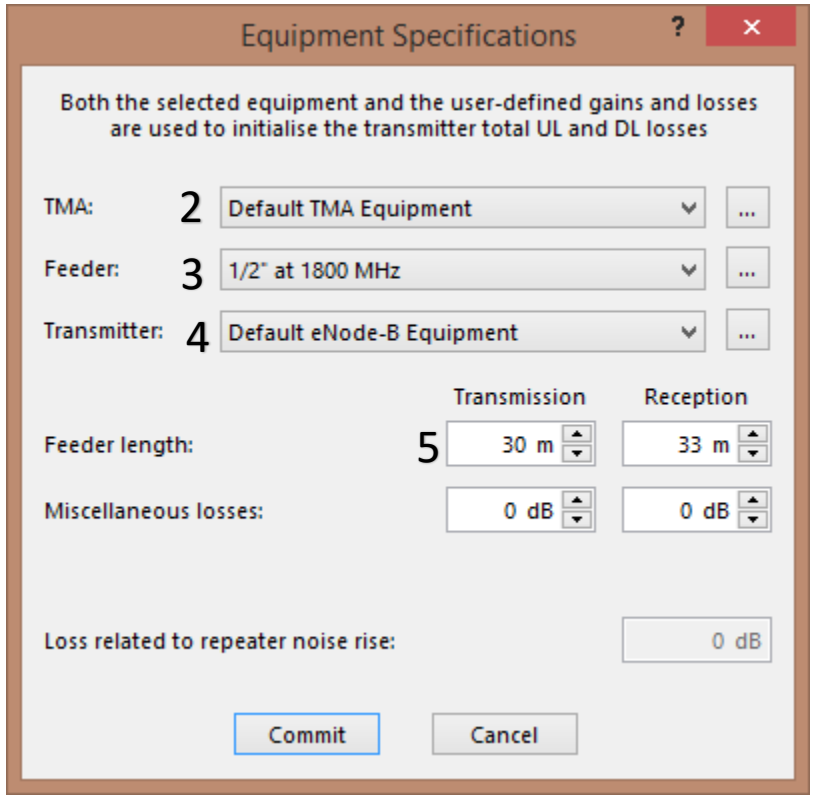


1. Right click Station Template →New
2. Fill the name of Station
3. Fill The Hexagon Radius
4. Fill the height
5. Fill your Main Antenna
6. Fill your antenna ports
7. Choose your propagation models



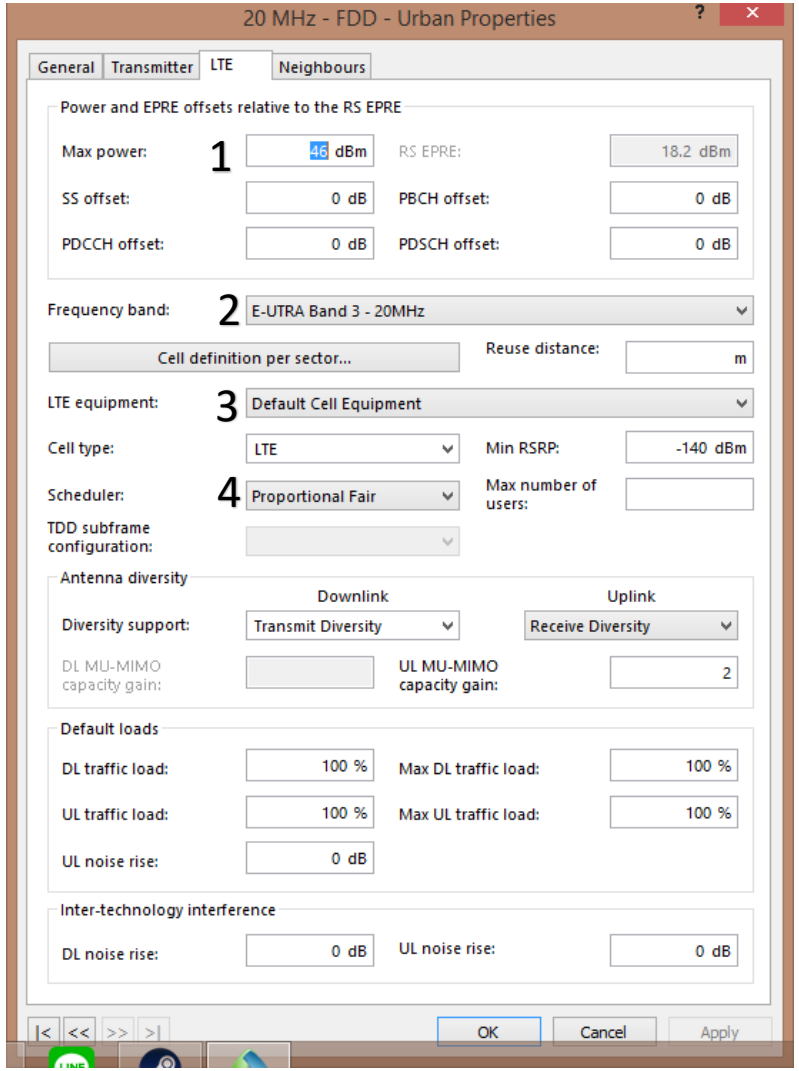
Station Template Configuration [2]

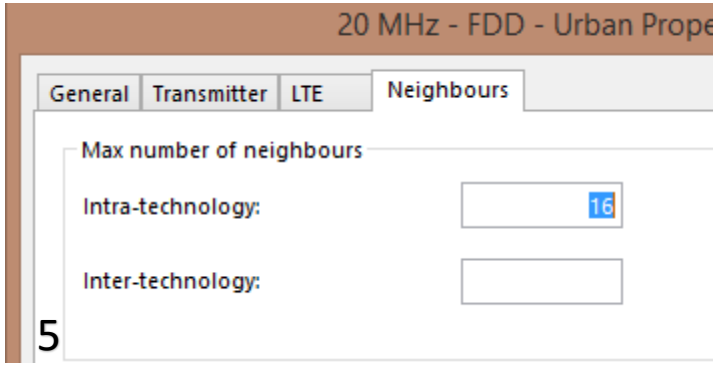


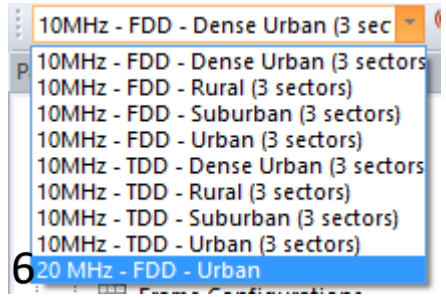


1. Go to Transmitter tab → Equipment
2. Choose TMA equipment
3. Choose Feeder
4. Choose Transmitter
5. Choose Feeder length → Commit

Station Template Configuration [3]

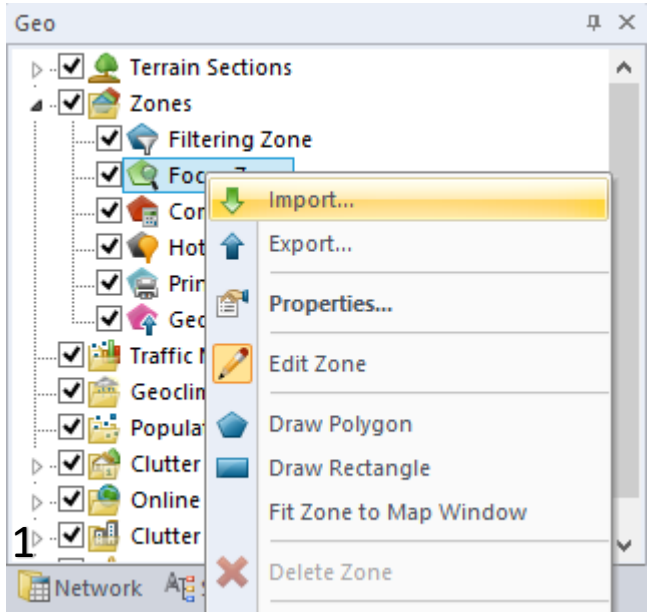




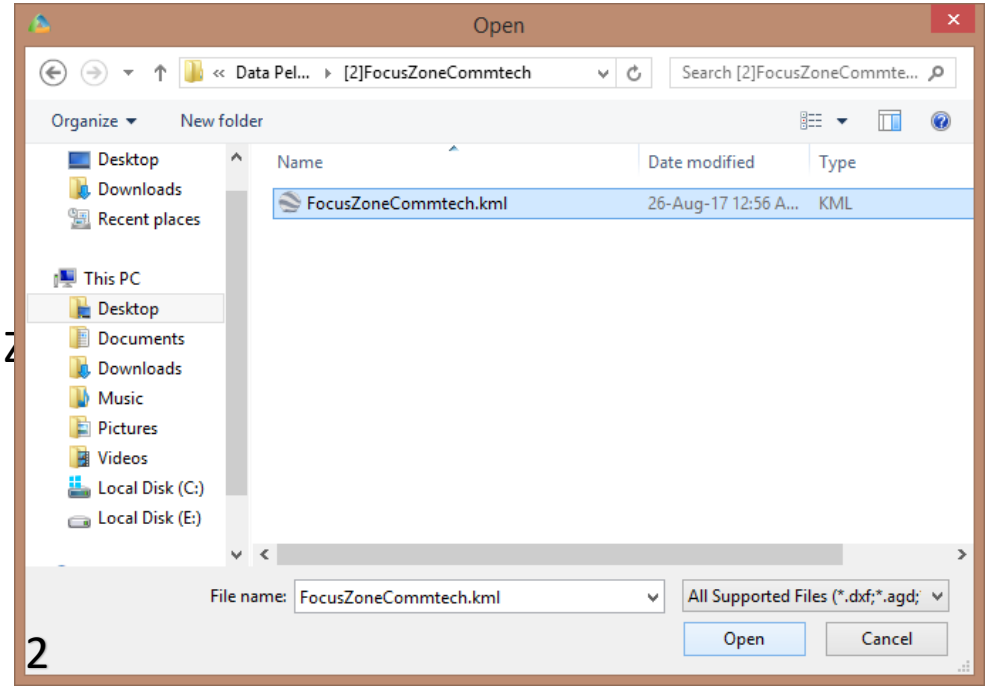


1. Choose your Max Power
2. Go to LTE tab → Choose your frequency band
3. Choose LTE equipment
4. Choose Scheduler
5. Go to Neighbour tab → set your neighbour → OK
6. In Workplace → Change your station to the new one

Focus Zone [1]

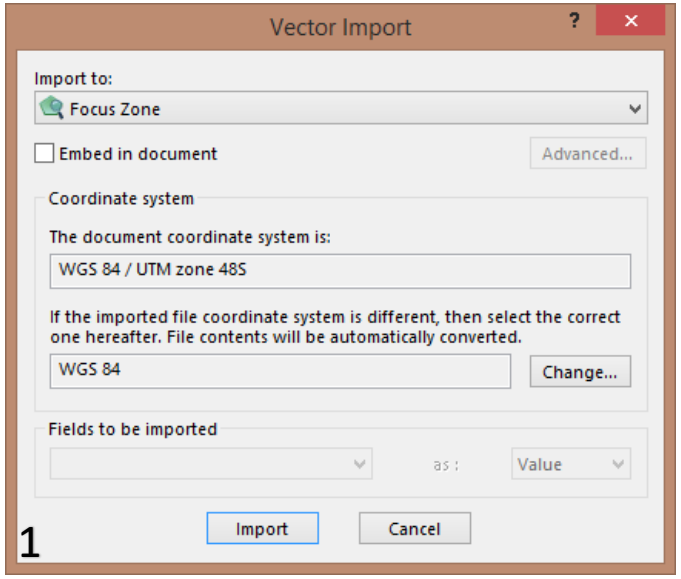


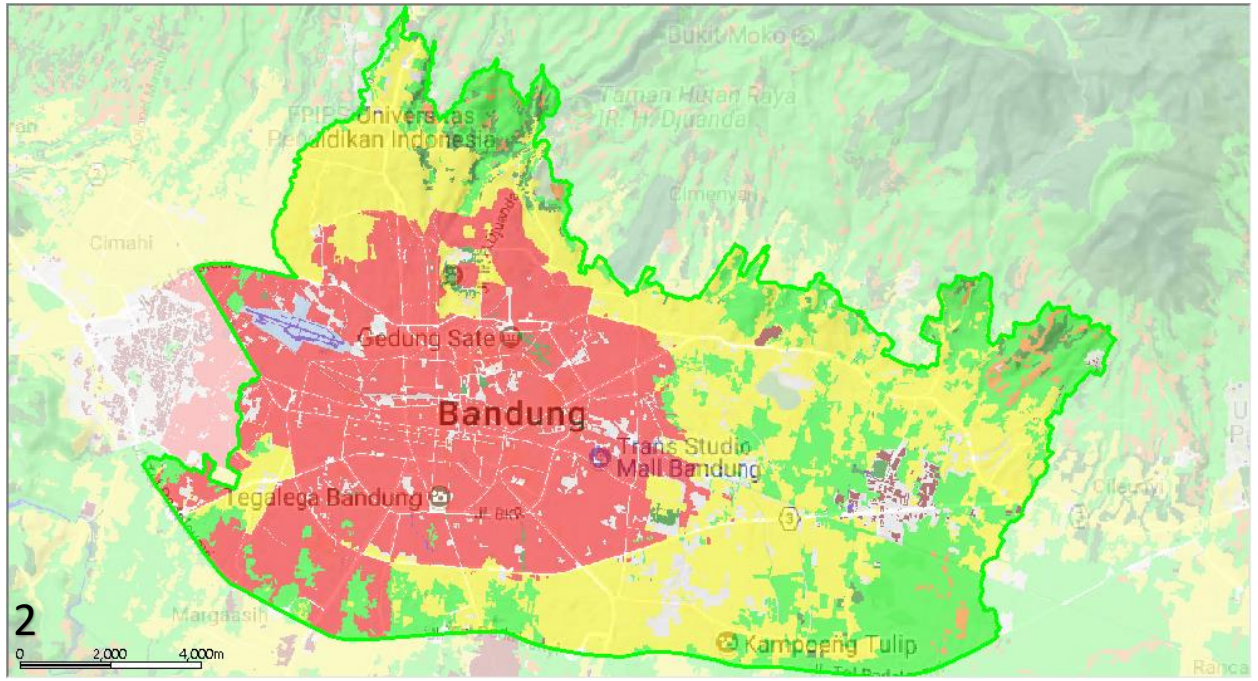
Focus Z



1. Go to Geo tab→ Right click Focus Zone → Import
2. Find your file → Open

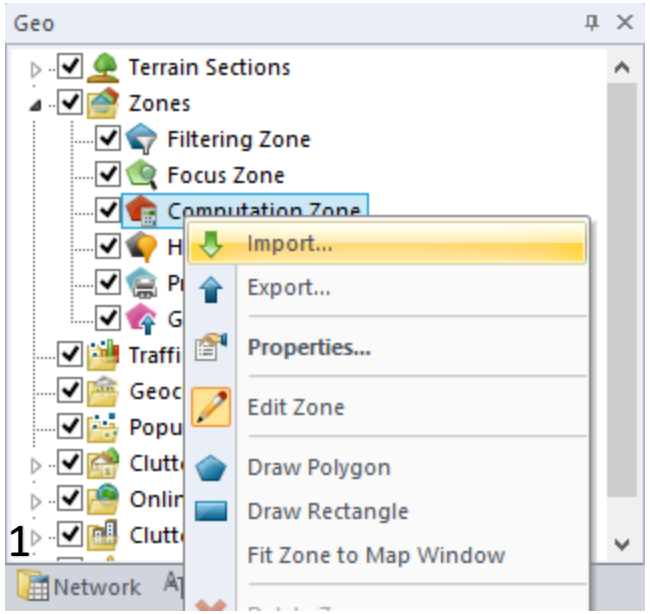
Focus Zone [2]

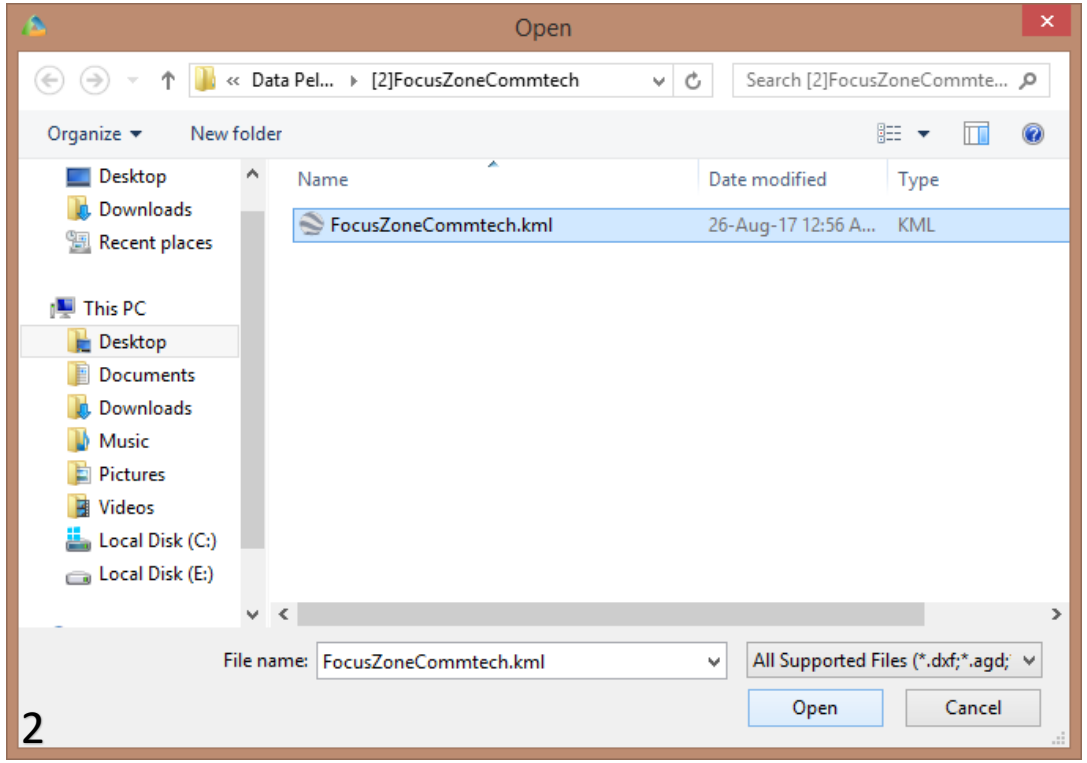




1. Click Import
2. Result of your Focus Zone

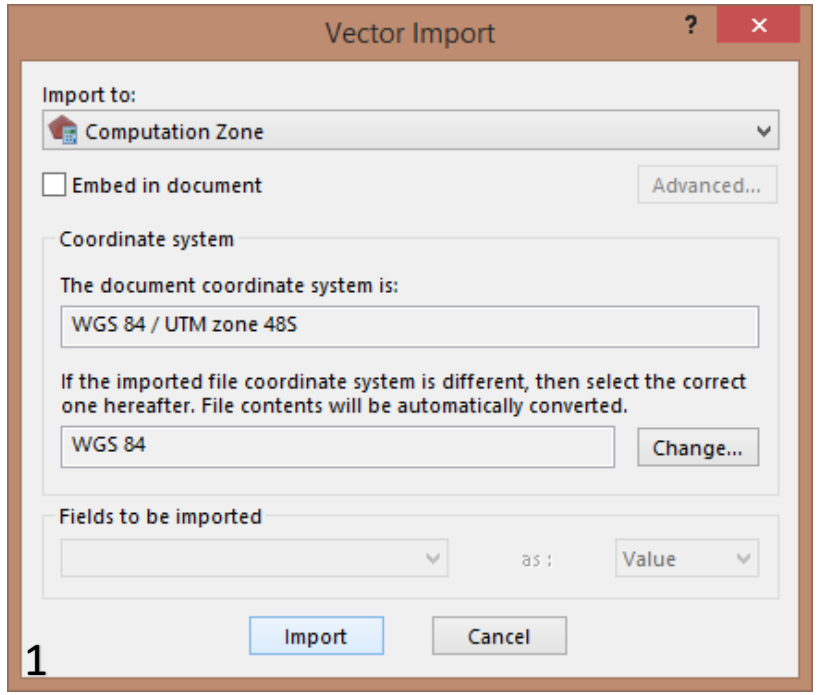
Computational Zone [1]

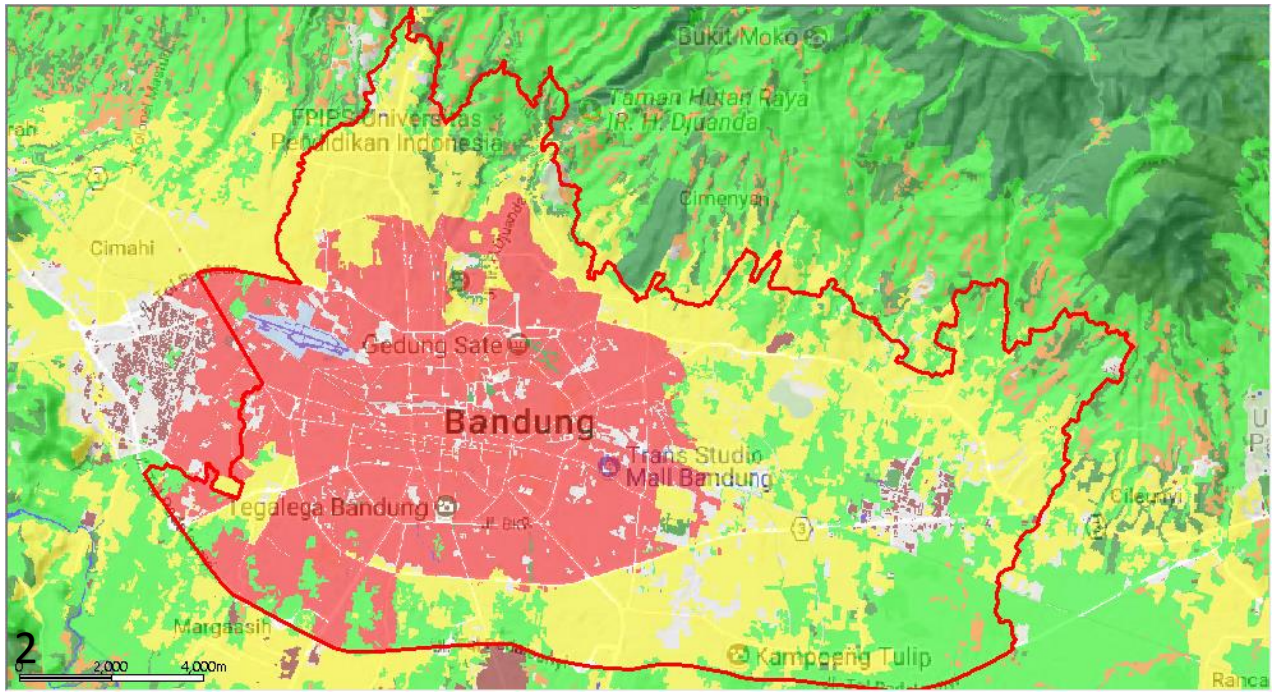




1. Right click Computational Zone → Import
2. Find your file → Open

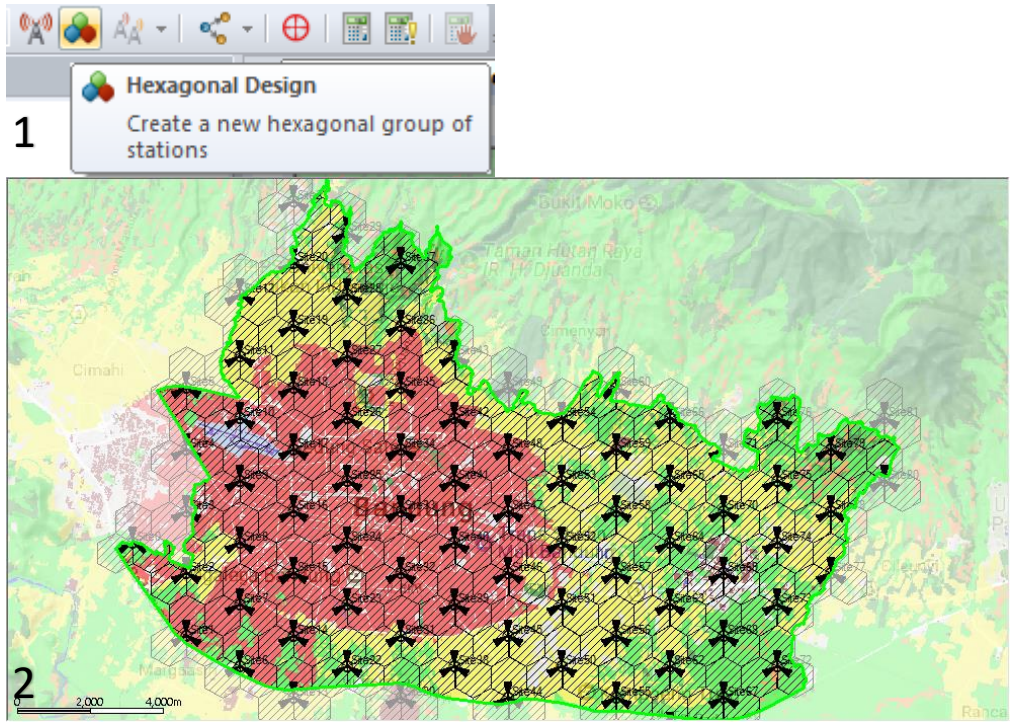
Computational Zone [2]

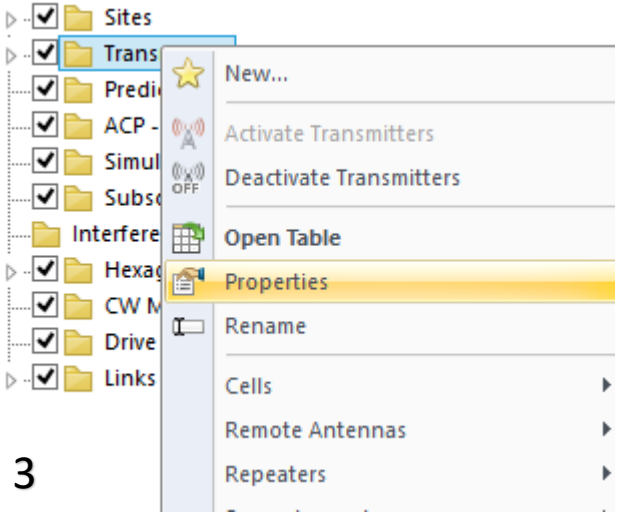




1. Select Import
2. The result of your Computational Zone

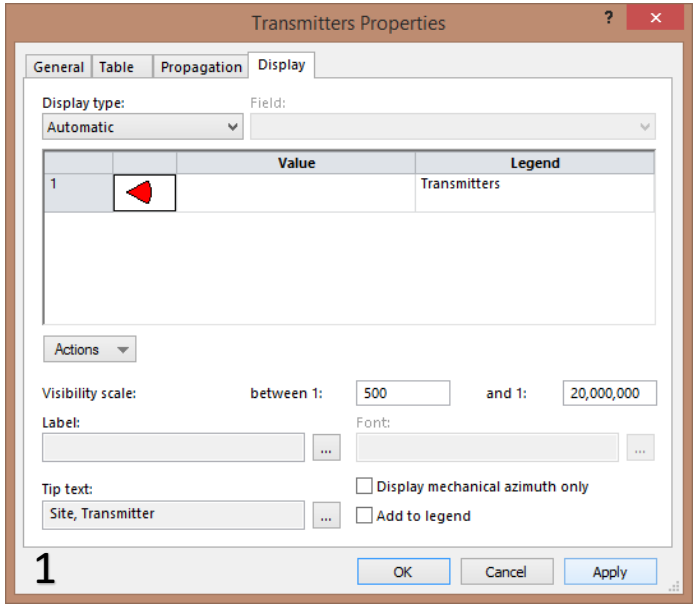
Plotting Site [1]

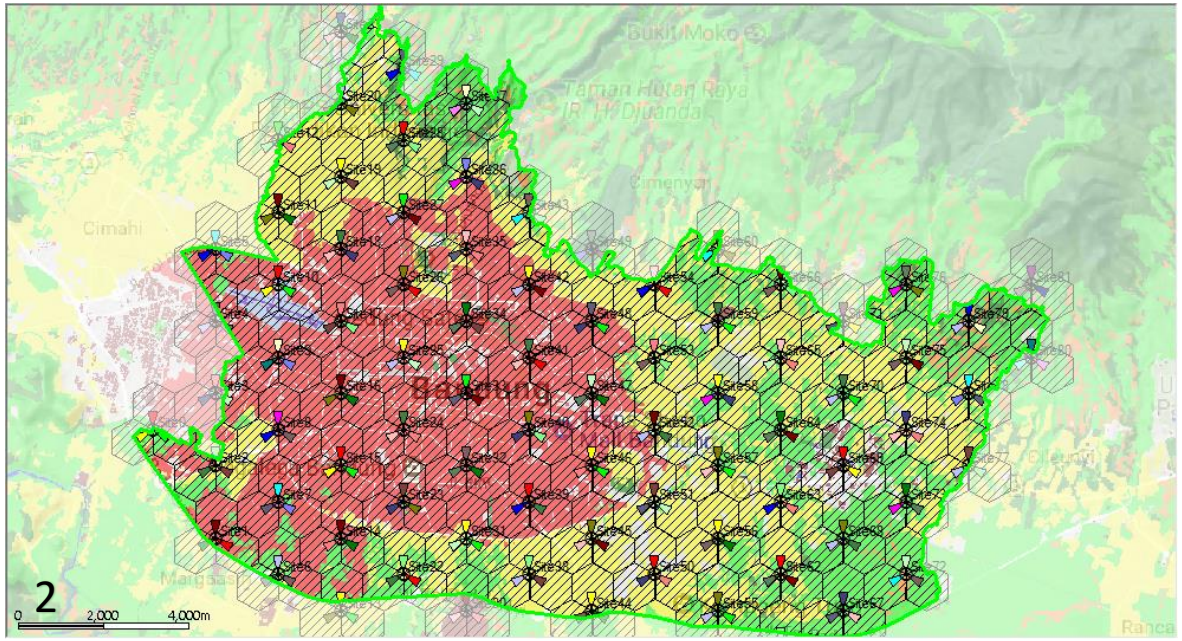




1. Click Hexagonal Design
2. Plot your site on map
3. Right Click Transmitter → Properties

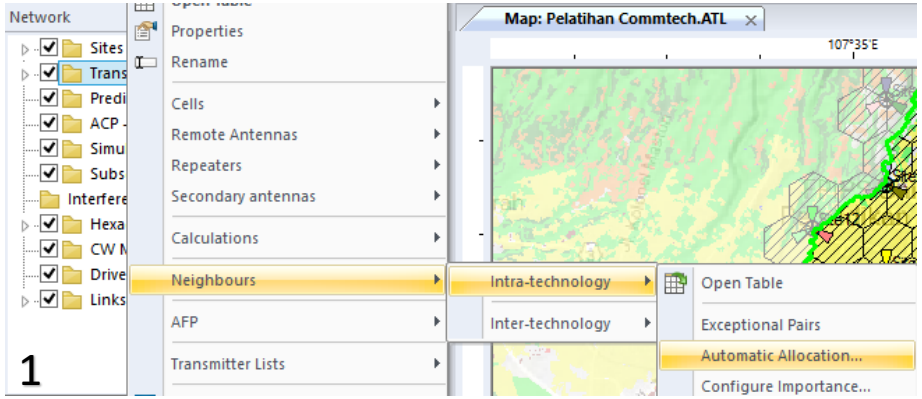
Plotting Site [2]



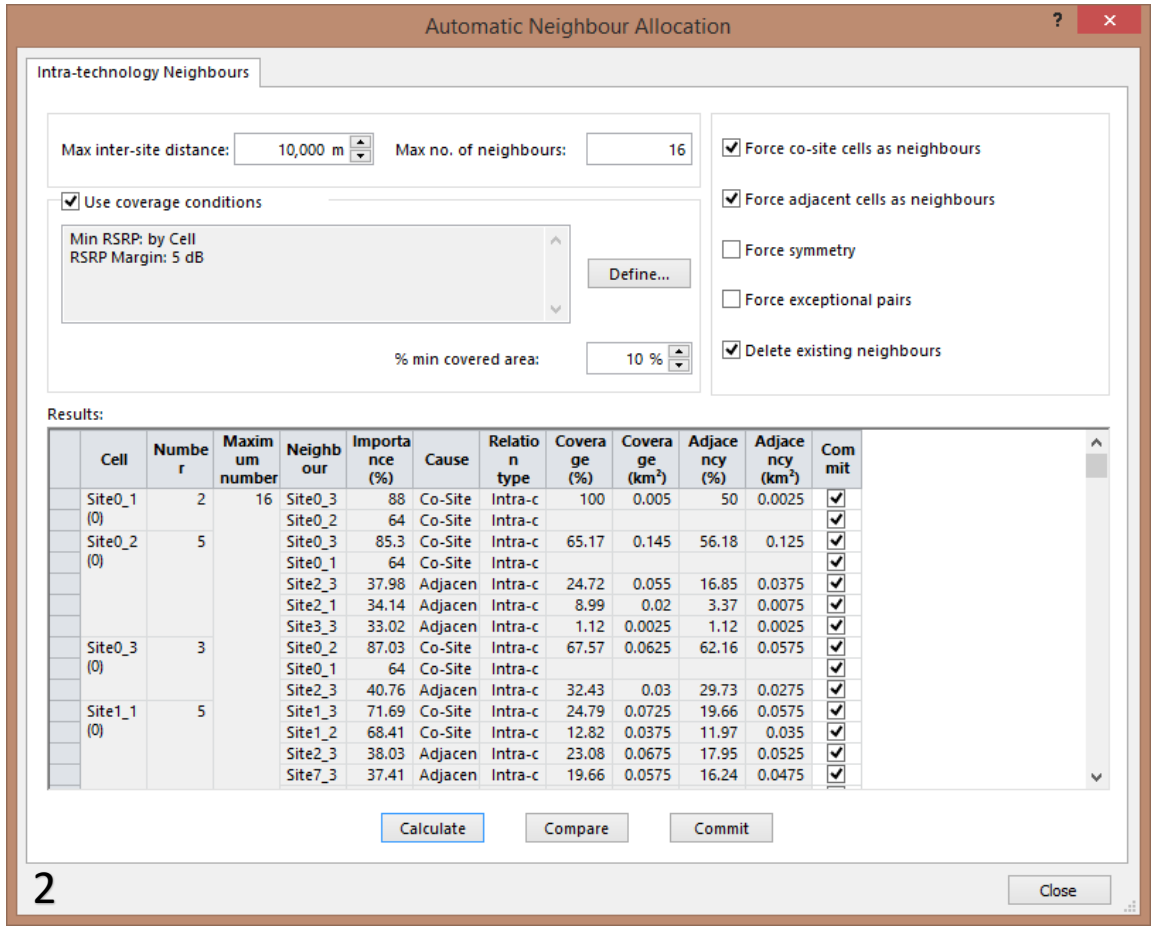


1. Choose your color
2. Your site has been colorised

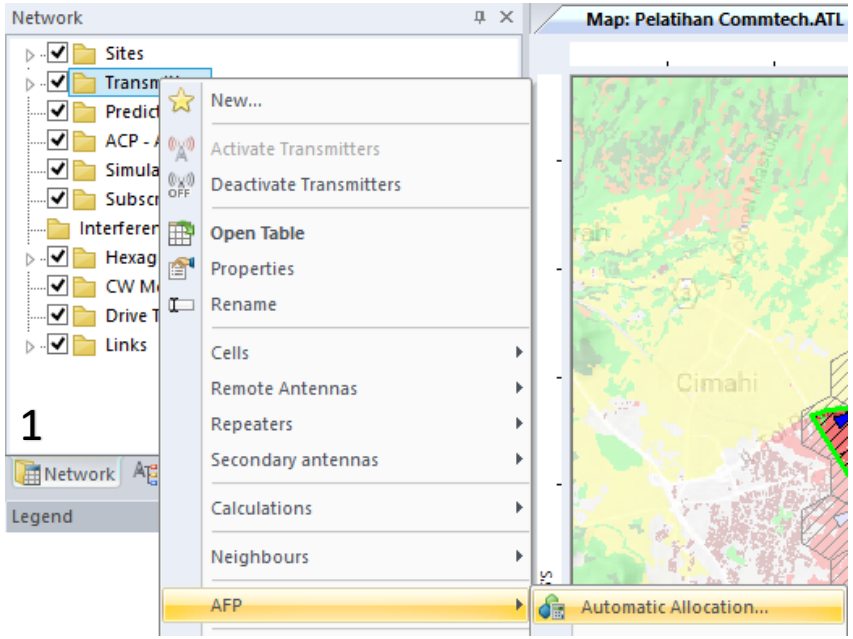
Neighbour Allocation

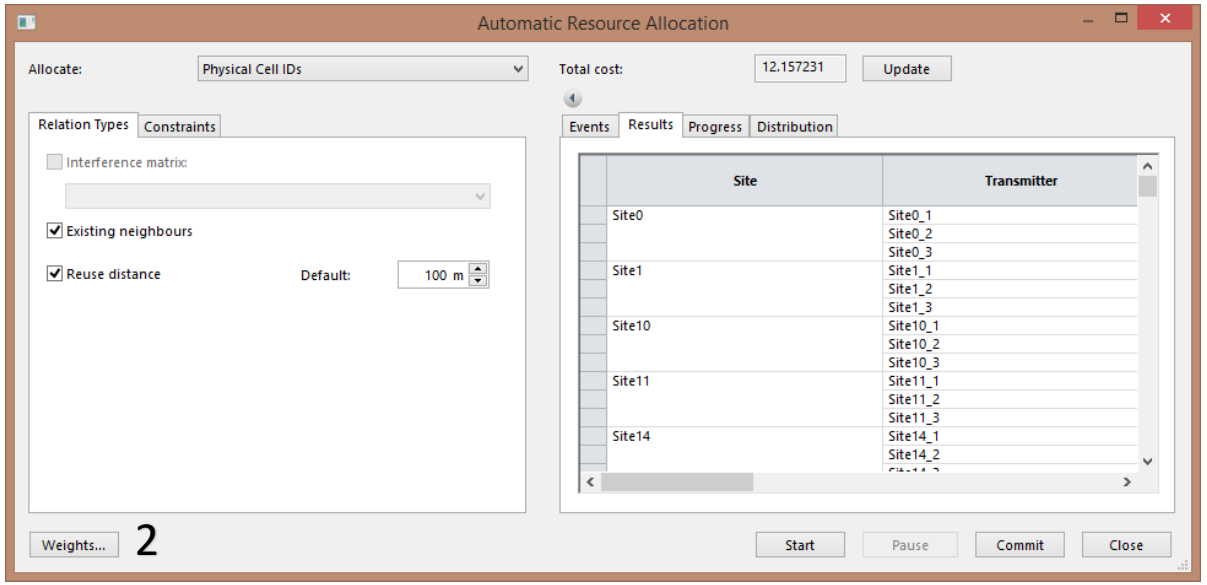


1. Right click Transmitter → Neighbours → Intra-Technology → Automatic Allocation
2. Calculate → Commit



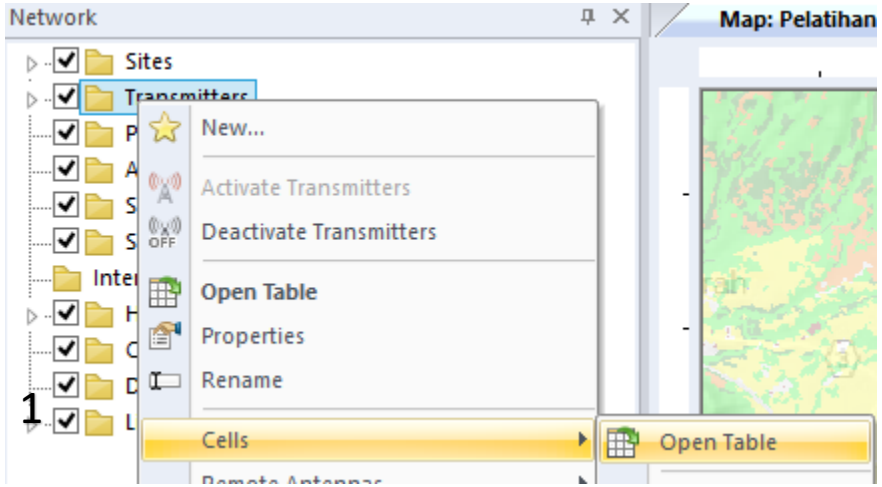
PCI Allocation [1]





1. Right click Transmitter → AFP → Automatic Allocation
2. Choose Physical Cell IDs, Calculate → Commit

PCI Allocation [2]

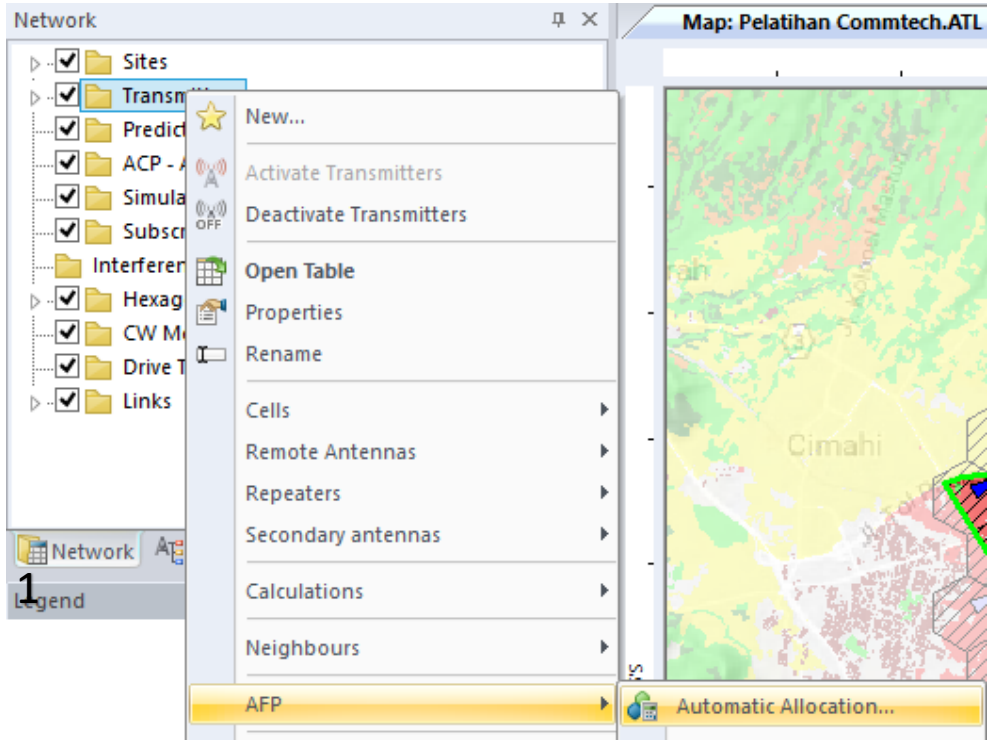


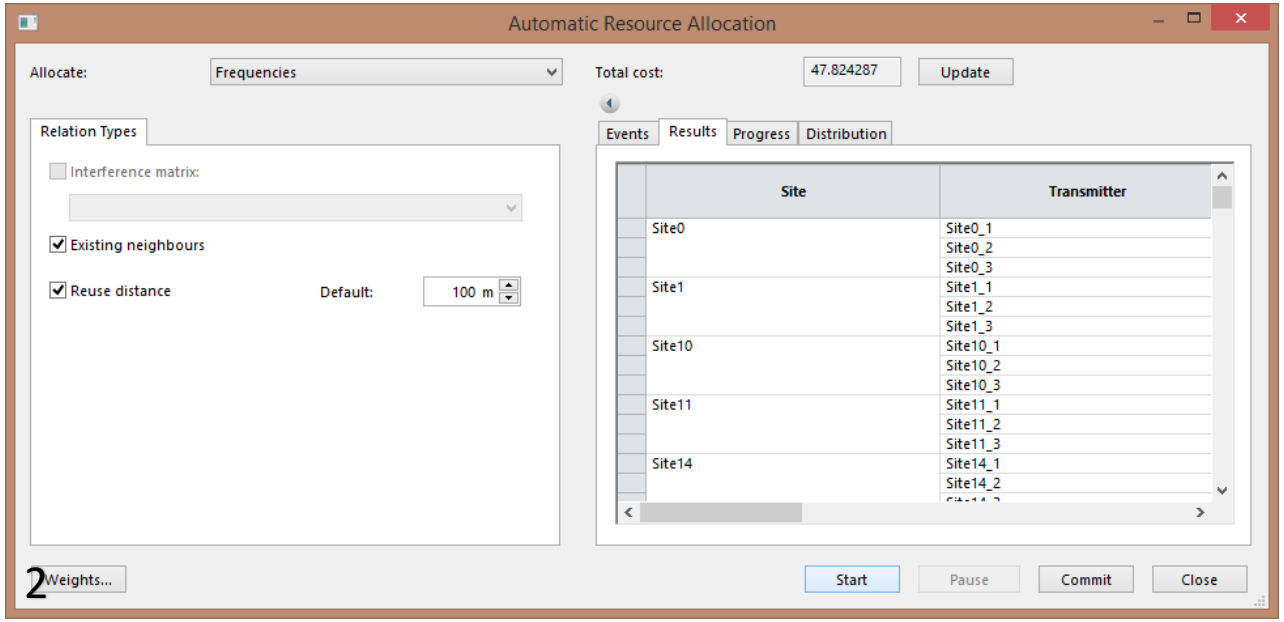
	Channel Number	Channel Allocation Status	Physical Cell ID Domain	Physical Cell ID	PSS ID	SSS ID	PSS ID status	SSS ID status	Reuse distance (m)	Max Power (dBm)
	1,300	Not Allocate		482	2	160	Allocated	Allocated		46
	1,300	Not Allocate		481	1	160	Allocated	Allocated		46
	1,300	Not Allocate		480	0	160	Allocated	Allocated		46
	1,300	Not Allocate		389	2	129	Allocated	Allocated		46
	1,300	Not Allocate		388	1	129	Allocated	Allocated		46
	1,300	Not Allocate		387	0	129	Allocated	Allocated		46
	1,300	Not Allocate		362	2	120	Allocated	Allocated		46
	1,300	Not Allocate		361	1	120	Allocated	Allocated		46
	1,300	Not Allocate		360	0	120	Allocated	Allocated		46
	1,300	Not Allocate		326	2	108	Allocated	Allocated		46
	1,300	Not Allocate		325	1	108	Allocated	Allocated		46
	1,300	Not Allocate		324	0	108	Allocated	Allocated		46
	1,300	Not Allocate		323	2	107	Allocated	Allocated		46
	1,300	Not Allocate		322	1	107	Allocated	Allocated		46
	1,300	Not Allocate		321	0	107	Allocated	Allocated		46
	1,300	Not Allocate		212	2	70	Allocated	Allocated		46
	1,300	Not Allocate		211	1	70	Allocated	Allocated		46
	1,300	Not Allocate		210	0	70	Allocated	Allocated		46
	1,300	Not Allocate		209	2	69	Allocated	Allocated		46
	1,300	Not Allocate		208	1	69	Allocated	Allocated		46
	1,300	Not Allocate		207	0	69	Allocated	Allocated		46
	1,300	Not Allocate		206	2	68	Allocated	Allocated		46
	1,300	Not Allocate		205	1	68	Allocated	Allocated		46
	1,300	Not Allocate		204	0	68	Allocated	Allocated		46
	1,300	Not Allocate		203	2	67	Allocated	Allocated		46
	1,300	Not Allocate		202	1	67	Allocated	Allocated		46
	1,300	Not Allocate		201	0	67	Allocated	Allocated		46
	1,300	Not Allocate		191	2	63	Allocated	Allocated		46
	1,300	Not Allocate		190	1	63	Allocated	Allocated		46
	1,300	Not Allocate		189	0	63	Allocated	Allocated		46
	1,300	Not Allocate		182	2	60	Allocated	Allocated		46

2

1. Right click Transmitter → Cells → Open Table
2. Your PCI already allocated

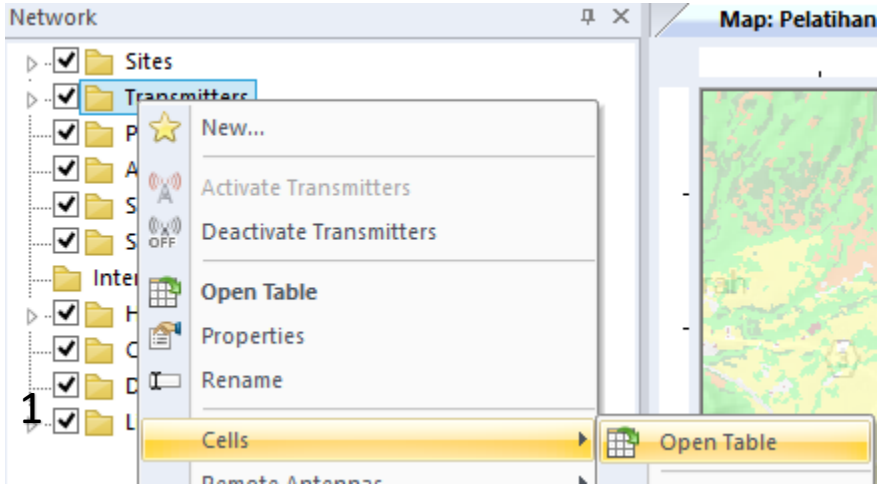
Frequency Allocation [1]





1. Right click Transmitter → AFP → Automatic Allocation
2. Choose Frequencies, Calculate → Commit

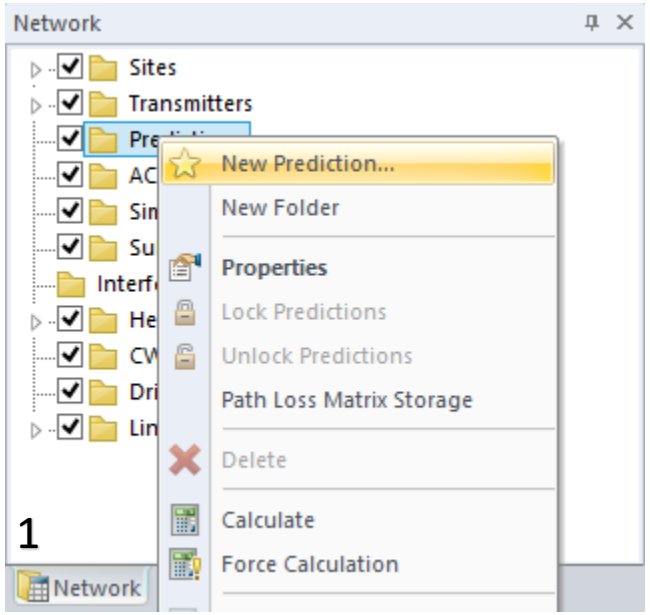
Frequency Allocation [2]

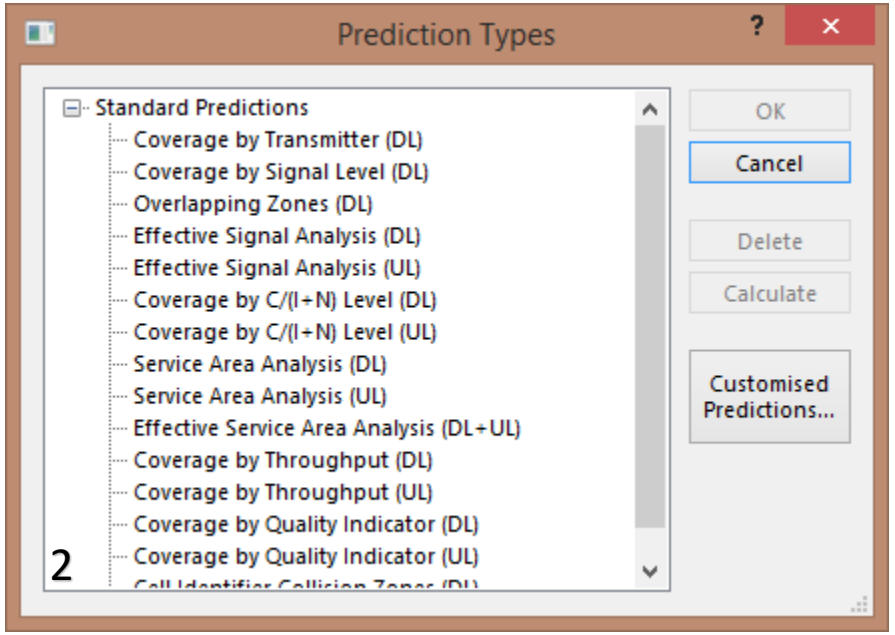


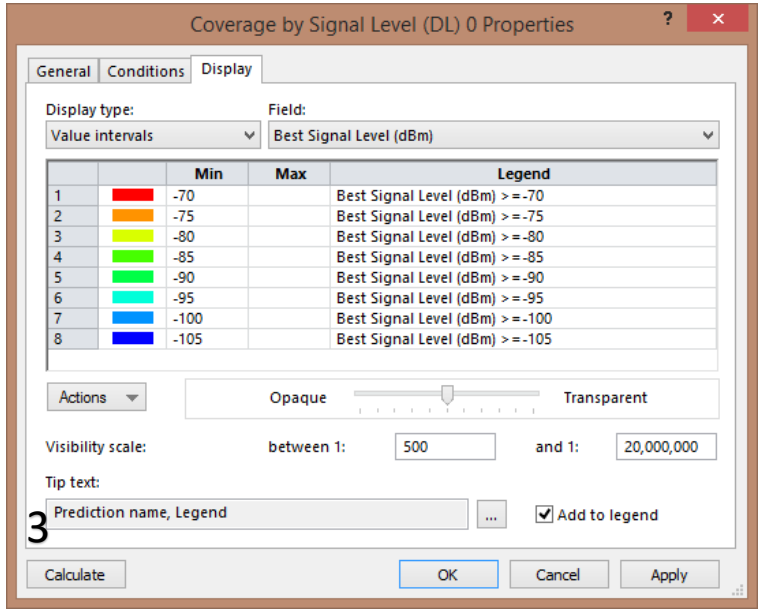
1. Right click Transmitter → Cells → Open Table
2. Your frequency already allocated

	Channel Number	Channel Allocation Status	Physical Cell ID Domain
▶	1,300	Allocated	
	1,700	Allocated	
	1,500	Allocated	
	1,300	Allocated	
	1,700	Allocated	
	1,500	Allocated	
	1,300	Allocated	
	1,500	Allocated	
	1,700	Allocated	
	1,500	Allocated	
	1,700	Allocated	
	1,300	Allocated	
	1,300	Allocated	
	1,500	Allocated	
	1,700	Allocated	
	1,300	Allocated	
	1,500	Allocated	
	1,700	Allocated	
	1,300	Allocated	
	1,500	Allocated	
	1,700	Allocated	
	1,300	Allocated	
	1,500	Allocated	
	1,700	Allocated	
	1,300	Allocated	
	1,500	Allocated	
	1,700	Allocated	
	1,300	Allocated	
	1,500	Allocated	
2	1,700	Allocated	
	1,300	Allocated	

Coverage Simulation [1]

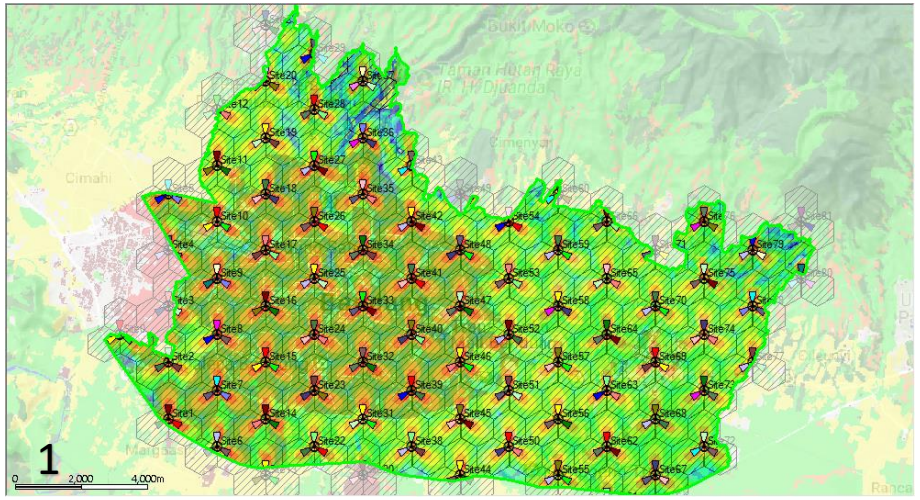


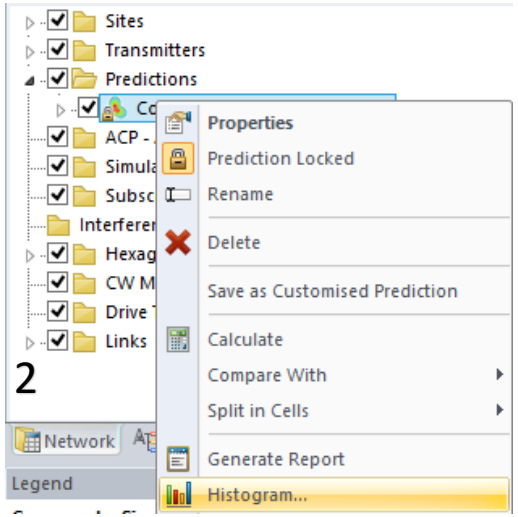


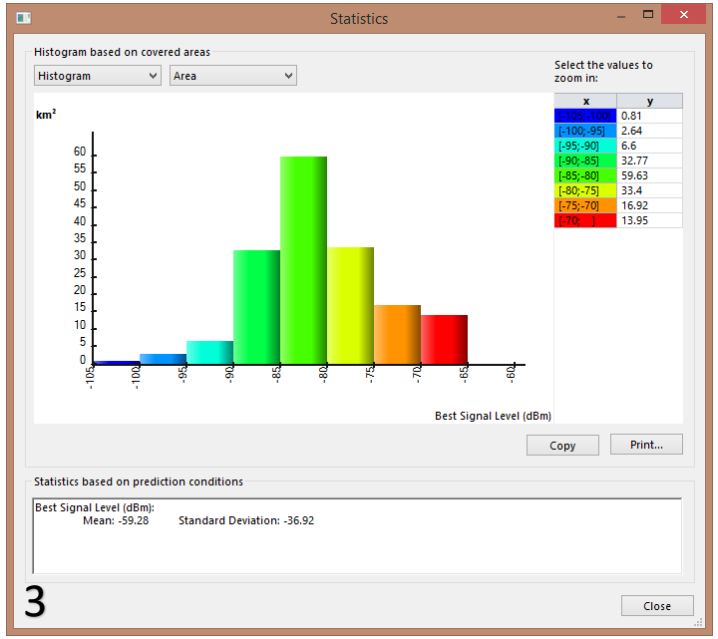


1. Right click Prediction → New Prediction
2. Select Prediction Types → OK
3. In Display Tab, click Calculate

Coverage Simulation [2]

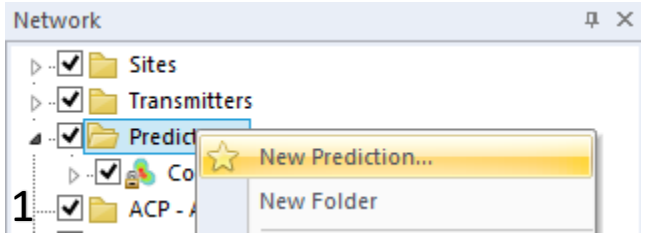


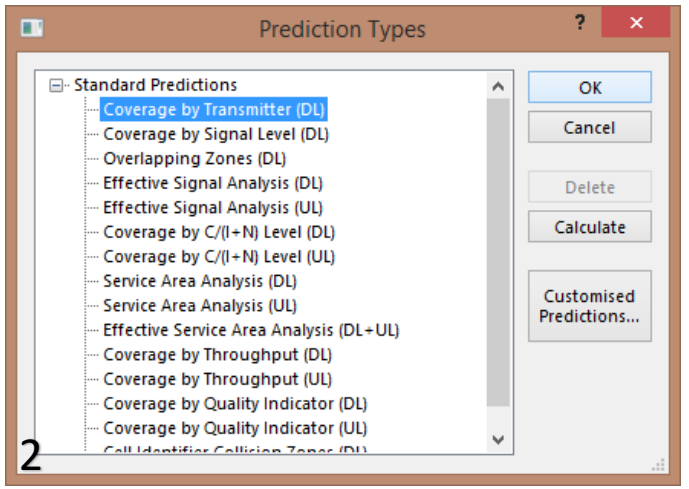


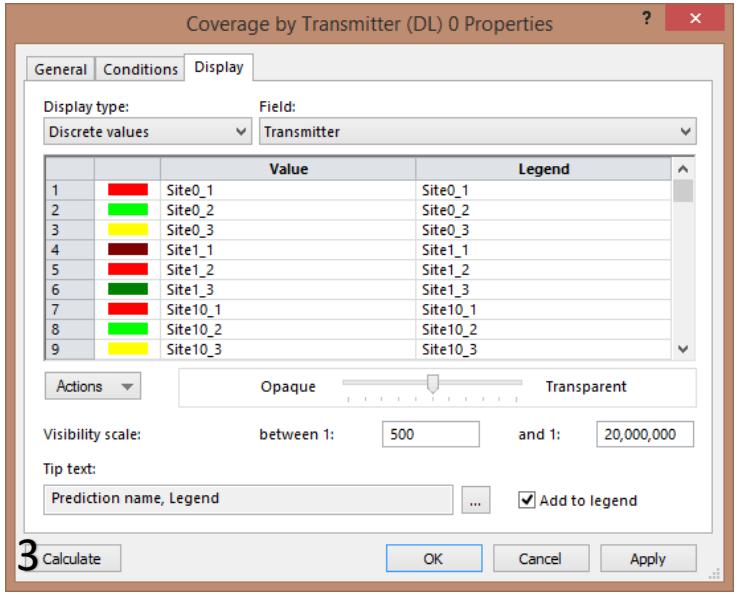


1. Prediction result
2. Right click Coverage prediction → Histogram
3. Histogram result

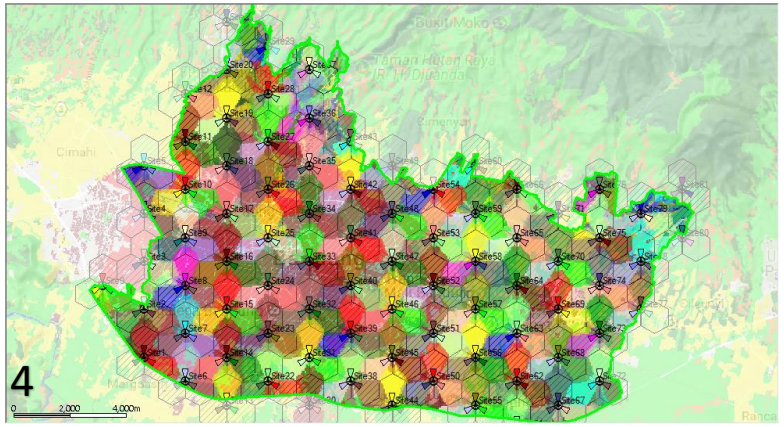
Coverage by Transmitter



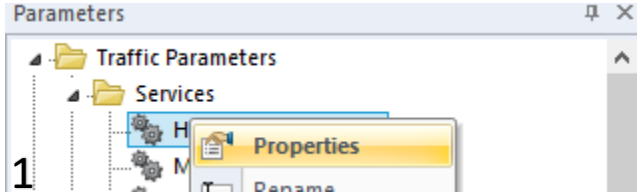


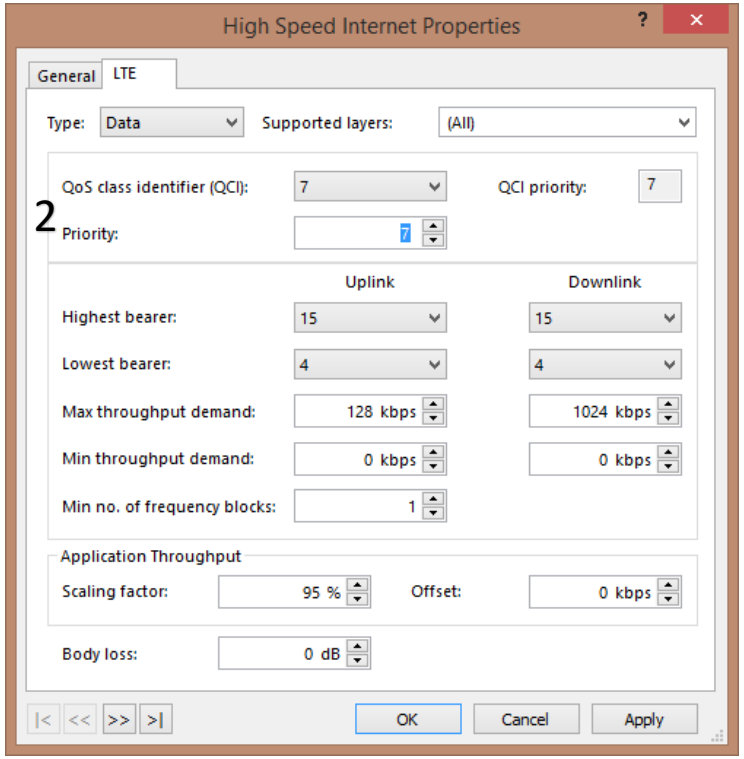


1. Right click Prediction → New Prediction
2. Select Prediction Types → OK
3. In Display Tab, click Calculate
4. Coverage by Transmitter result



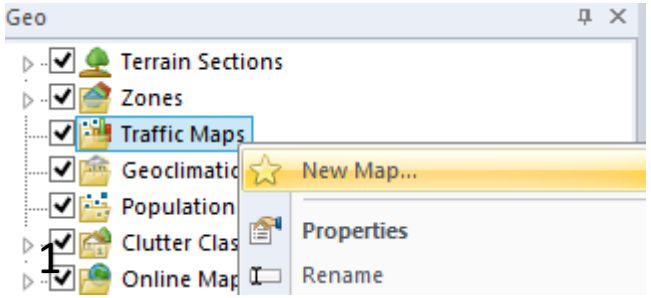
Traffic & QOS Simulation [1]

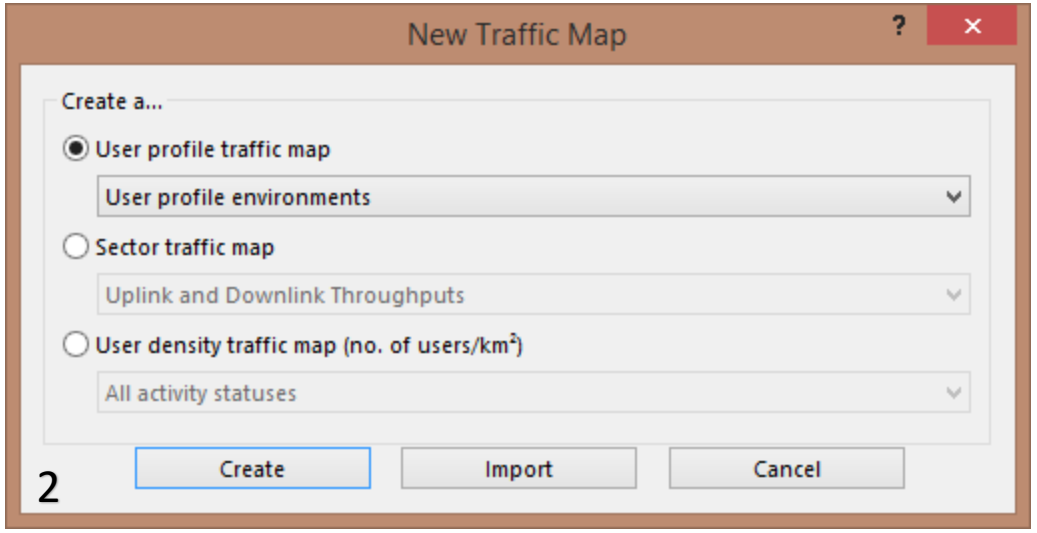




1. Go to Traffic Parameter → Right click services → Right click High Speed Internet → Properties
2. Input QoS class indentifier (QCI) based on QCI table

Traffic & QOS Simulation [2]



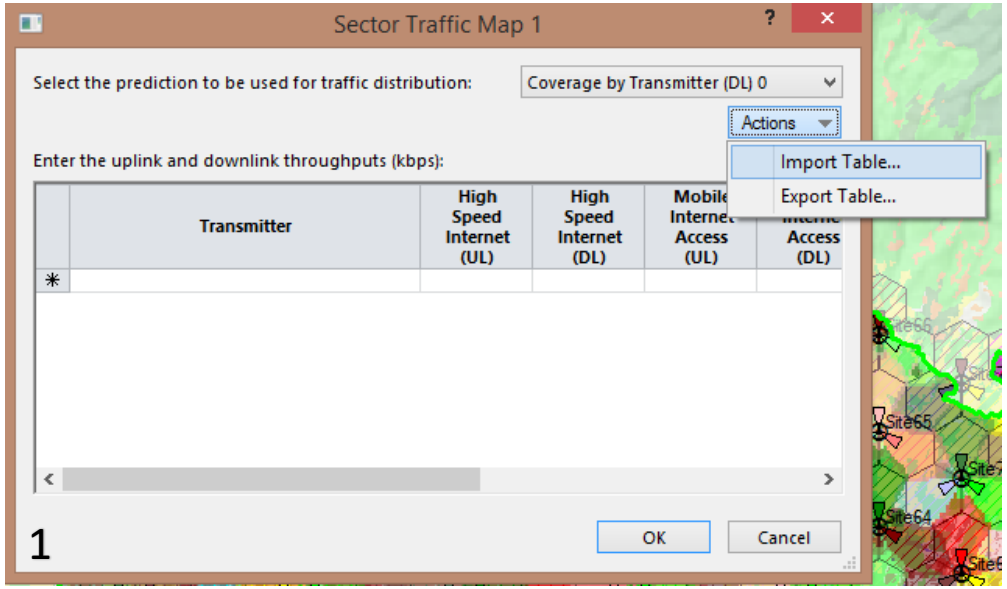


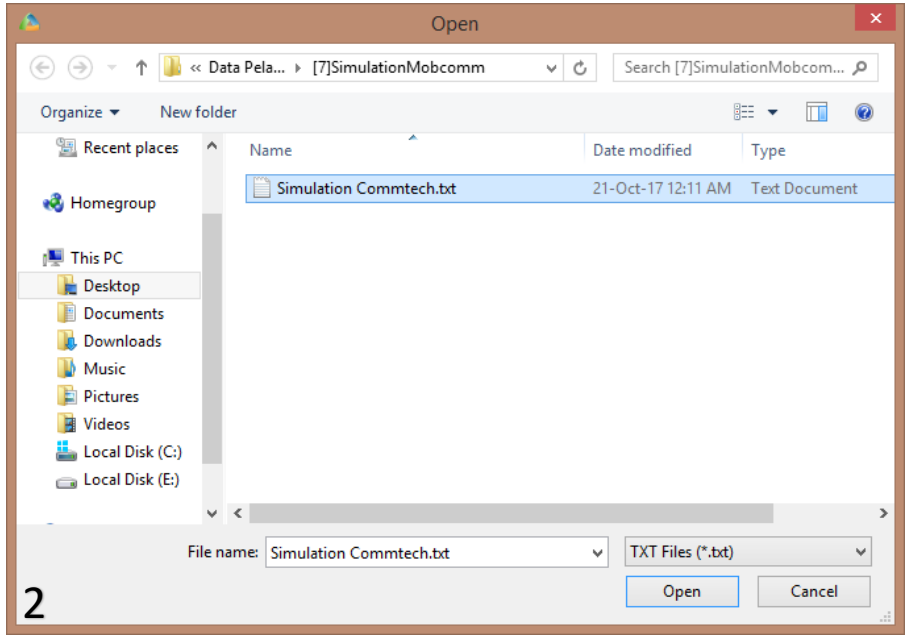
1. Go to Traffic Maps → New Map

2. Explanation

- User Profile Traffic Map: Describe usr densities with user profiles,mobility type, and user profile environment based traffic map
- Sector traffic Map: describes spred of traffic over coverage area of each transmitter
- User Density Traffic Map: Provide the number of connected user rs per unit of surface, i.e. the density of users, as input

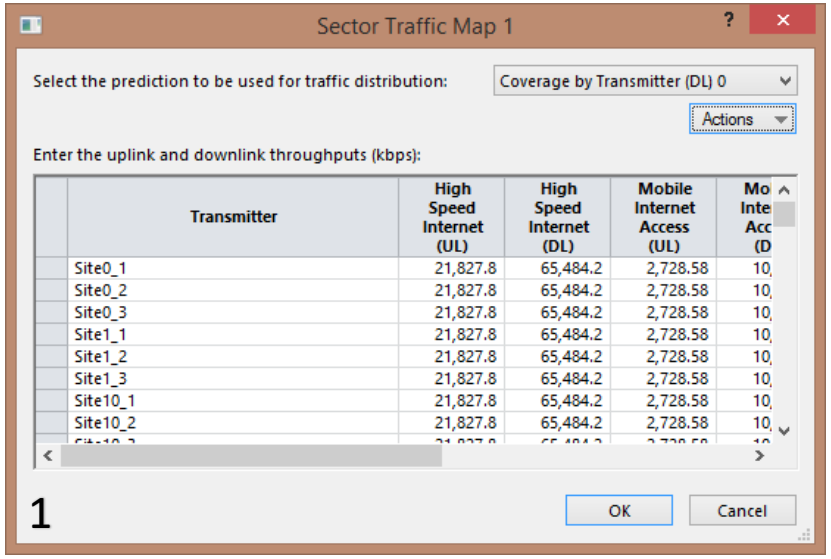
Traffic & QOS Simulation [3]

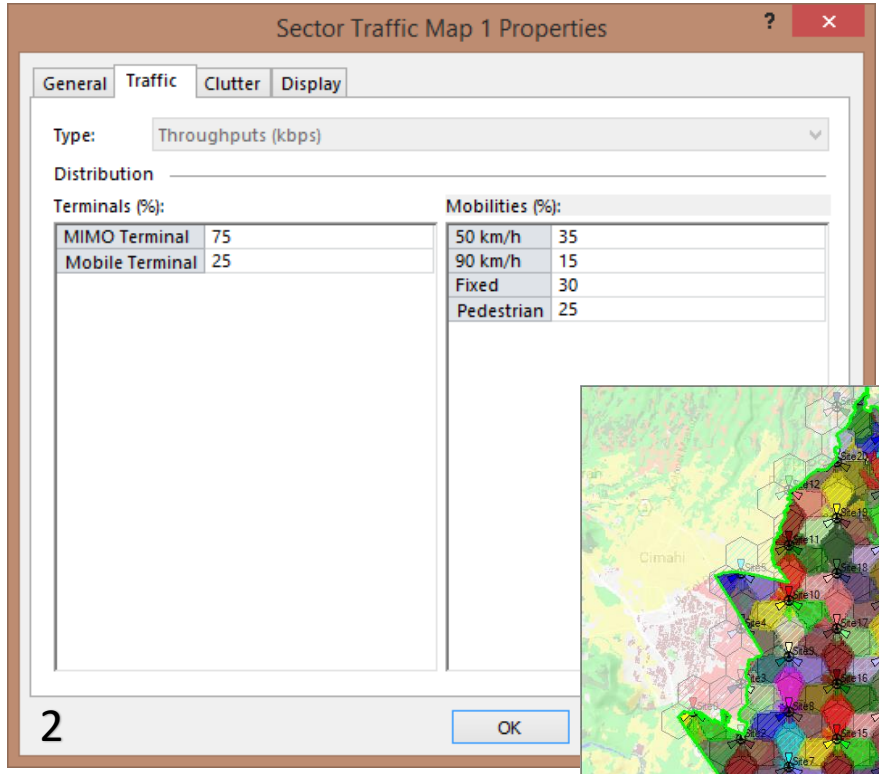


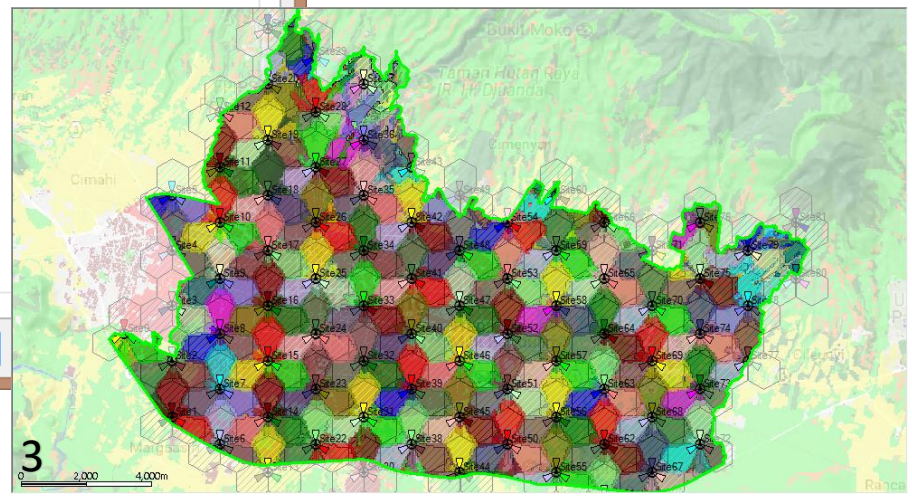


1. Right click Actions → Import Table
2. Choose your file → Open

Traffic & QOS Simulation [4]

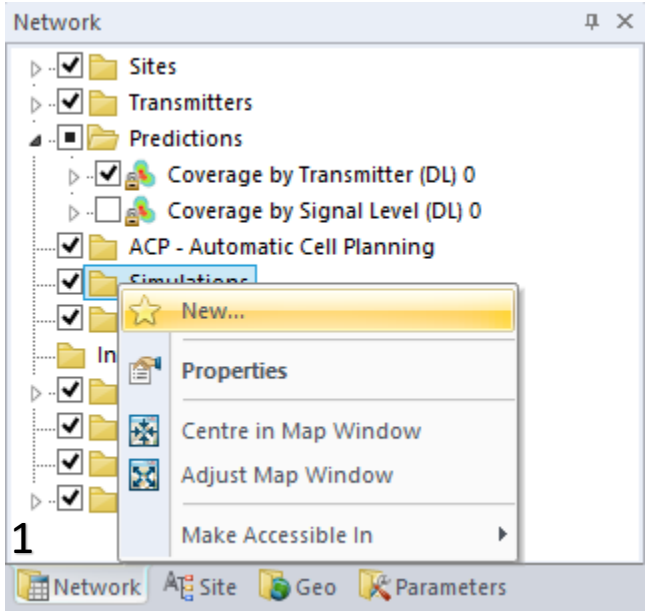


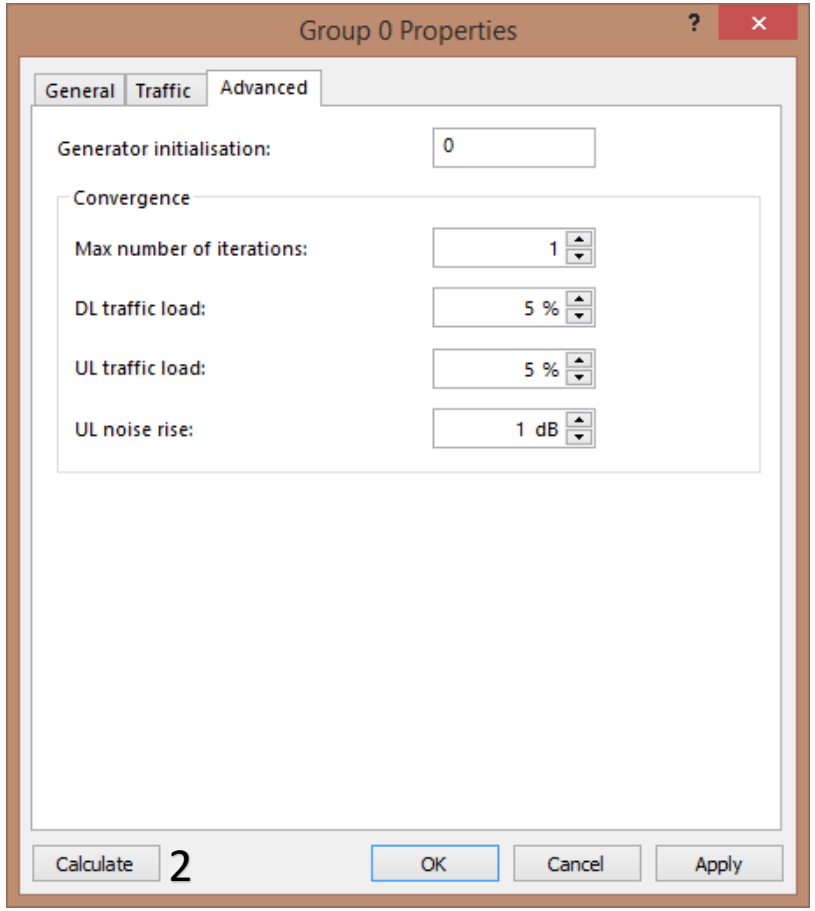




1. Click OK
2. Fill the Terminals and Mobility → OK
3. Result

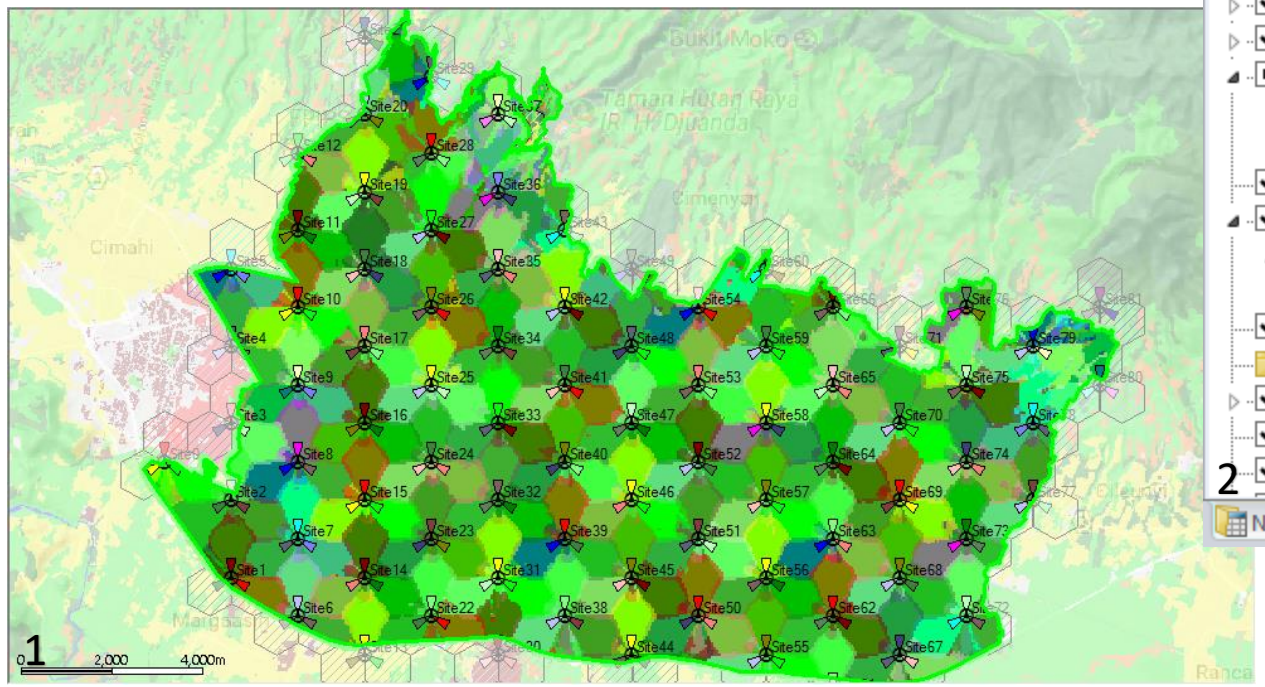
Traffic & QOS Simulation [5]

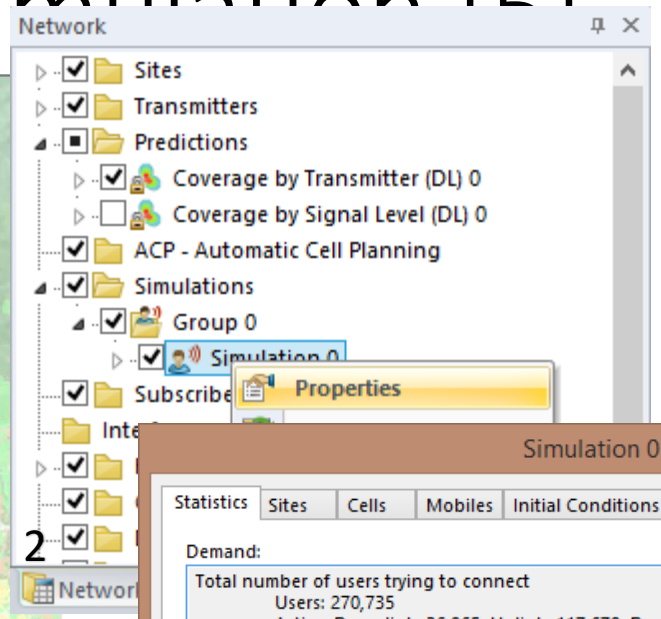


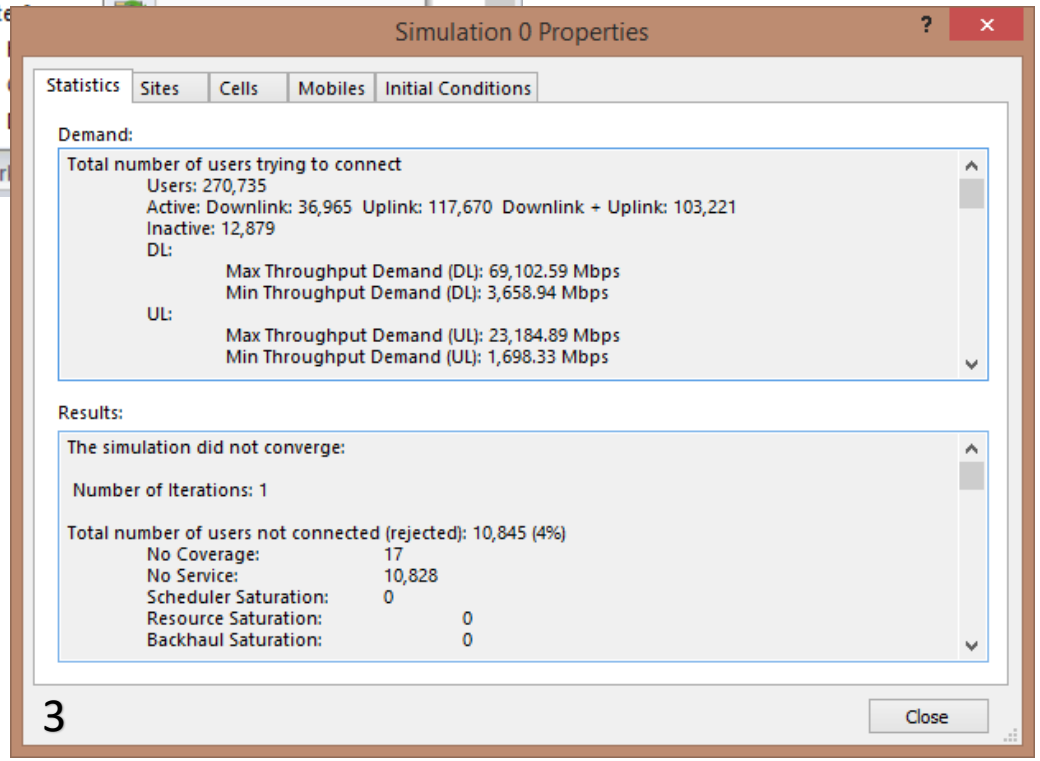


1. Network Tab →Right click Simulation → New
2. Click Calculate

Traffic & QOS Simulation [5]







1. Simulation Result
2. Network Tab → Simulations → Right click your simulation → Properties
3. Simulation Properties