



# LTE PLANNING

## Coverage Planning

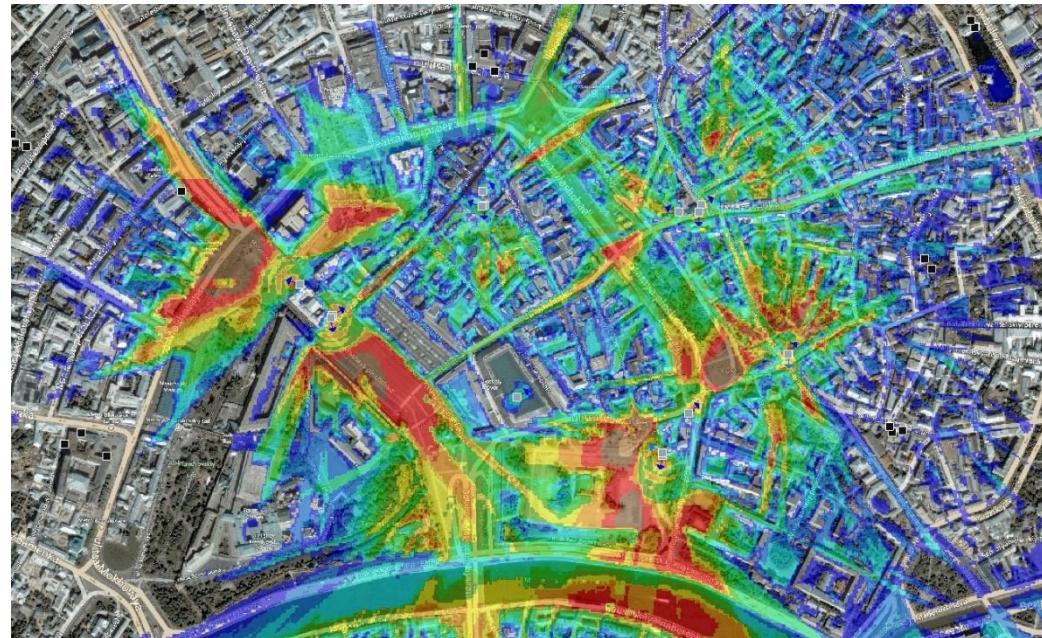
Wireless Access Communication



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

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

$$\begin{aligned}PL &= 49,3 + 110,35373 - 20,41381574 + (35,224855) \log d - a(hr) \\&\quad (\text{Jika } hr = 1,5 \text{ maka } a(hr) = 0)\end{aligned}$$

# Calculation COST 231 Propagation

$$129,75 = 139,2399143 + (35,224855)\log d$$
$$-9,48991426 = (35,224855)\log d$$

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

$$\log d = -0,2694096047$$

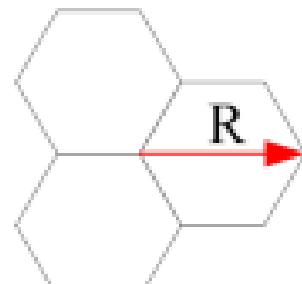
$$D = 10^{-0,2694096047}$$

$$D = 0,538 \text{ km}$$

# Site Calculation

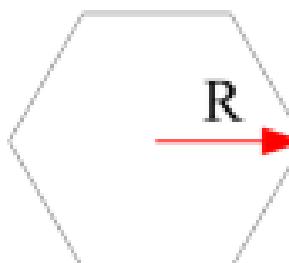
Bandung Area Wide = 168.23 km<sup>2</sup>

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



3-sector site

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



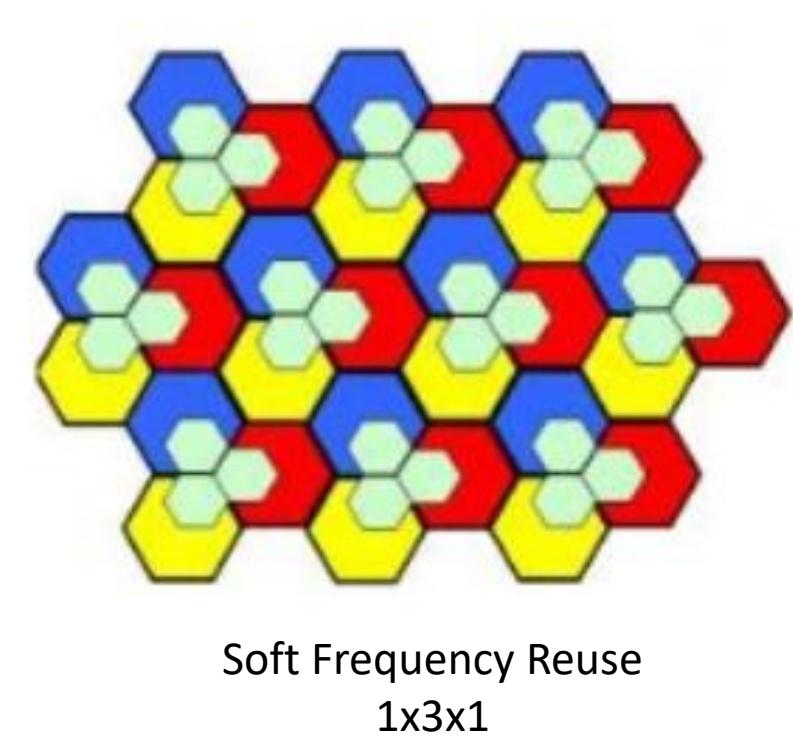
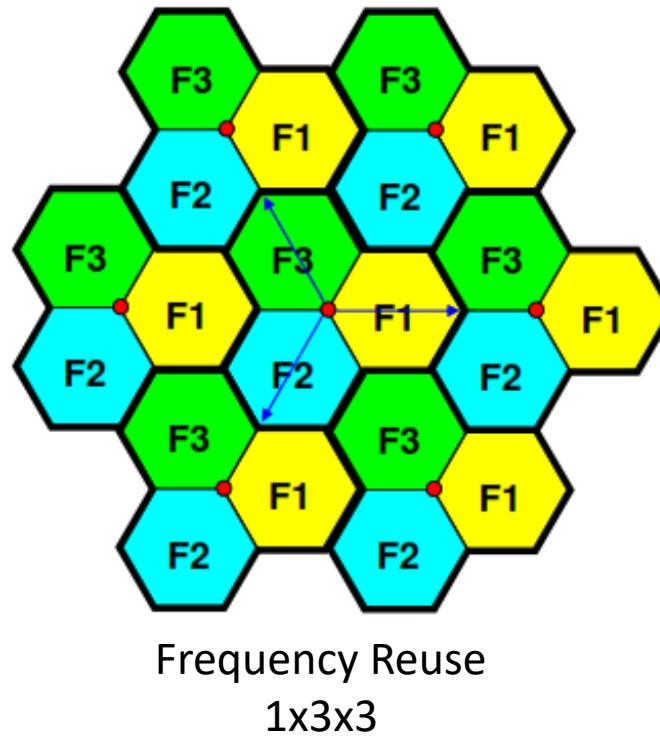
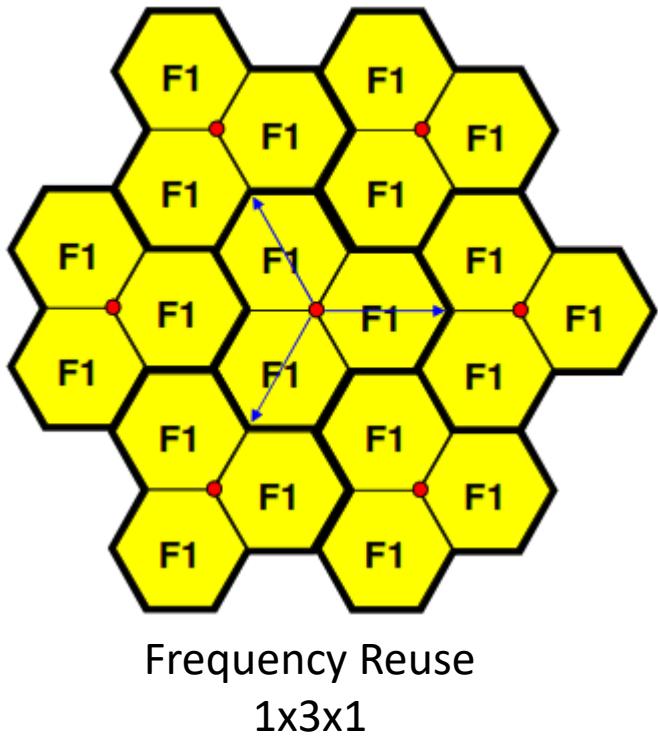
Omni site

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

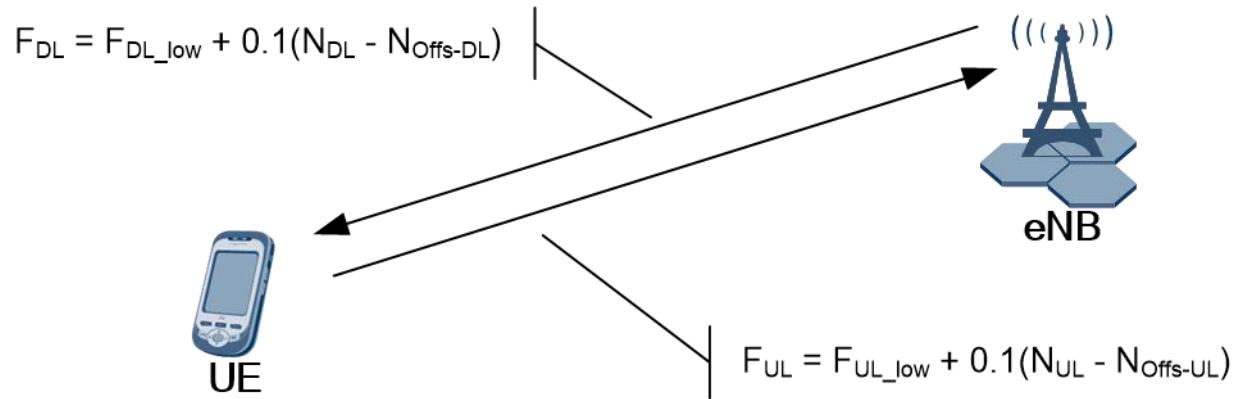
# LTE CELL PLANNING

# 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 Planning (EARFCN)



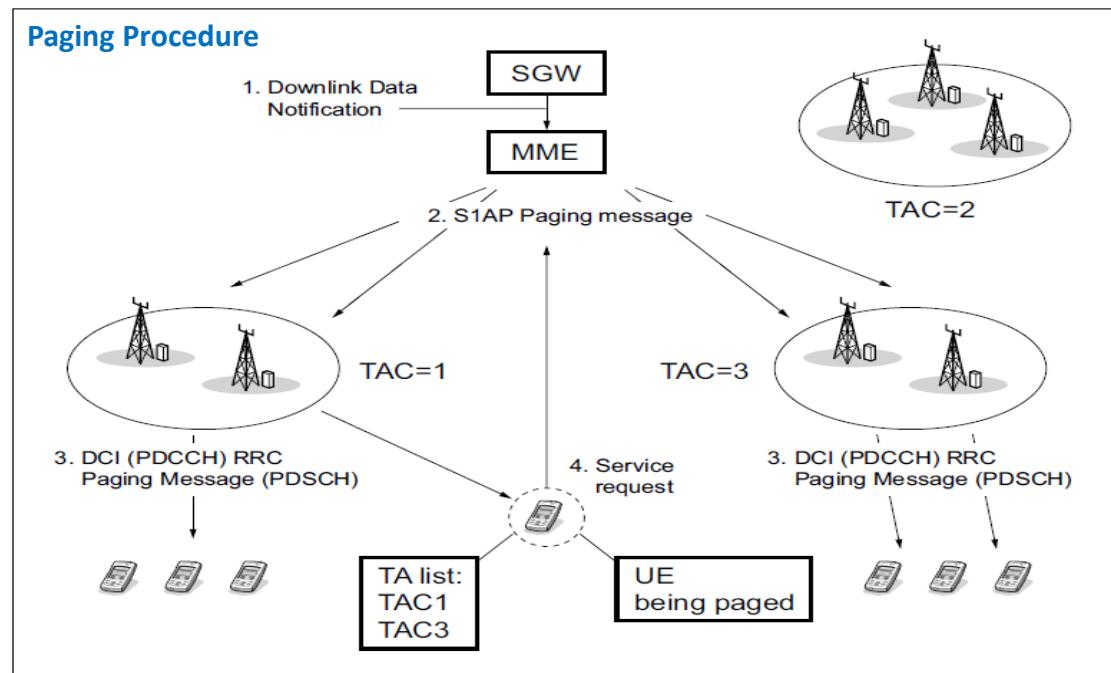
Band	Downlink			Uplink		
	$F_{DL\_low}$ (Mhz)	$N_{OFF\_DL}$	Range of $N_{DL}$	$F_{UL\_low}$ (Mhz)	$N_{OFF\_UL}$	Range of $N_{UL}$
1	2110	0	0 – 599	1920	18000	18000 – 18599
3	1805	1200	1200 – 1949	1710	19200	19200 – 19949
5	869	2400	2400 – 2649	824	20400	20400 – 20649
8	925	3450	3450 – 3799	880	21450	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

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

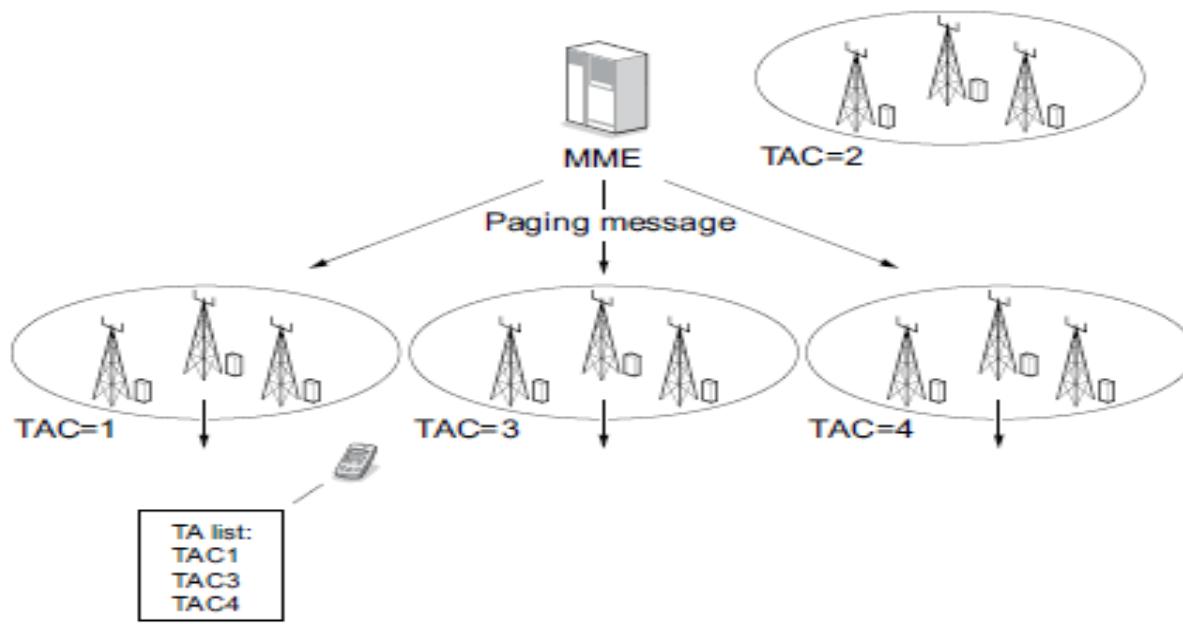
# Tracking Area Concept

- 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 some product specification, One TAL supports up to 16 TAs, each TA supports maximum 100 eNodeB in one MME



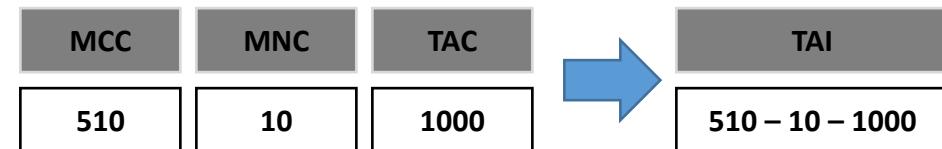
**TAC** = Tracking Area Code (1~65533, and 65535)

**TAI** = Tracking Area ID = MCC + MNC + TAC

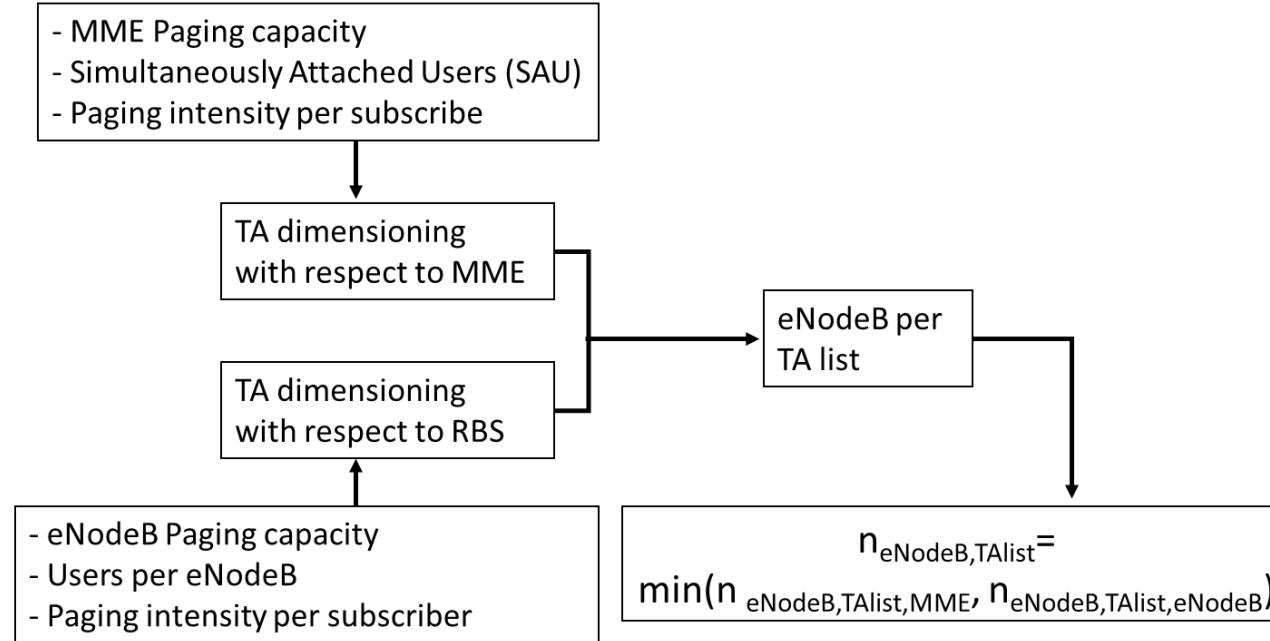
**TAL** = Tracking Area List

1 TAL = up to 16 TAC

TAL value range: 0~ 65534



# 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

$$\text{PCI ID} = (3 \times \text{SSS ID}) + \text{PSS ID}$$

$$\text{Total PCI} = 3 \times 168 = 504 \text{ PCI}$$

Primary Synchronization Signal (PSS):

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

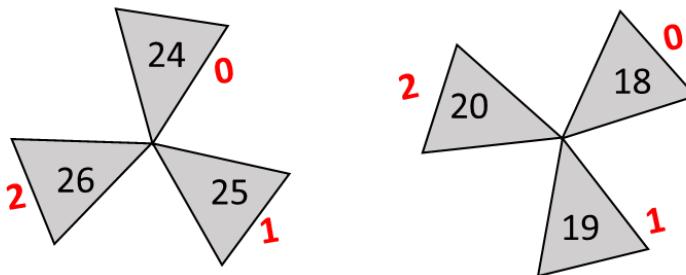


Secondary Synchronization Signal (SSS):

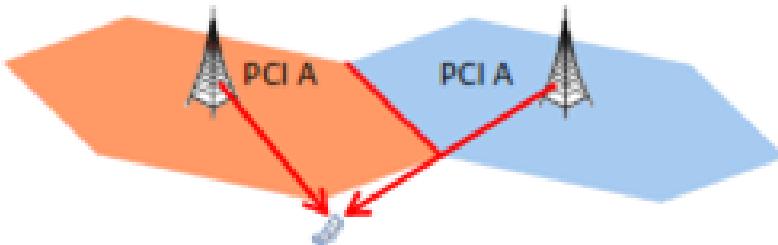
- Detection of radio frame timing
- Detection of cell ID group (0-167)
- Detection of MIMO & CP configuration

# PCI Allocation

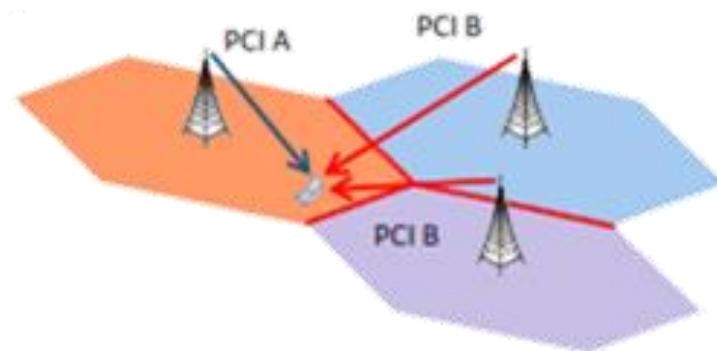
PCI can be allocated manually using Modulo 3 concept. The result of mod 3 assigned on each sector cannot be face-to-face.



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

- $N_{CS} * T_s > T_{RTD} + T_{MDS} + T_{dev}$

[  $N_{CS} * (800/839) > (6.67*R) + 5 + 2$  ]

- $N_{CS}$  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  $T_{MDS} = 5$ us, UE timing deviation = 2us
- $T_s$  is PRACH sampling period, and  $T_s = 800/839$  [us]
- If planned cell radius = 8Km, then  $N_{CS} = 76$  (Dense Urban, Urban)
- If planned cell radius = 12Km, then  $N_{CS} = 93$  (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	-

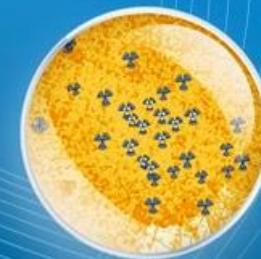
# PRACH Planning Procedures

- **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  $839/6=139$  ( $0, 6, 12, \dots, 6*n, \dots, 828$ )
- **Step 4:** The available root sequence indexes are assigned to cells. The reuse distance shall be as far as possible

# Atoll Simulation

**Atoll**  
version 3.2.1

- › *New LTE-Advanced Features*
- › *Automatic Planning and Optimisation of Multi-RAT HetNets*
- › *New Automatic Site Positioning Module (ASP)*



# Atoll Overview



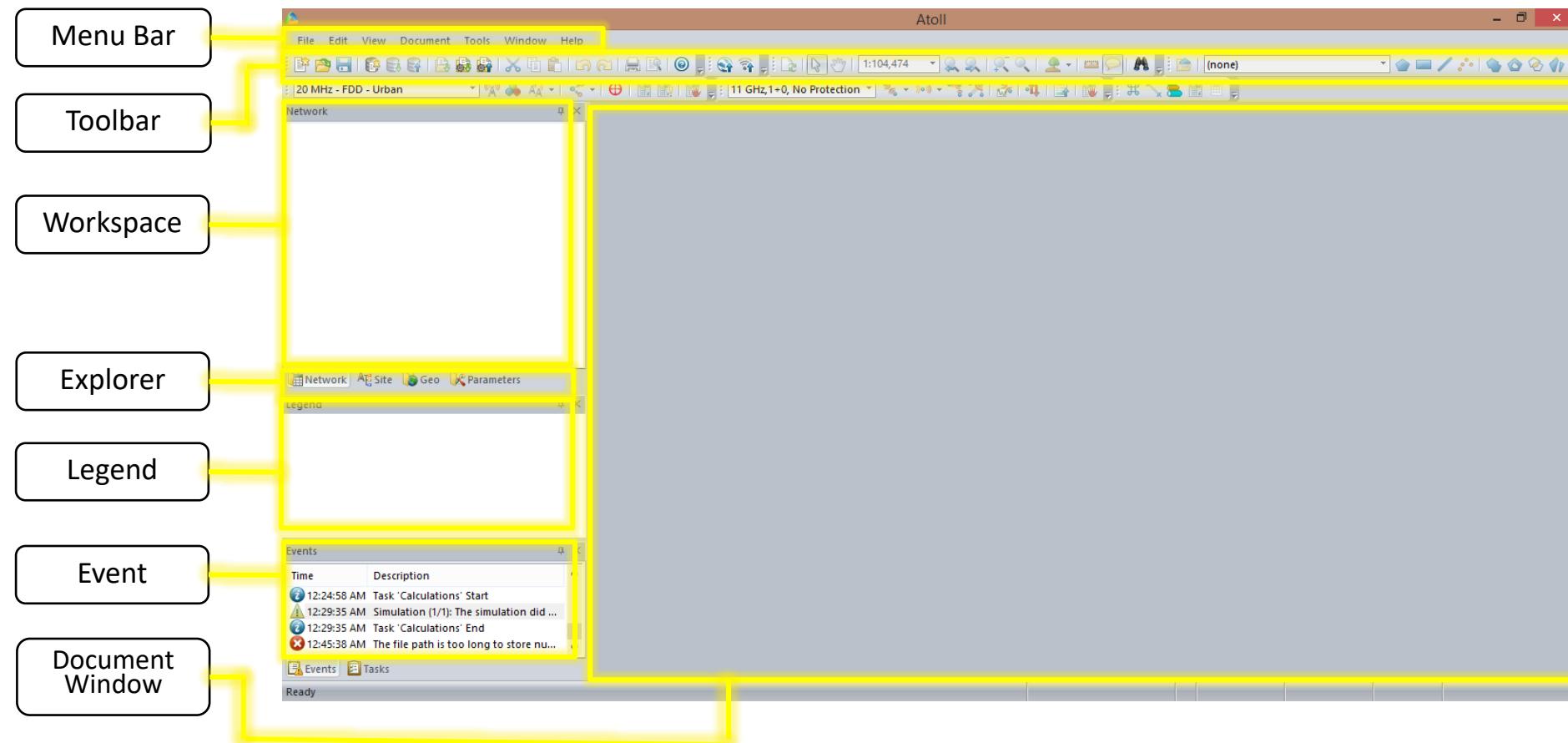
Forsk is an independent company providing radio planning and optimisation software solutions to the wireless industry since 1987.

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.

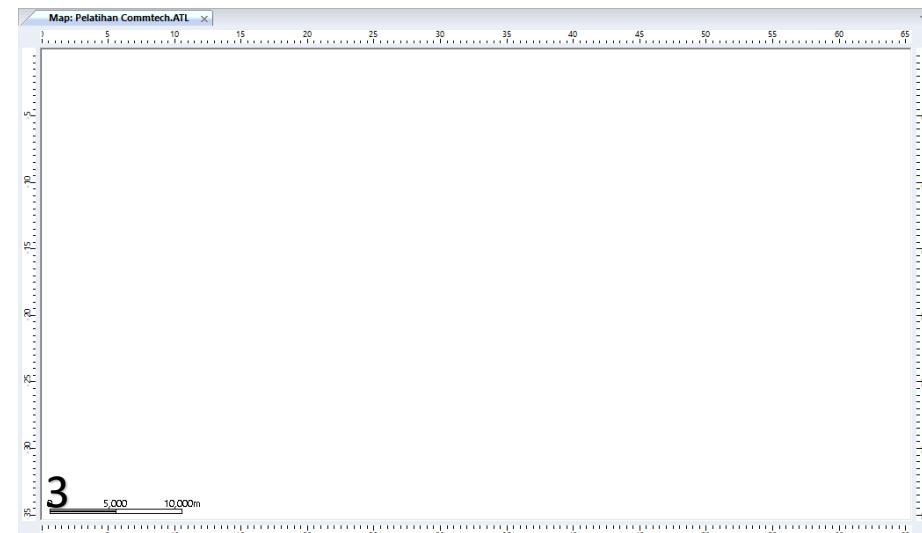
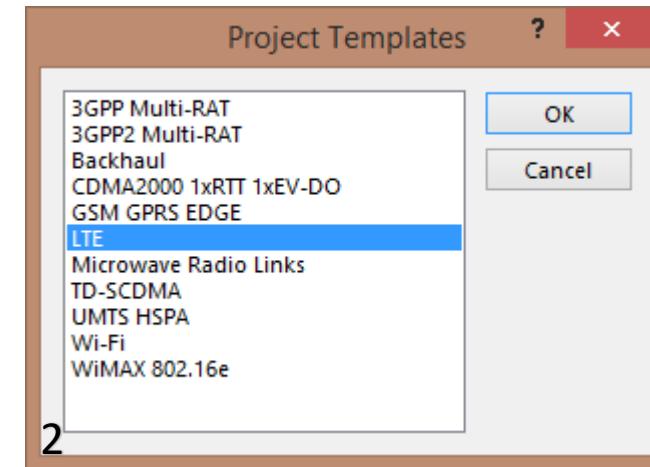
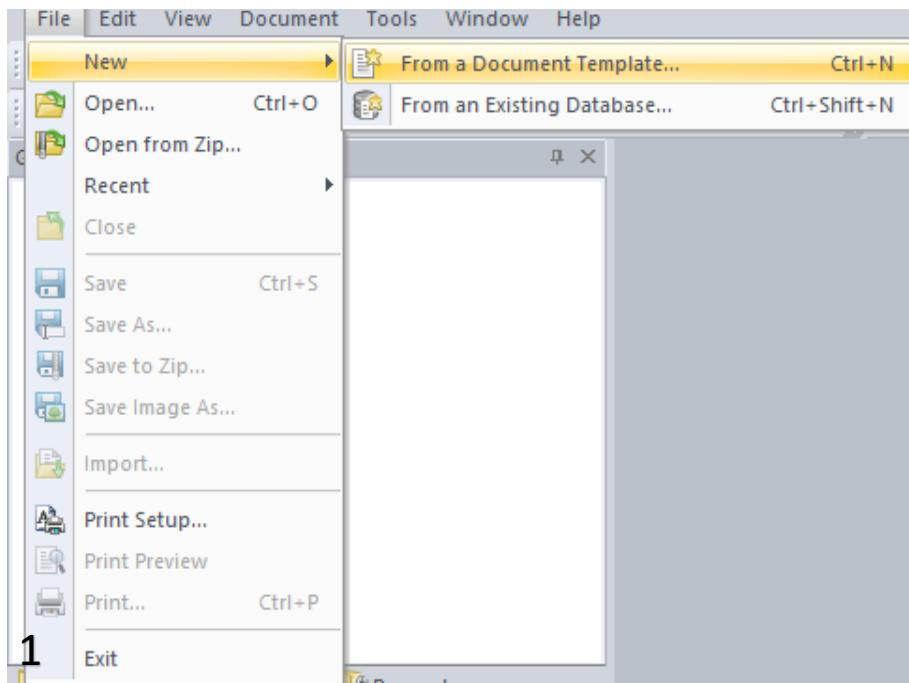
## Atoll Supported Technology:

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

# Atoll User Interface

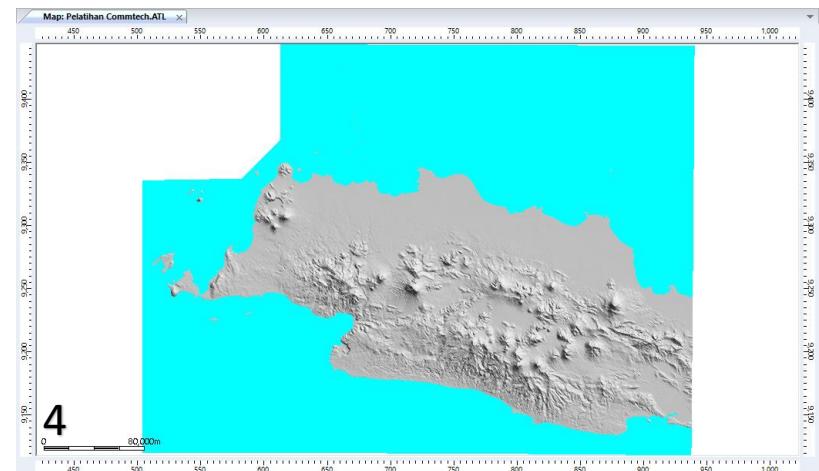
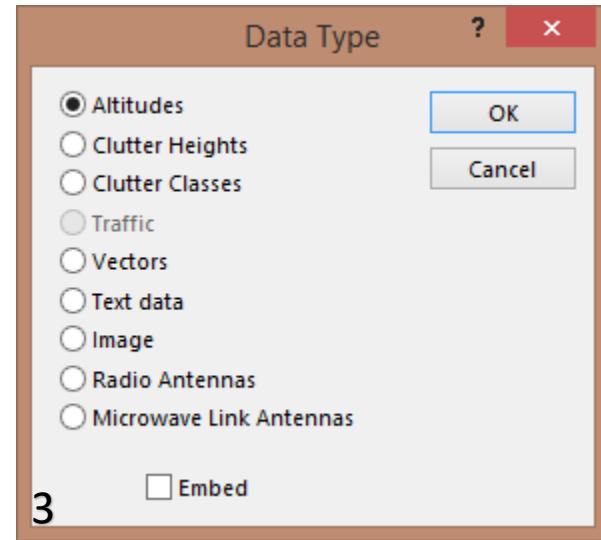
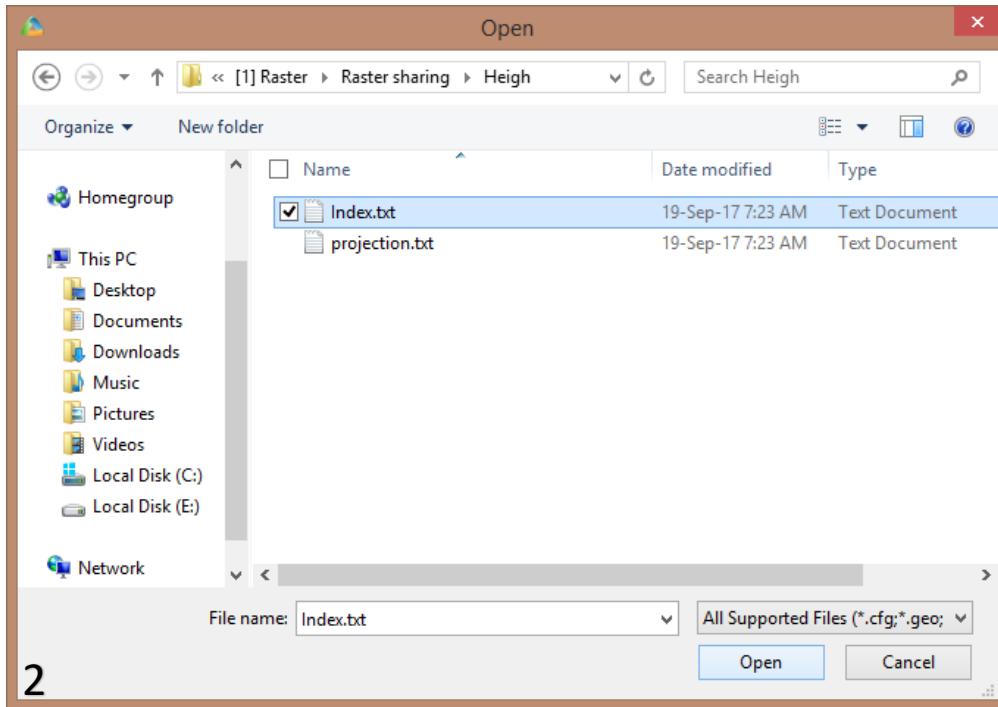
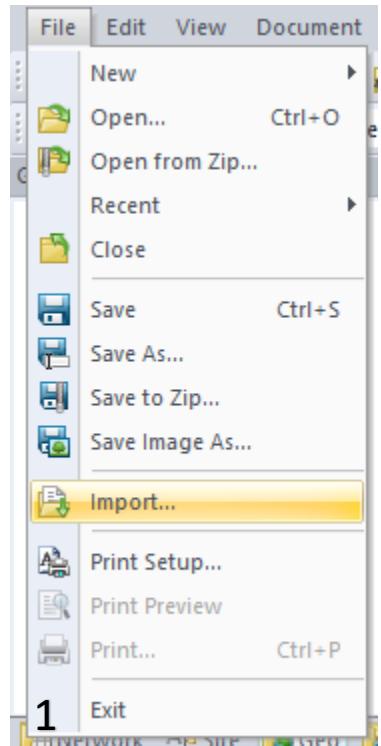


# Create New Project



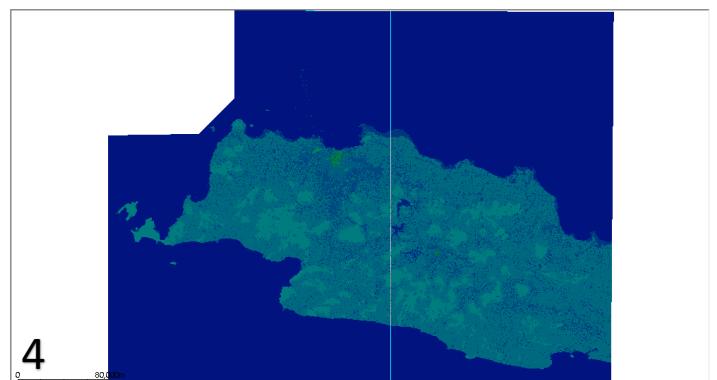
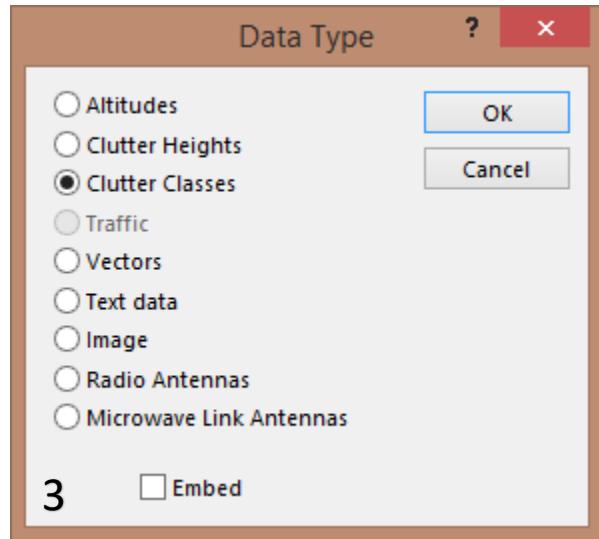
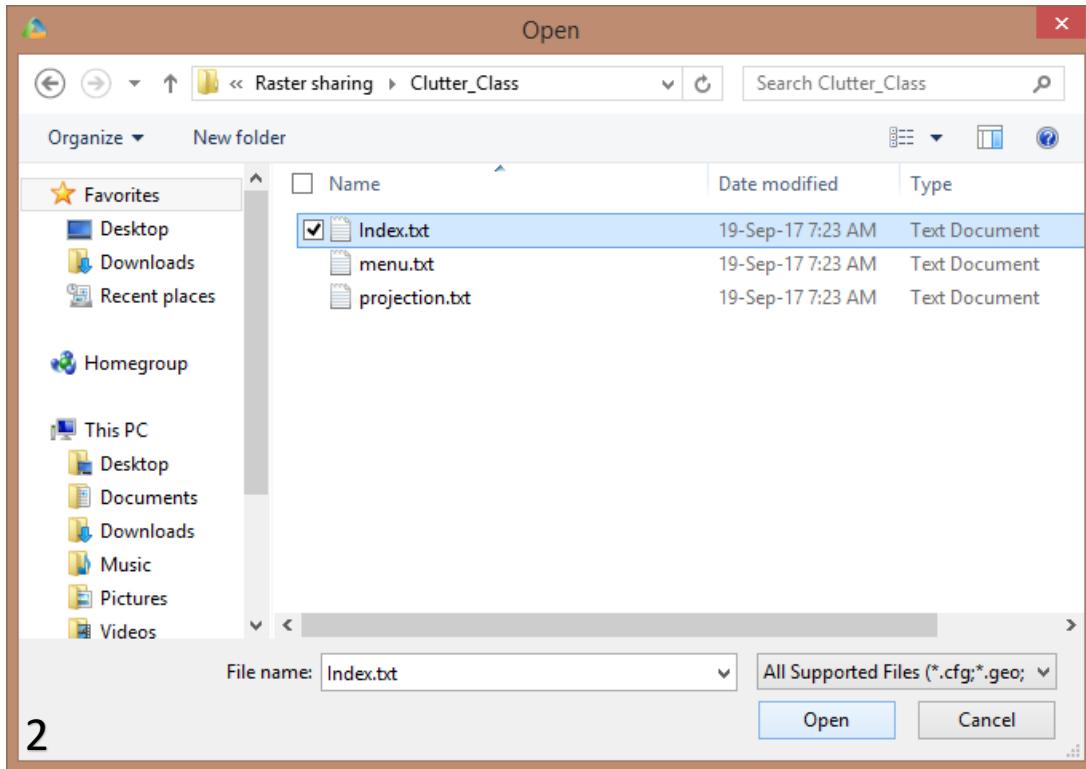
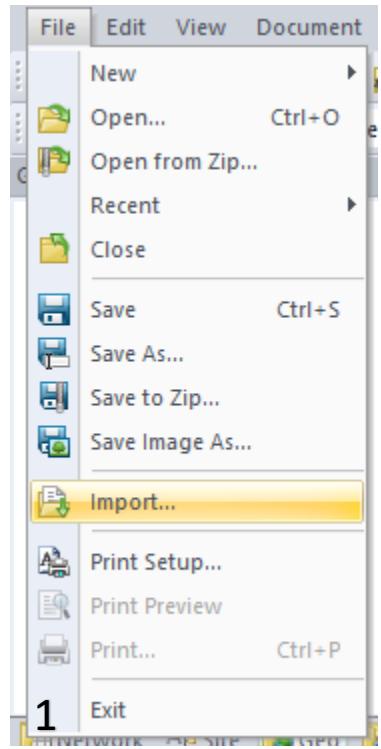
1. File → New → From a Document Template
2. Choose your project templates → LTE → OK
3. Result

# Importing Maps [1]



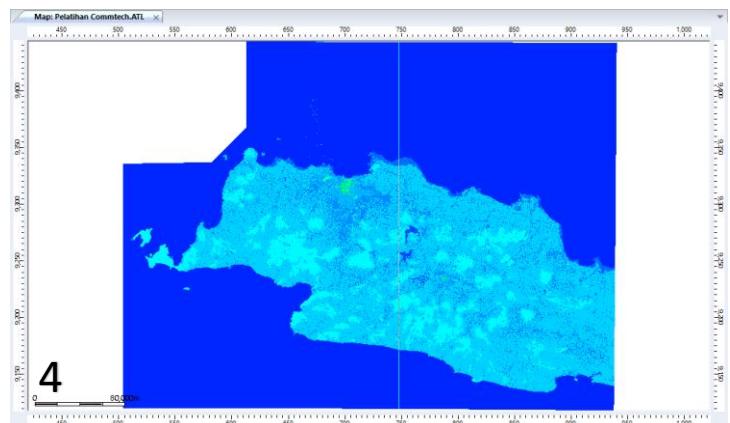
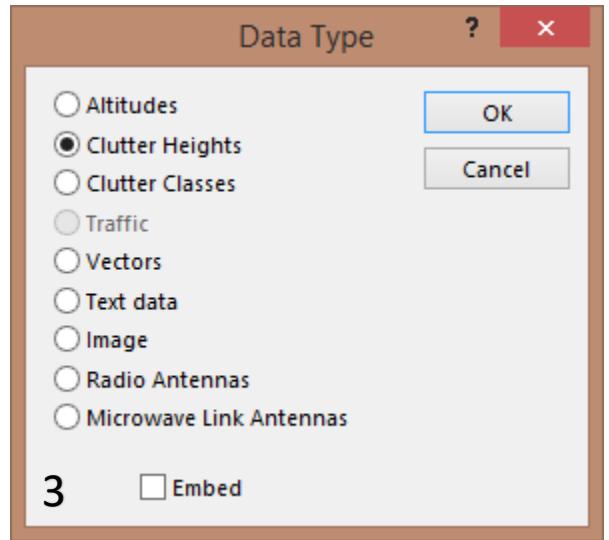
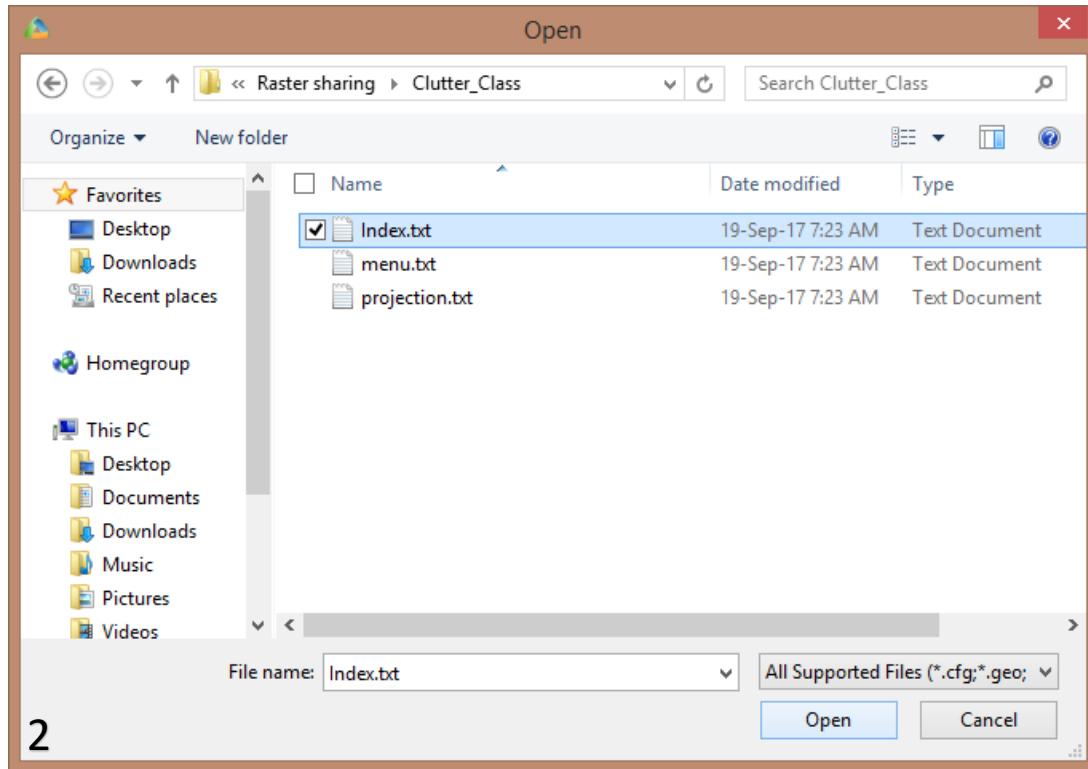
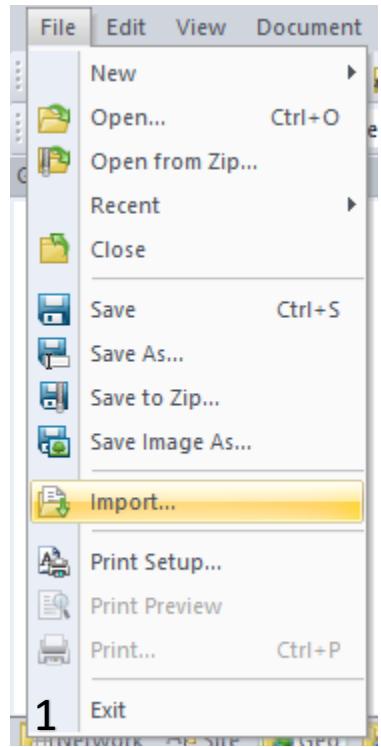
1. Select File then Import
2. Choose “Heigh” → click “Index.txt” → Open
3. Choose Altitudes
4. Result will be shown in document window

# Importing Maps [2]



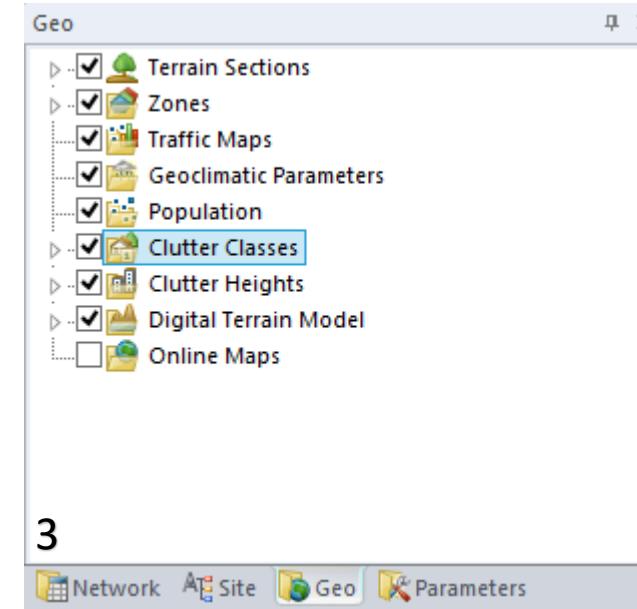
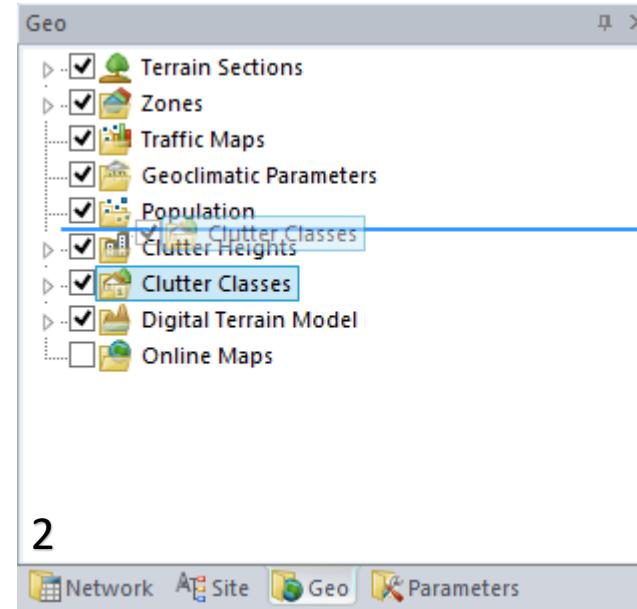
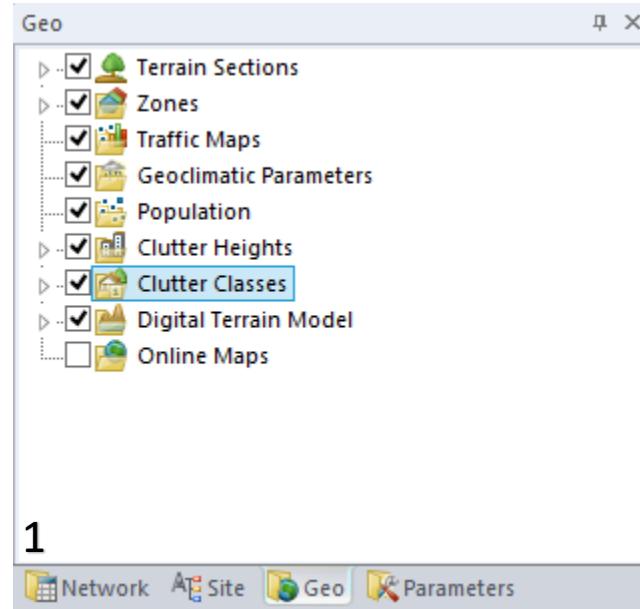
1. Select File then Import
2. Choose “Clutter\_Class” → select “Index.txt” → Open
3. Choose Clutter Classes
4. Result will be shown in document window

# Importing Maps [3]

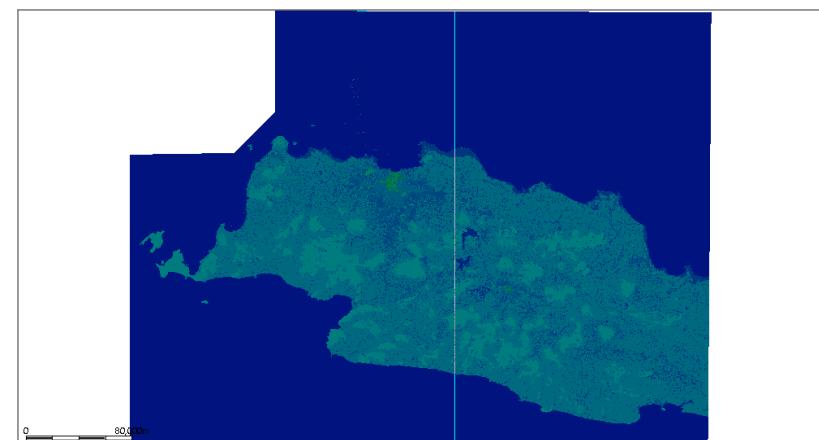


1. Select File then Import
2. Choose “Clutter\_Class” → select “Index.txt” → Open
3. Choose Clutter Heights
4. Result will be shown in document window

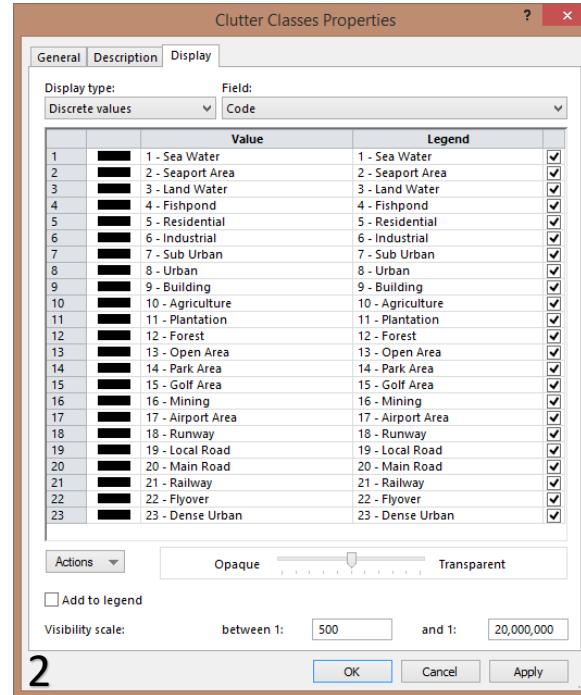
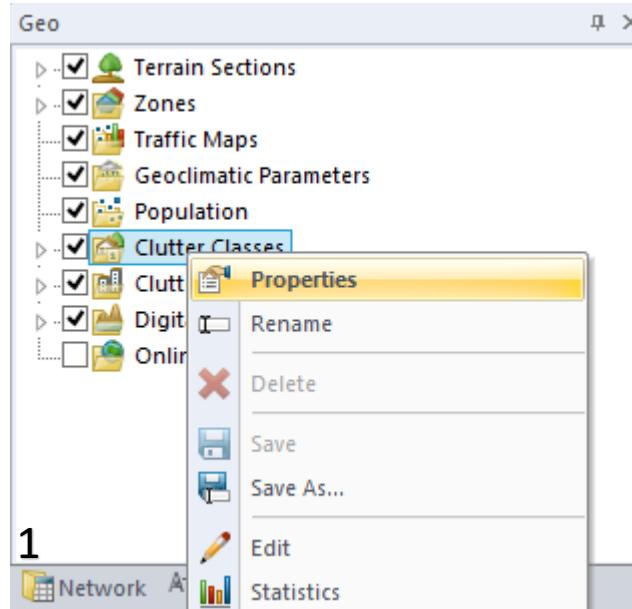
# Setting Clutter Classes Legend [1]



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]



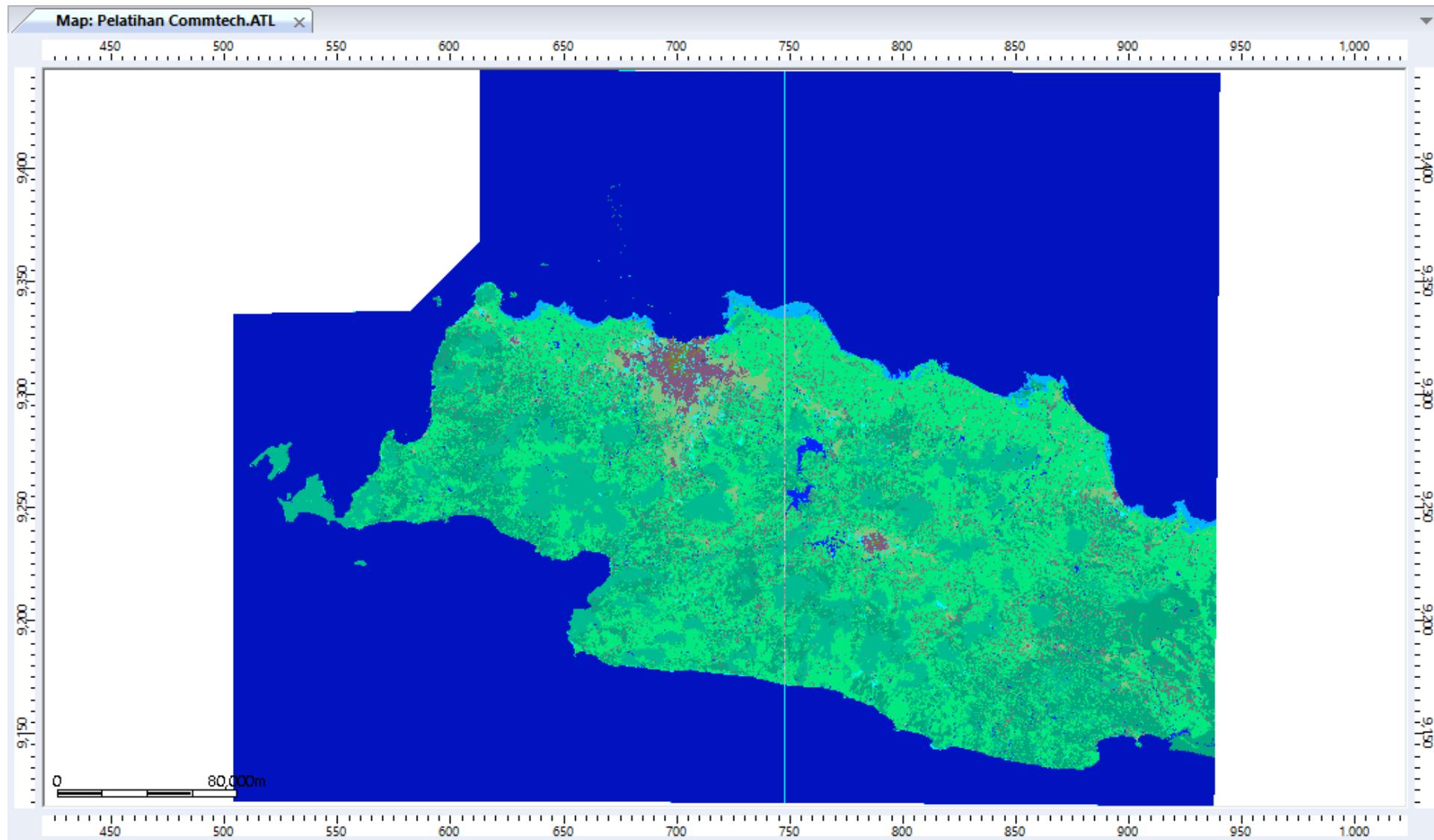
1. Right click Clutter Class → Properties
2. Clutter Class has not colored yet
3. Select the colour you want
4. Result

	Value	Legend
1	1 - Sea Water	1 - Sea Water
2	2 - Seaport Area	2 - Seaport Area
3	3 - Land Water	3 - Land Water
4	4 - Fishpond	4 - Fishpond
5	5 - Residential	5 - Residential
6	6 - Industrial	6 - Industrial
7	7 - Sub Urban	7 - Sub Urban
8	8 - Urban	8 - Urban
9	9 - Building	9 - Building
10	10 - Agriculture	10 - Agriculture
11	11 - Plantation	11 - Plantation
12	12 - Forest	12 - Forest
13	13 - Open Area	13 - Open Area
14	14 - Park Area	14 - Park Area
15	15 - Golf Area	15 - Golf Area
16	16 - Mining	16 - Mining
17	17 - Airport Area	17 - Airport Area
18	18 - Runway	18 - Runway
19	19 - Local Road	19 - Local Road
20	20 - Main Road	20 - Main Road
21	21 - Railway	21 - Railway
22	22 - Flyover	22 - Flyover
23	23 - Dense Urban	23 - Dense Urban

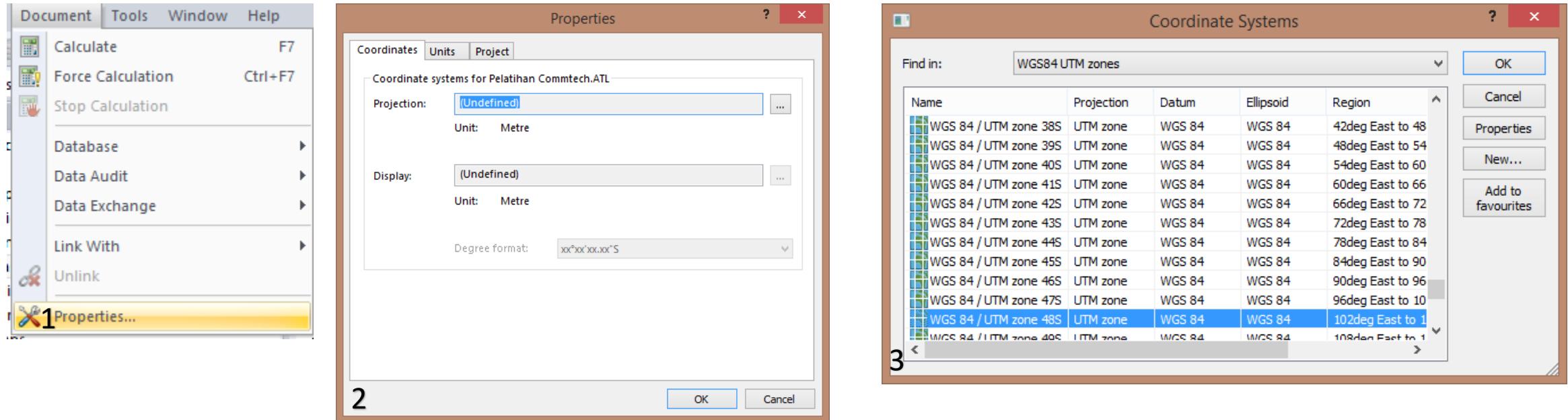
	Value	Legend
1	1 - Sea Water	1 - Sea Water
2	2 - Seaport Area	2 - Seaport Area
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4	4 - Fishpond	4 - Fishpond
5	5 - Residential	5 - Residential
6	6 - Industrial	6 - Industrial
7	7 - Sub Urban	7 - Sub Urban
8	8 - Urban	8 - Urban
9	9 - Building	9 - Building
10	10 - Agriculture	10 - Agriculture
11	11 - Plantation	11 - Plantation
12	12 - Forest	12 - Forest
13	13 - Open Area	13 - Open Area
14	14 - Park Area	14 - Park Area
15	15 - Golf Area	15 - Golf Area
16	16 - Mining	16 - Mining
17	17 - Airport Area	17 - Airport Area
18	18 - Runway	18 - Runway
19	19 - Local Road	19 - Local Road
20	20 - Main Road	20 - Main Road
21	21 - Railway	21 - Railway
22	22 - Flyover	22 - Flyover
23	23 - Dense Urban	23 - Dense Urban

4

# Map Result

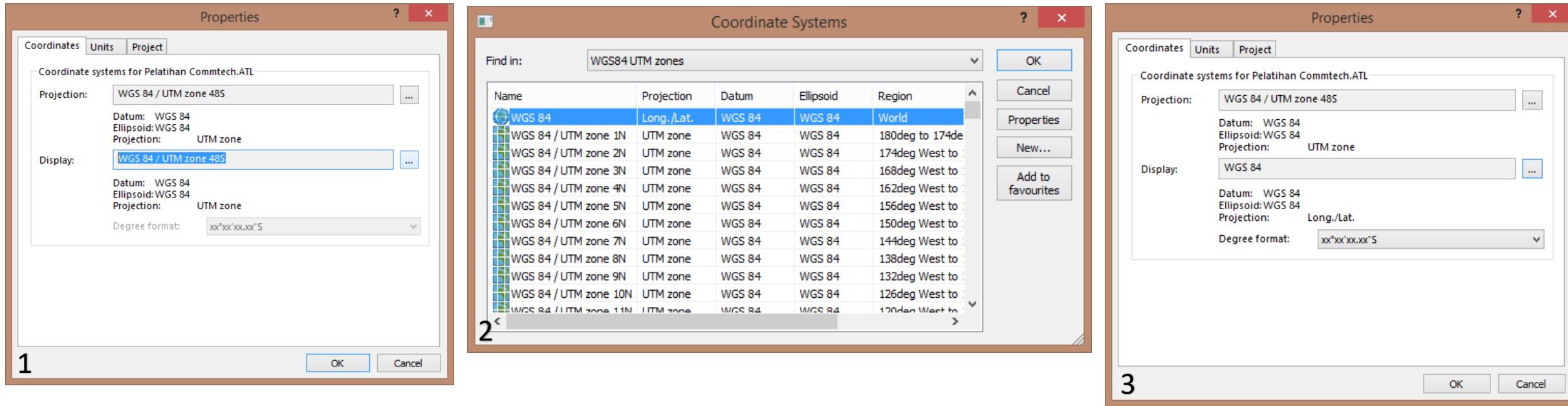


# Selecting Projection Map [1]



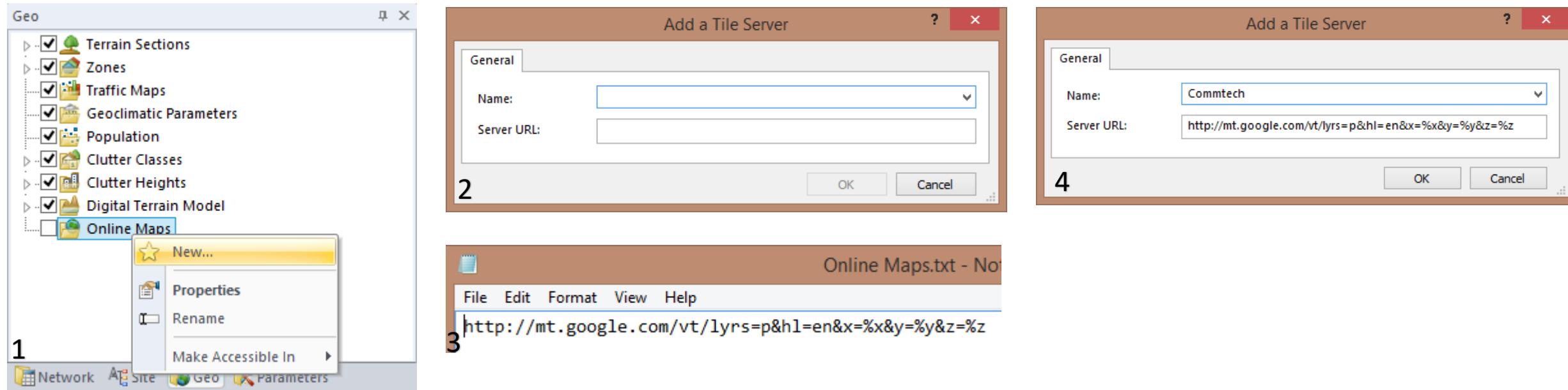
1. Select Document then Properties
2. Projection Map has not selected yet → select “...”
3. On Find In, choose WGS84 UTM zones → UTM zone 48S → OK

# Selecting Projection Map [2]



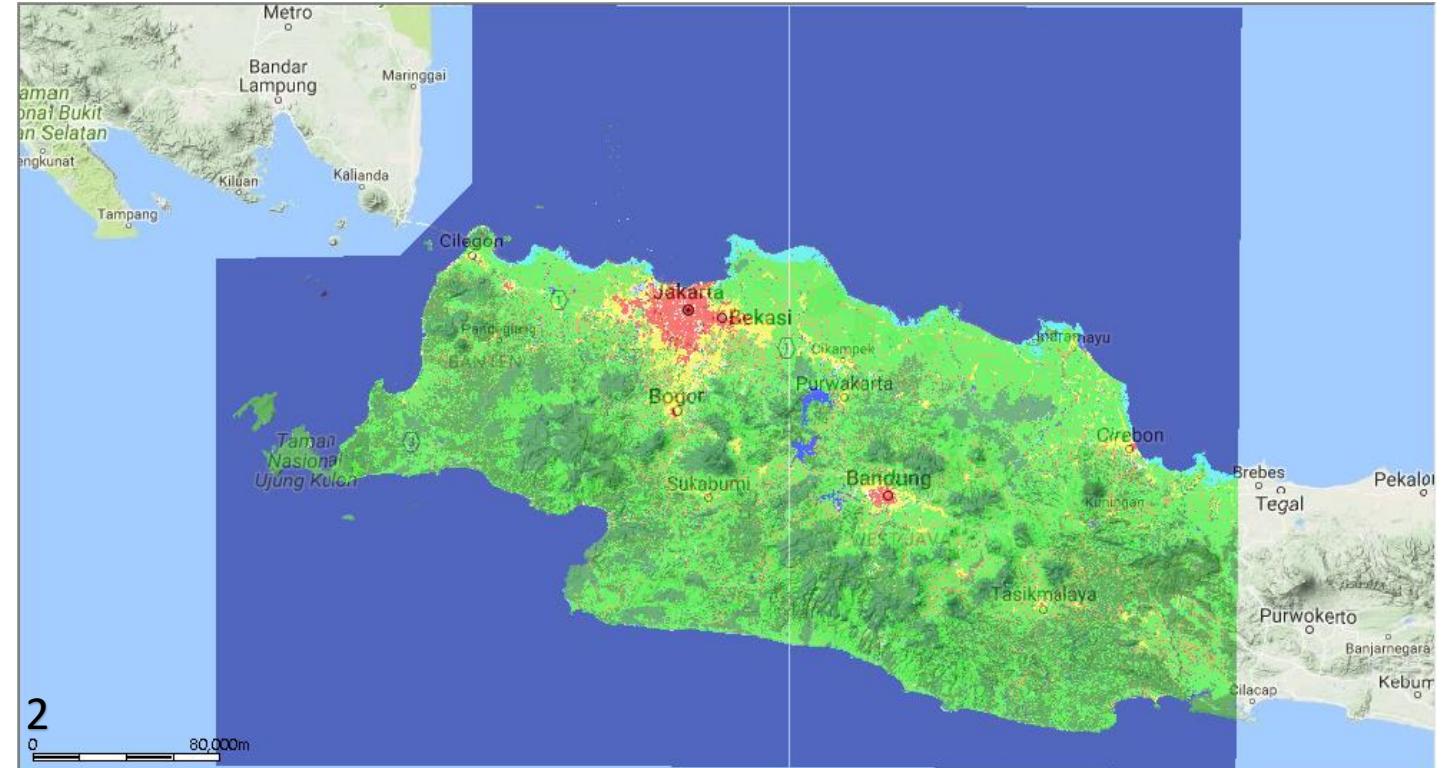
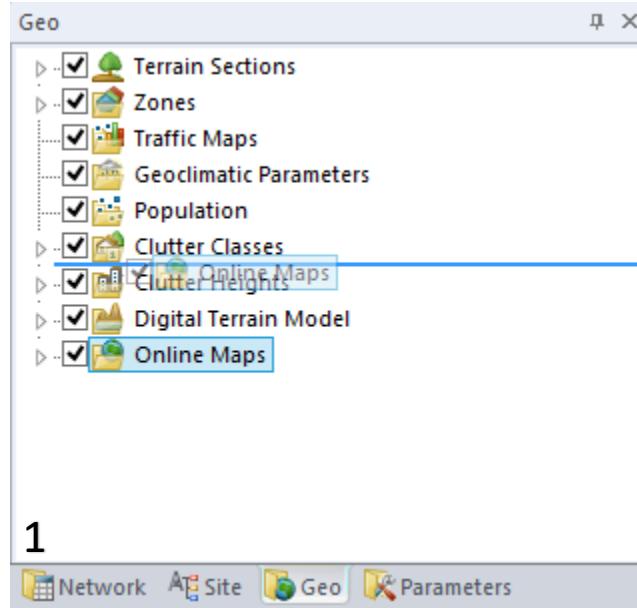
1. On Display → select “...”
2. Choose WGS 48 → OK
3. Projection Map already set

# Online Maps [1]



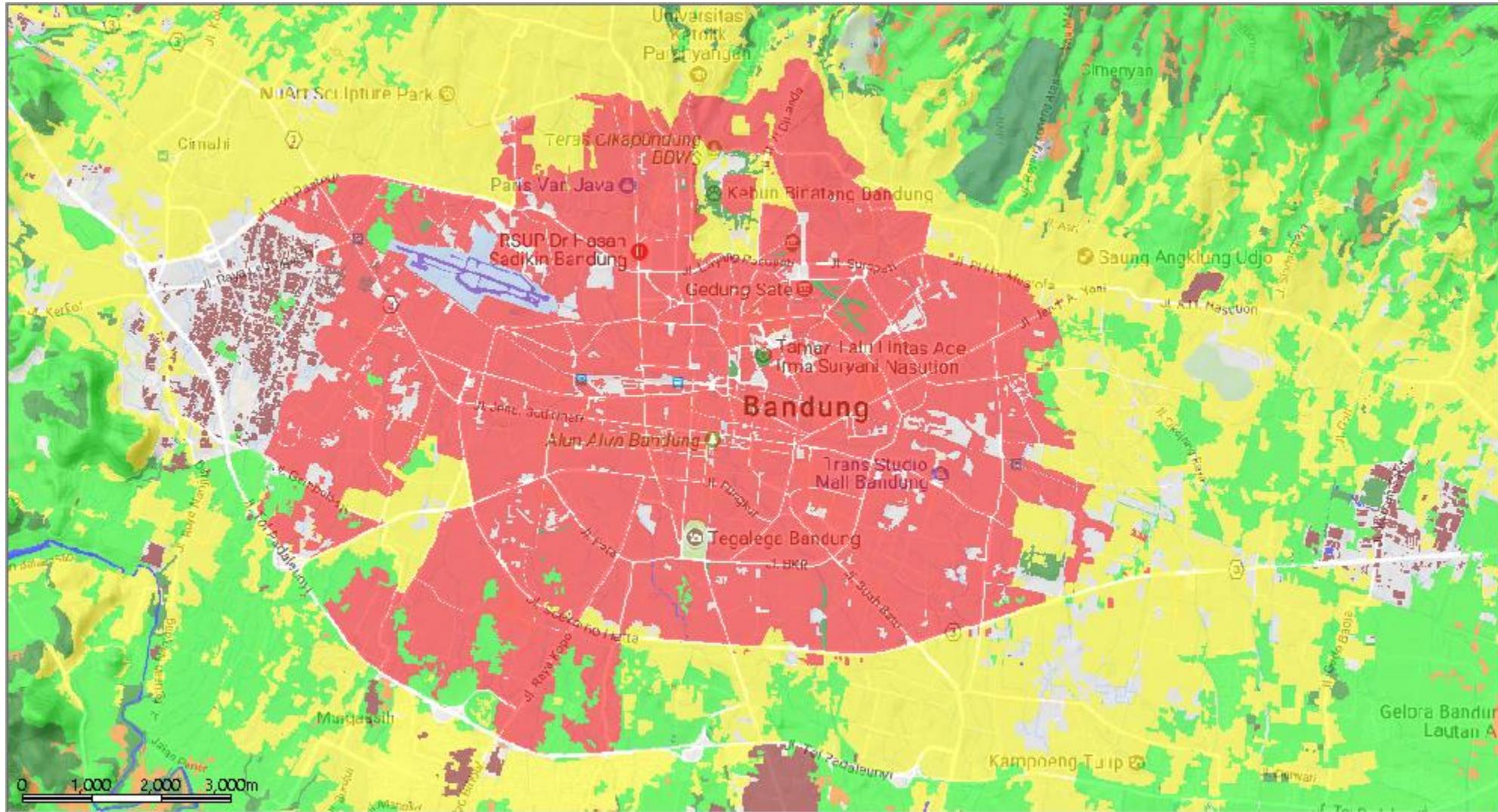
1. Open Geo Tab → right click Online Maps → New
2. Online Maps still blank
3. Minimize Atoll → open your training data → Open Online Maps.txt → Copy the URL
4. Online Maps already filled

# 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

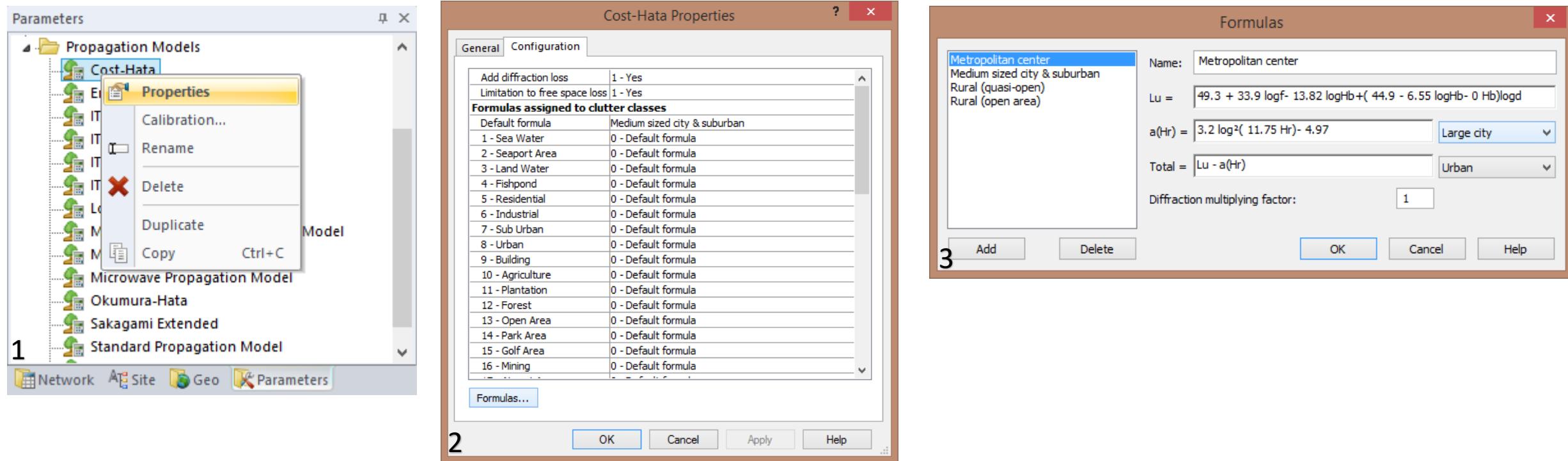


# Selecting Frequency Band

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
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

The screenshot shows a software interface for managing network parameters. On the left, the 'Parameters' tab is active, displaying a hierarchical tree structure of network equipment. The 'Radio Network Equipment' section is expanded, and the 'Antennas' folder is selected. A context menu is open at this node, with the 'Open Table' option highlighted. On the right, a detailed table provides specific information for each antenna model, including its name, gain, manufacturer, and comments. The table includes columns for Name, Gain (dBi), Manufacturer, and Comments. Several antenna models are listed, such as '100deg 14dBi 0Tilt Broadcast' and '30deg 18dBi 0Tilt 1800MHz'. The last row, which corresponds to the 'Open Table' option in the context menu, is currently selected.

	Name	Gain (dBi)	Manufacturer	Comments
1	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

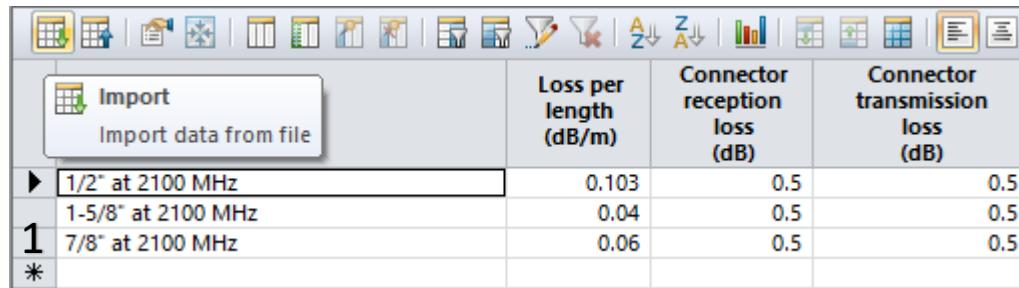
# Selecting Feeder

The screenshot shows the NetworkMiner software interface. On the left, the 'Parameters' tab is selected, displaying a tree view of network parameters. Under 'Radio Network Equipment', the 'Feeders' node is highlighted and right-clicked, with a context menu open containing the 'Open Table' option. To the right, a table lists various feeder options with their properties.

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

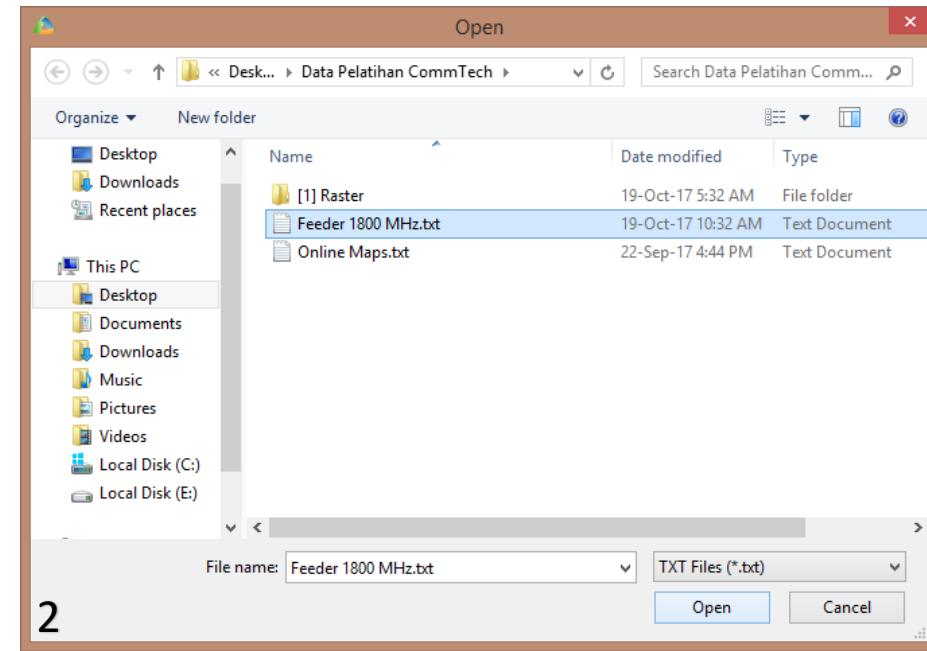
1. Go to Parameters Tab → Expand Radio Network Equipment → Right Click Feeders → Open Table
2. Check your Feeder

# Importing Feeders [1]

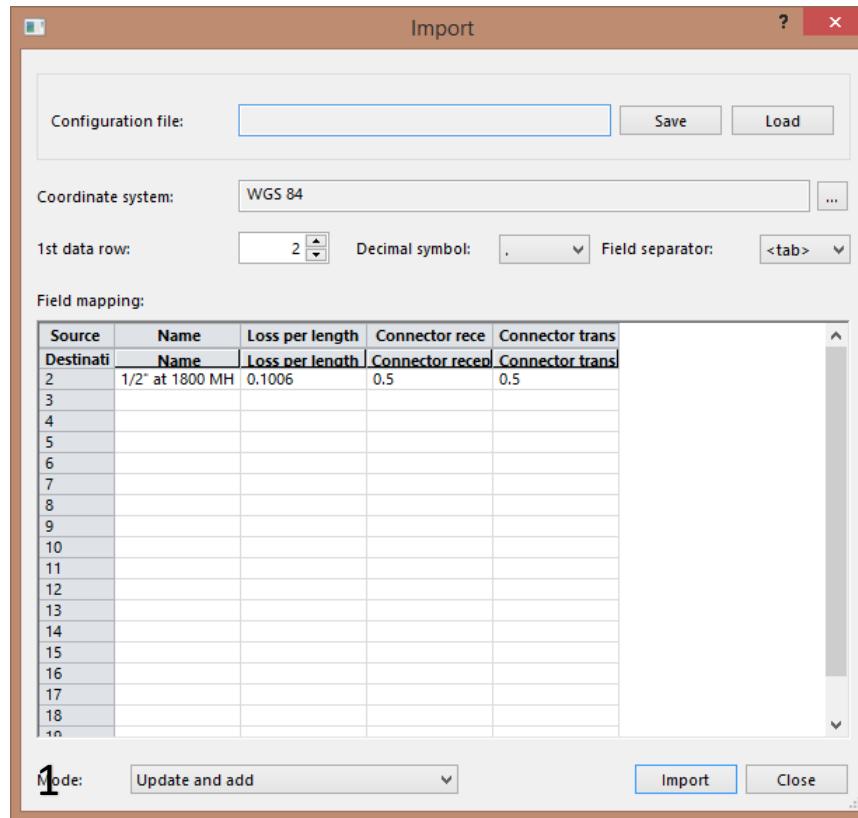


	Loss per length (dB/m)	Connector reception loss (dB)	Connector transmission loss (dB)
►	1/2" at 2100 MHz	0.103	0.5
1	1-5/8" at 2100 MHz	0.04	0.5
1	7/8" at 2100 MHz	0.06	0.5

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 Equipment

The image shows two screenshots of the 'Parameters' tab in a software interface, illustrating the steps to select equipment.

**Left Screenshot:** The 'Radio Network Equipment' section is expanded, showing 'Antennas', 'Smart Antennas', 'TMA', 'Feeders', 'Transmitter Equipment', 'Inter-technology Interference Reduction Factors', and 'Repeater Equipment'. The 'TMA' item is selected, and a context menu is open with the option 'Open Table' highlighted.

Name	Noise Figure (dB)	Reception gain (dB)	Transmission losses (dB)
Default TMA Equipment	1.5	12	0.5
*			

**Right Screenshot:** The 'Transmitter Equipment' item under 'Radio Network Equipment' is selected, and a context menu is open with the option 'Open Table' highlighted.

Name	Noise Figure (dB)	DL Losses due to the configuration (dB)	UL Losses due to the configuration (dB)
Default eNode-B Equipment	4	0	0
*			

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

The screenshot shows the Commtech.ATL software interface. On the left, the 'Parameters' tab is open, displaying a tree view of network settings. Under 'Radio Network Settings', the 'Frame Configuration' node is selected and highlighted with a yellow box. A sub-menu with the option 'Open Table' is shown next to it. The main workspace displays a table titled 'Frame Configurations: Pelatihan Com...'. The table has the following columns: Name, Total number of frequency blocks, PDCH 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), and Group 0 frequency blocks. The table lists several default configurations:

Name	Total number of frequency blocks	PDCH 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

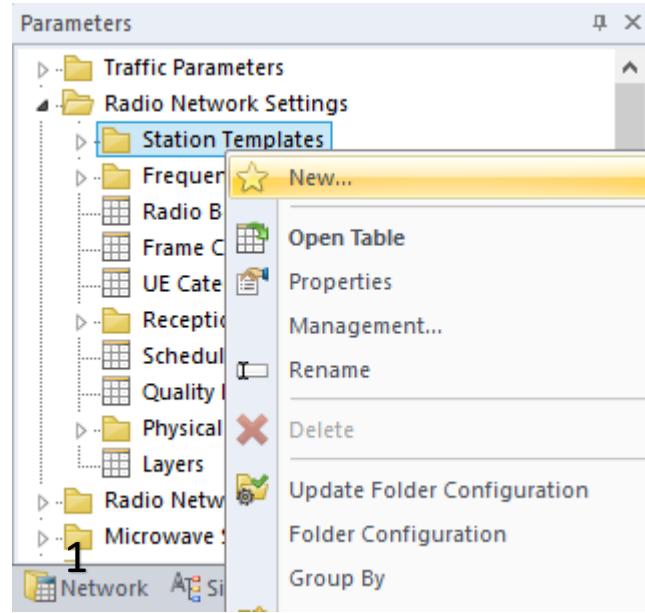
1

2

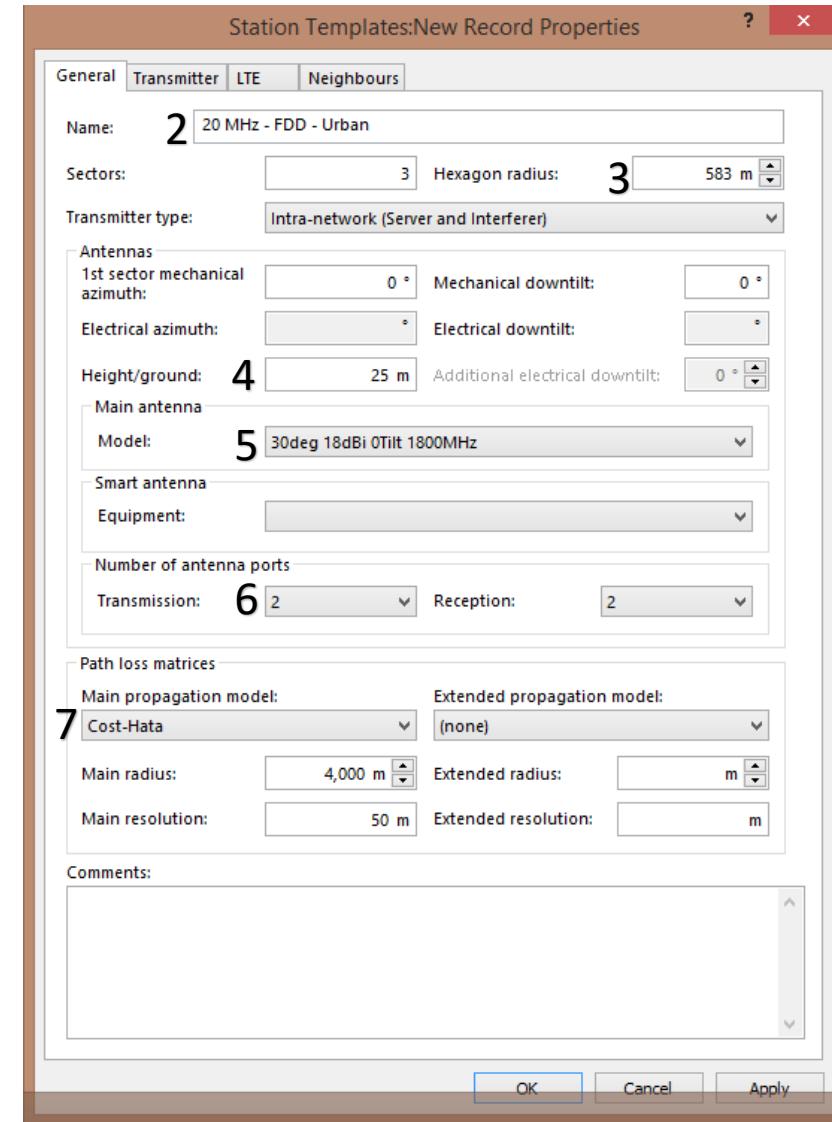
3

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]

Station Templates:New Record Properties

General Transmitter LTE Neighbours

Active

Transmission/Reception

Transmission		Reception	
Real	Computed	Real	Computed
4.02 dB	4.02 dB	-1.62 dB	-1.62 dB
		4 dB	4 dB

Total losses: 1

Noise figure:

Equipment Specifications

Both the selected equipment and the user-defined gains and losses are used to initialise the transmitter total UL and DL losses

TMA: 2 Default TMA Equipment ...

Feeder: 3 1/2" at 1800 MHz ...

Transmitter: 4 Default eNode-B Equipment ...

Transmission Reception

Feeder length: 5 30 m ↑ ↓ 33 m ↑ ↓

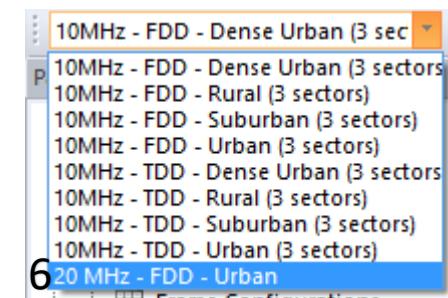
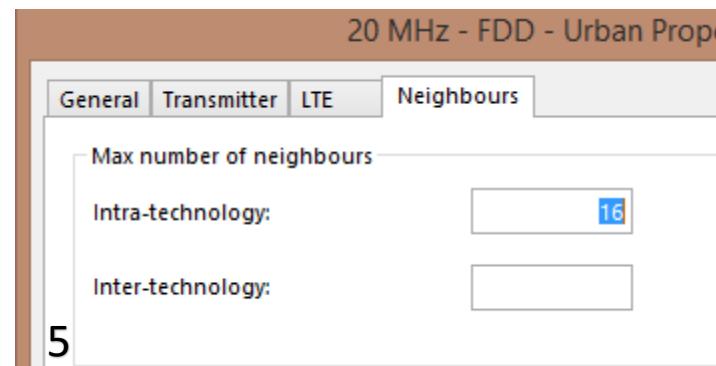
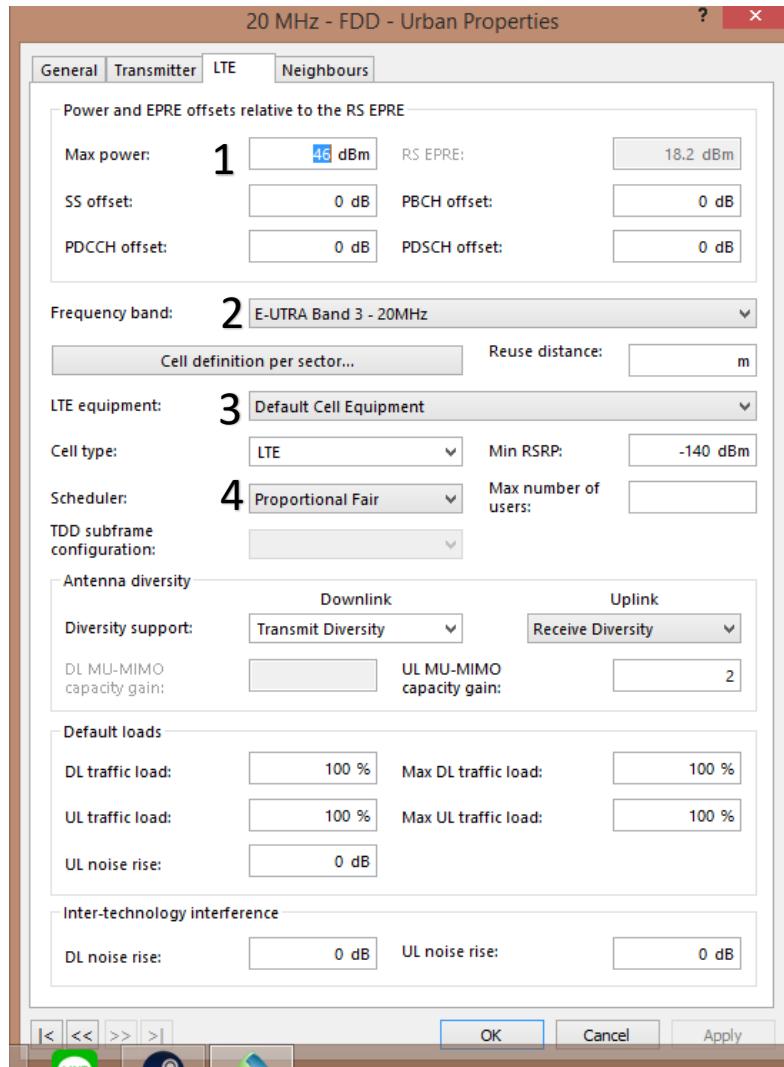
Miscellaneous losses: 0 dB ↑ ↓ 0 dB ↑ ↓

Loss related to repeater noise rise: 0 dB

Commit Cancel

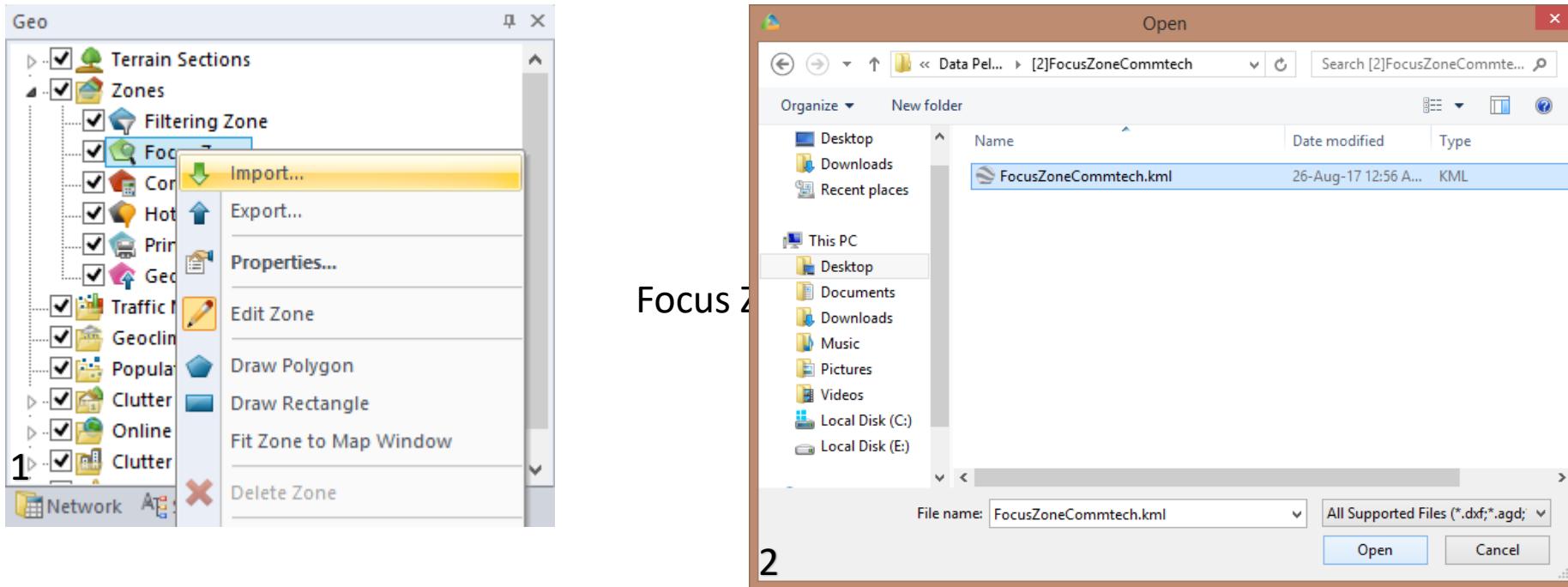
1. Go to Transmitter tab → Equipment
2. Choose TMA equipment
3. Choose Feeder
4. Choose Transmitter
5. Choose Feeder length → Commit

# Station Template Configuration [3]



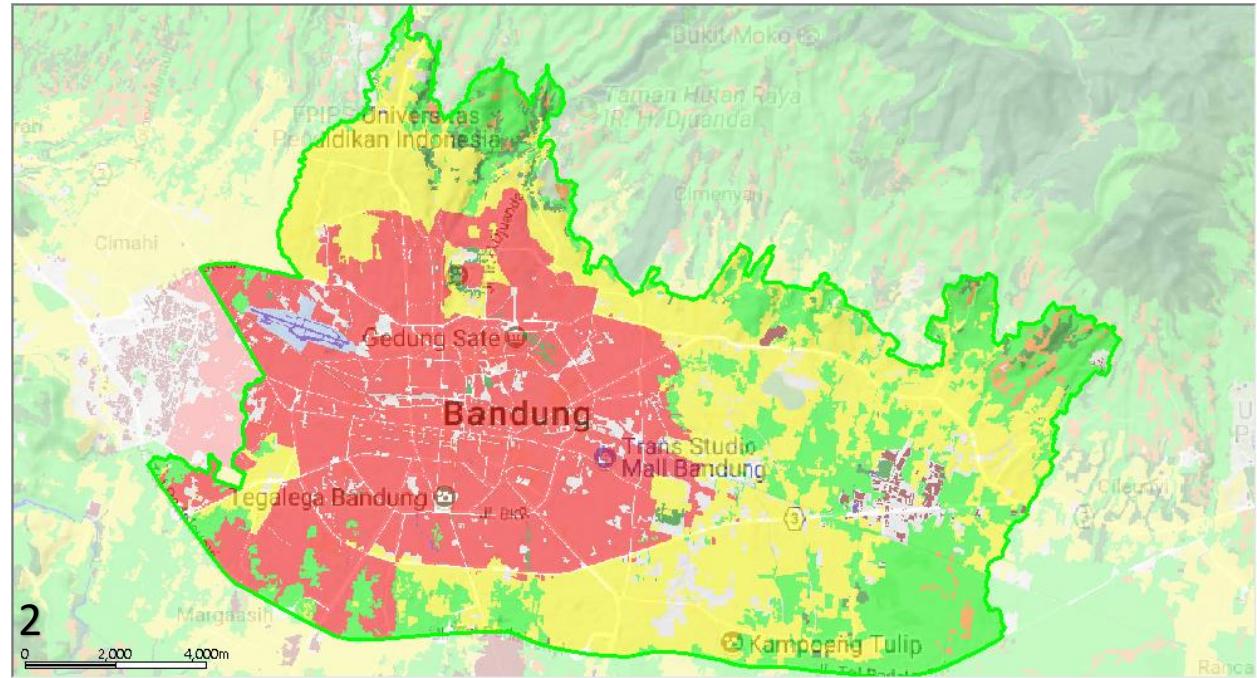
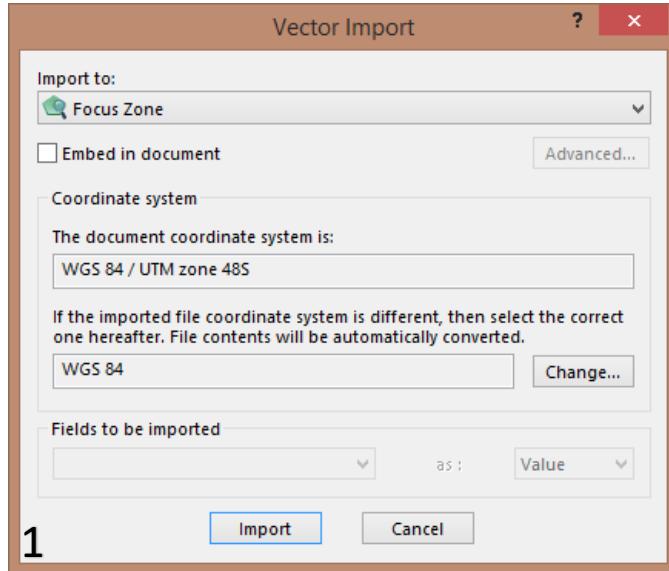
1. Choose your Max Power
2. Go to LTE tab → Choose your frequency band
3. Choose LTE equipment
4. Choose Scheduler
5. Go to Neighbour tab → set your neighbour → OK
6. In Workplace → Change your station to the new one

# Focus Zone [1]



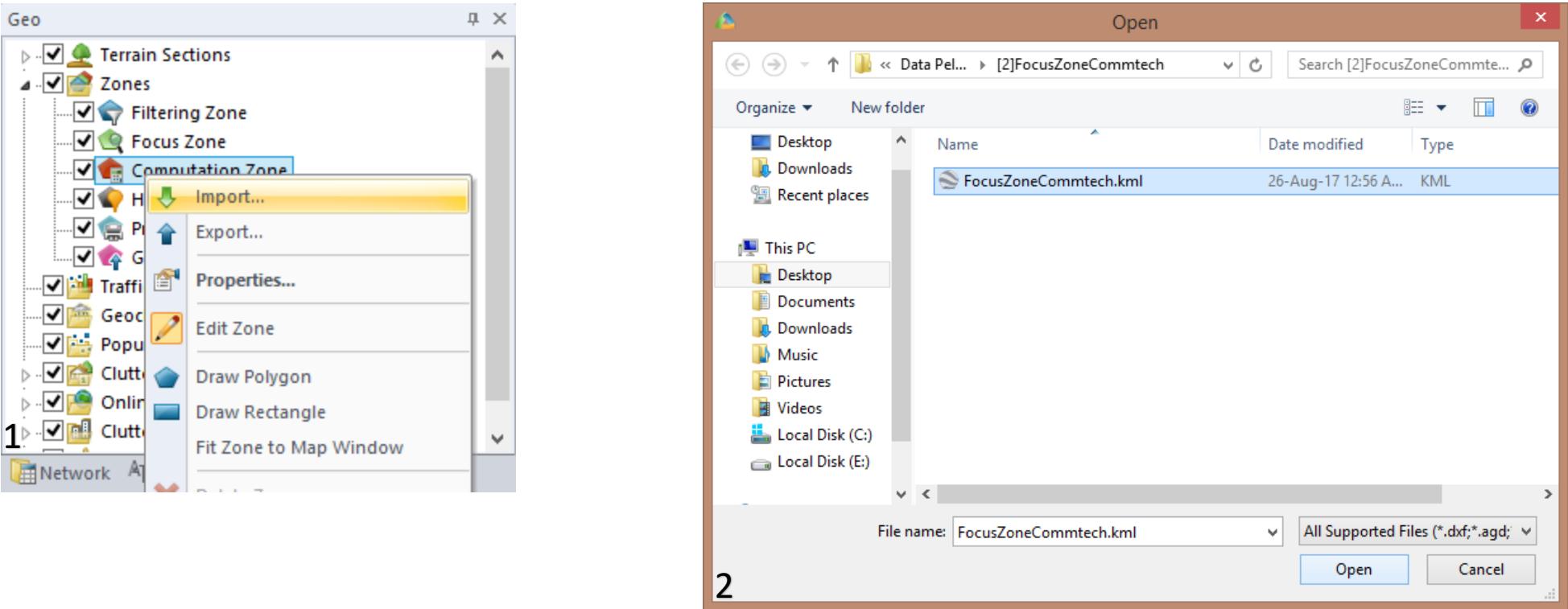
1. Go to Geo tab → Right click Focus Zone → Import
2. Find your file → Open

# Focus Zone [2]



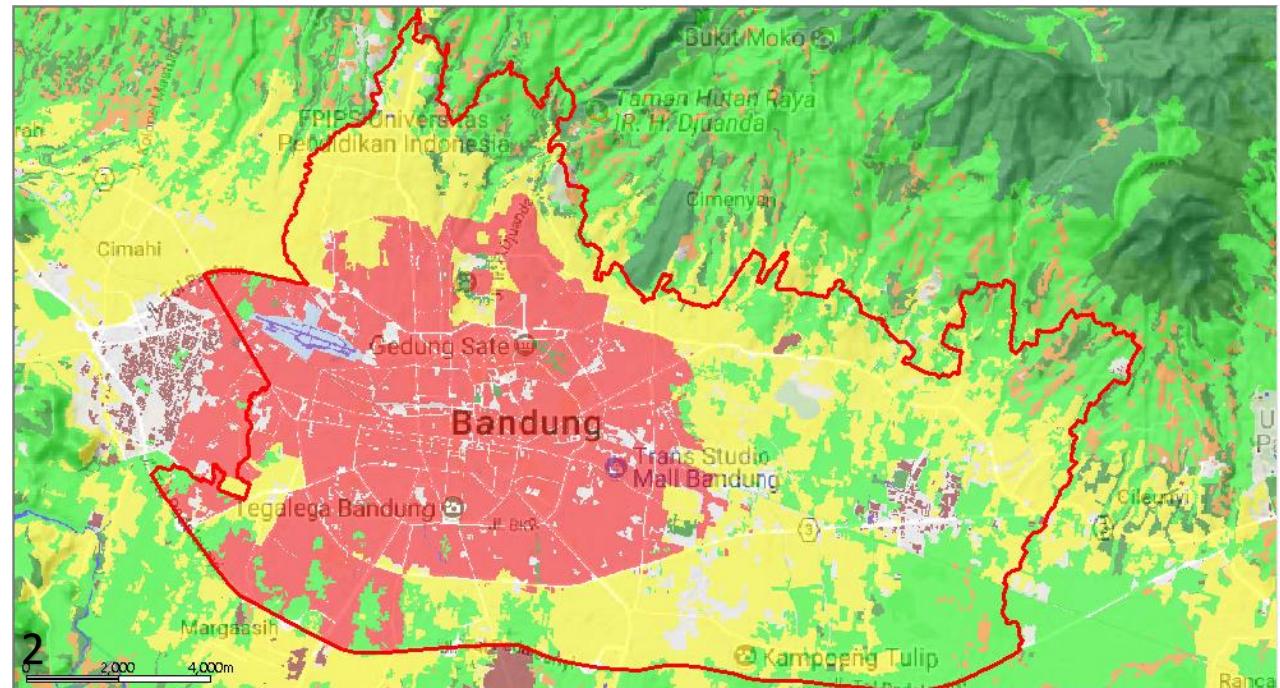
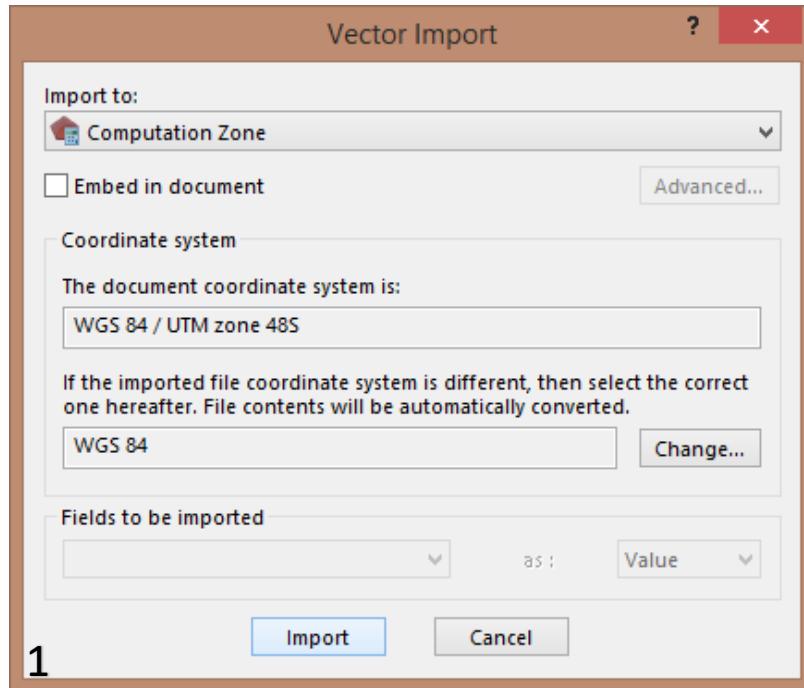
1. Click Import
2. Result of your Focus Zone

# Computational Zone [1]



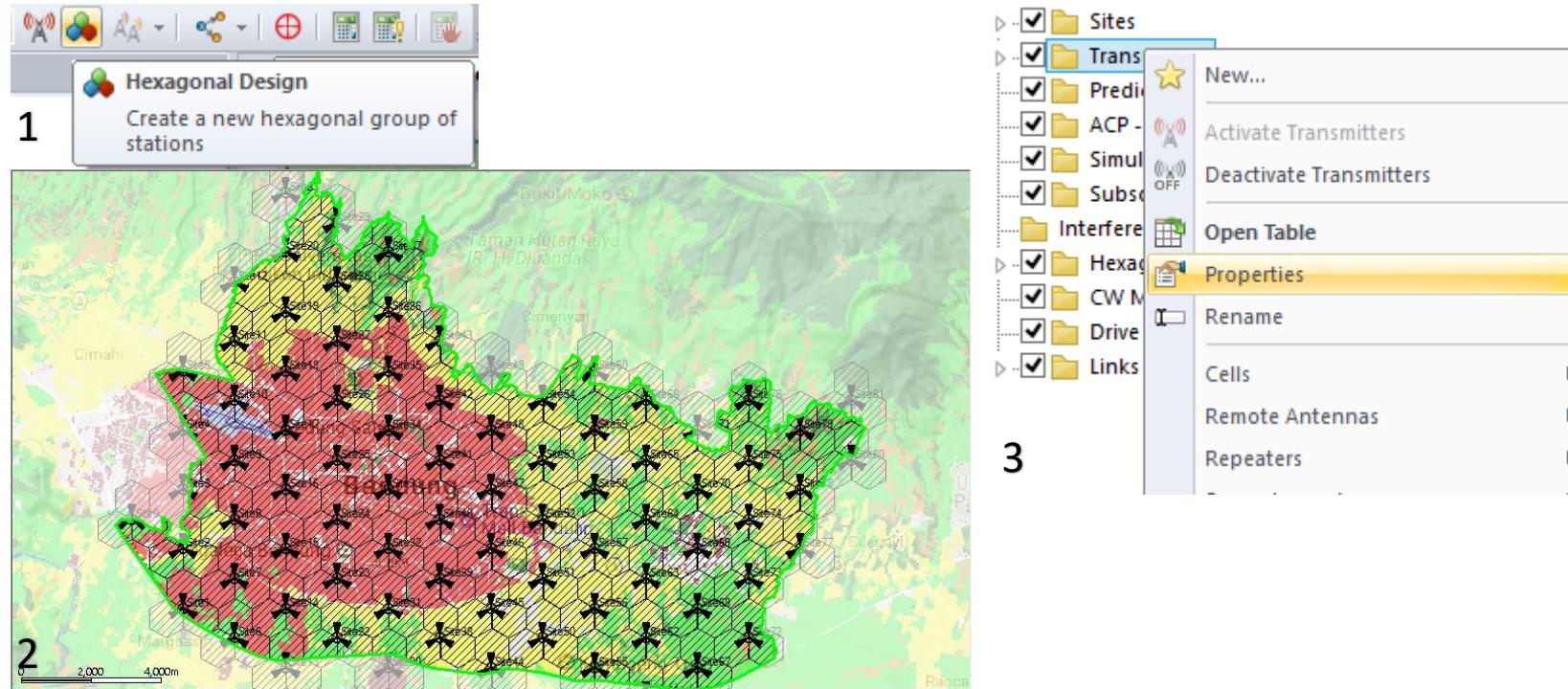
1. Right click Computational Zone → Import
2. Find your file → Open

# Computational Zone [2]



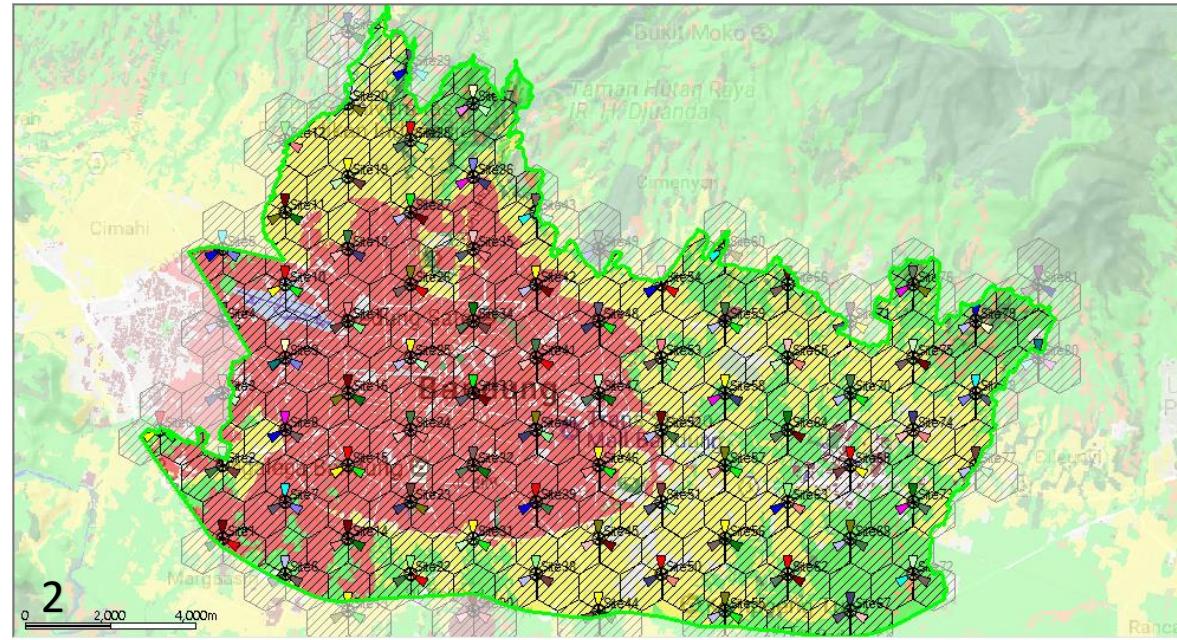
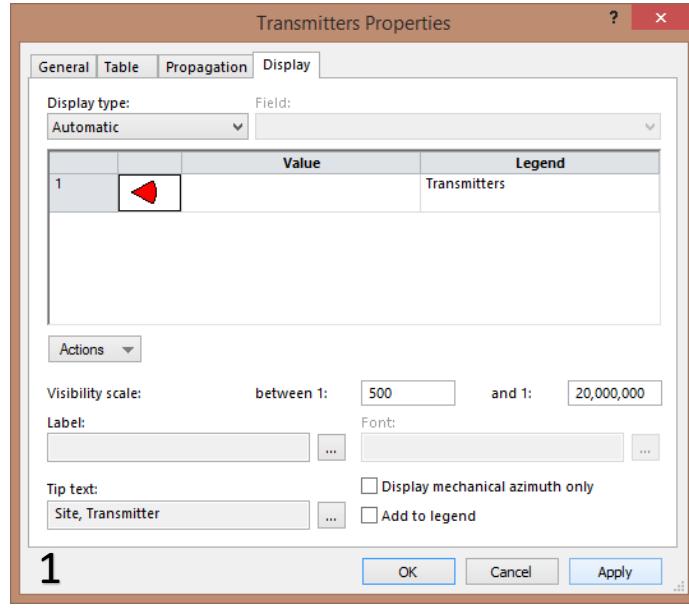
1. Select Import
2. The result of your Computational Zone

# Plotting Site [1]



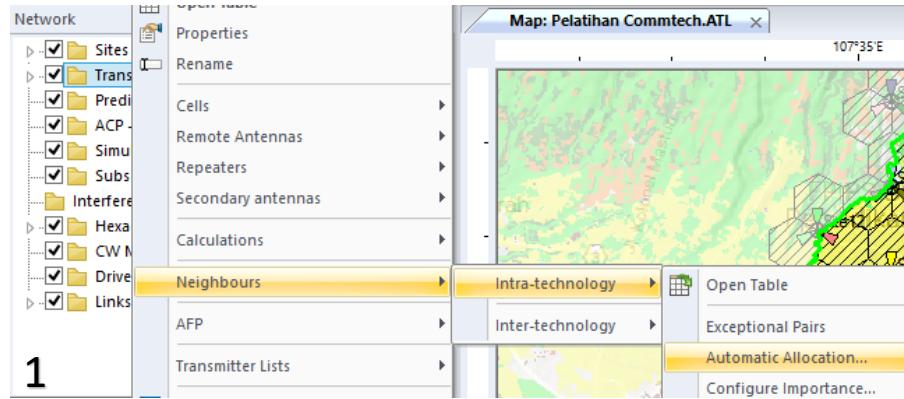
1. Click Hexagonal Design
2. Plot your site on map
3. Right Click Transmitter → Properties

# 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

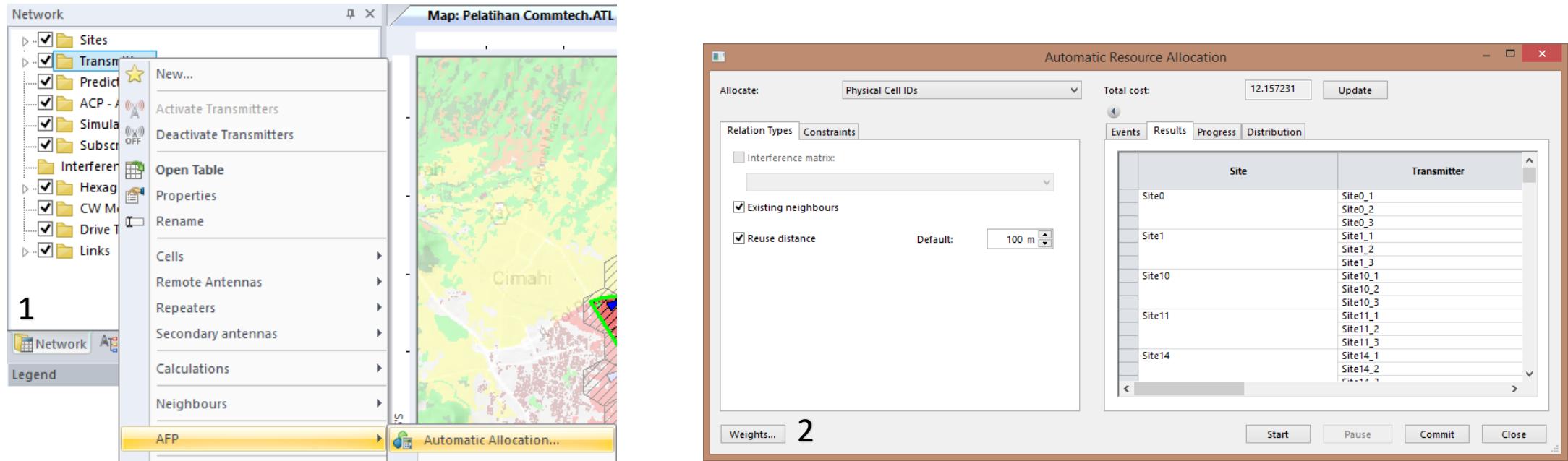
The screenshot shows the 'Automatic Neighbour Allocation' dialog box. The 'Intra-technology Neighbours' tab is active. Configuration settings include: Max inter-site distance: 10,000 m, Max no. of neighbours: 16, Use coverage conditions (checked), Min RSRP by Cell: RSRP Margin: 5 dB, Define... button, and % min covered area: 10 %. On the right, several checkboxes are checked: Force co-site cells as neighbours, Force adjacent cells as neighbours, Force symmetry (unchecked), Force exceptional pairs (unchecked), and Delete existing neighbours. Below the configuration is a 'Results:' table:

Cell	Number	Maximum number	Neighbour	Importance (%)	Cause	Relation type	Coverage (%)	Coverage (km²)	Adjacency (%)	Adjacency (km²)	Commit
Site0_1 (0)	2	16	Site0_3	88	Co-Site	Intra-c	100	0.005	50	0.0025	<input checked="" type="checkbox"/>
			Site0_2	64	Co-Site	Intra-c					<input checked="" type="checkbox"/>
Site0_2 (0)	5		Site0_3	85.3	Co-Site	Intra-c	65.17	0.145	56.18	0.125	<input checked="" type="checkbox"/>
			Site0_1	64	Co-Site	Intra-c					<input checked="" type="checkbox"/>
Site2_3			Site2_3	37.98	Adjacent	Intra-c	24.72	0.055	16.85	0.0375	<input checked="" type="checkbox"/>
			Site2_1	34.14	Adjacent	Intra-c	8.99	0.02	3.37	0.0075	<input checked="" type="checkbox"/>
Site3_3			Site3_3	33.02	Adjacent	Intra-c	1.12	0.0025	1.12	0.0025	<input checked="" type="checkbox"/>
			Site0_2	87.03	Co-Site	Intra-c	67.57	0.0625	62.16	0.0575	<input checked="" type="checkbox"/>
Site0_3 (0)	3		Site0_1	64	Co-Site	Intra-c					<input checked="" type="checkbox"/>
			Site2_3	40.76	Adjacent	Intra-c	32.43	0.03	29.73	0.0275	<input checked="" type="checkbox"/>
Site1_1 (0)	5		Site1_3	71.69	Co-Site	Intra-c	24.79	0.0725	19.66	0.0575	<input checked="" type="checkbox"/>
			Site1_2	68.41	Co-Site	Intra-c	12.82	0.0375	11.97	0.035	<input checked="" type="checkbox"/>
Site2_3			Site2_3	38.03	Adjacent	Intra-c	23.08	0.0675	17.95	0.0525	<input checked="" type="checkbox"/>
			Site7_3	37.41	Adjacent	Intra-c	19.66	0.0575	16.24	0.0475	<input checked="" type="checkbox"/>

Buttons at the bottom include Calculate, Compare, Commit, and Close.

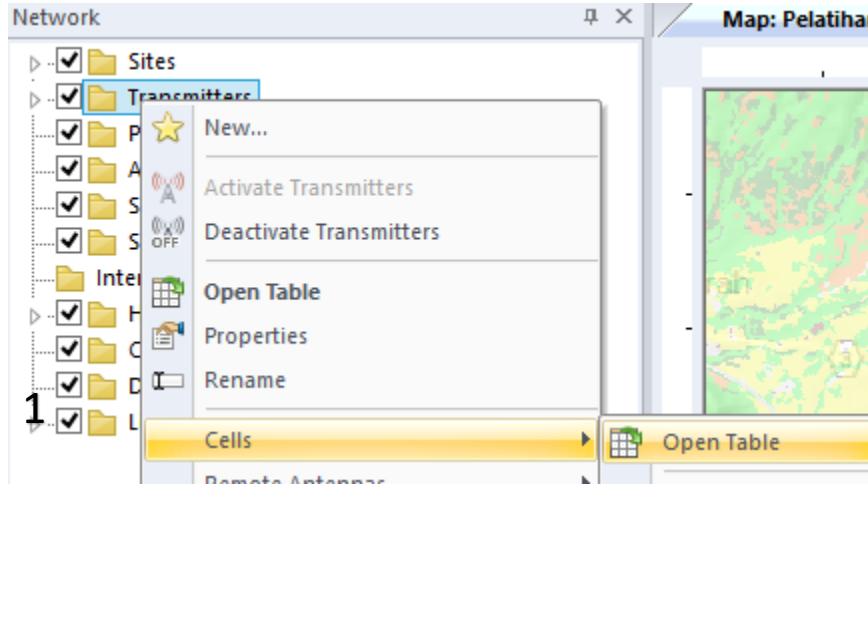
2

# PCI Allocation [1]



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

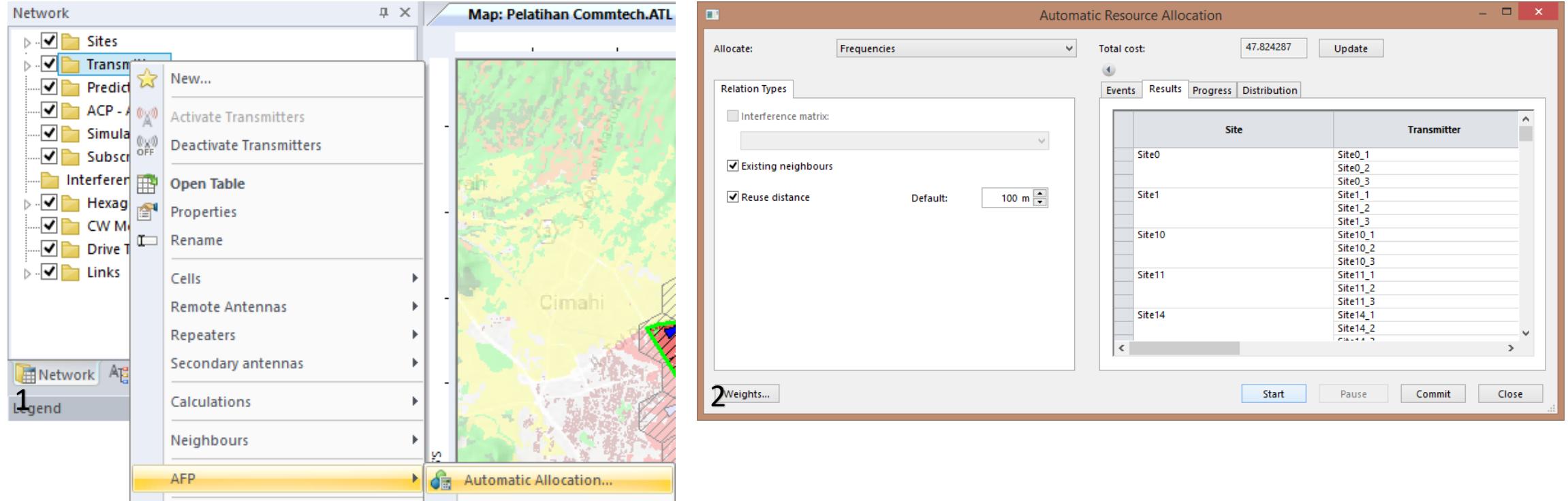
# PCI Allocation [2]



	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	1,300	Not Allocate		482	2	160	Allocated	Allocated		46
2	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

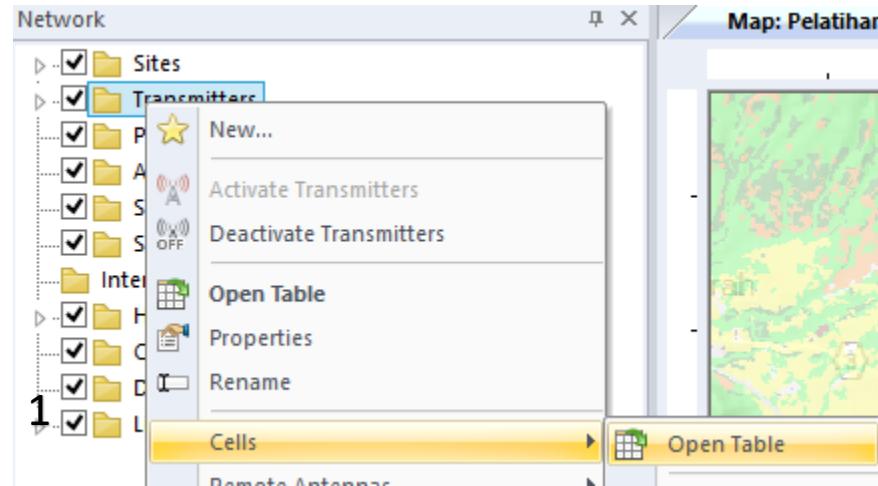
1. Right click Transmitter → Cells → Open Table
2. Your PCI already allocated

# Frequency Allocation [1]



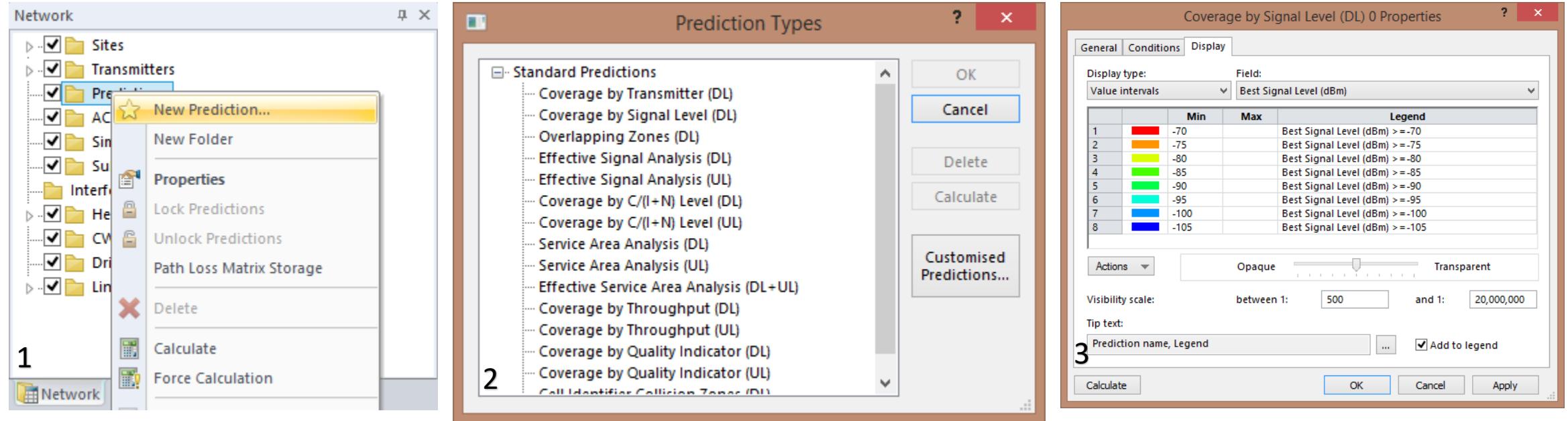
1. Right click Transmitter → AFP → Automatic Allocation
2. Choose Frequencies, Calculate → Commit

# Frequency Allocation [2]



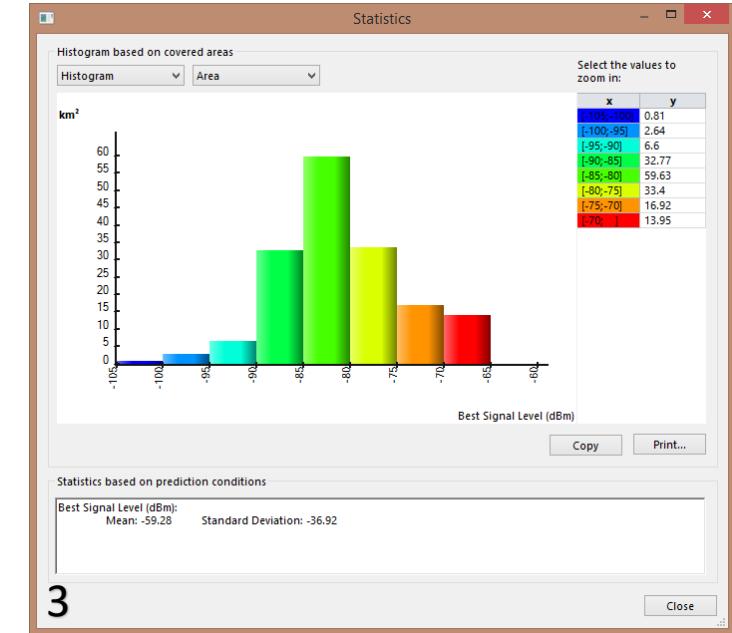
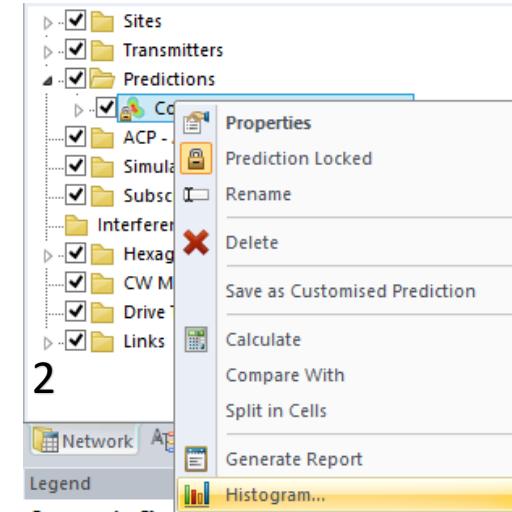
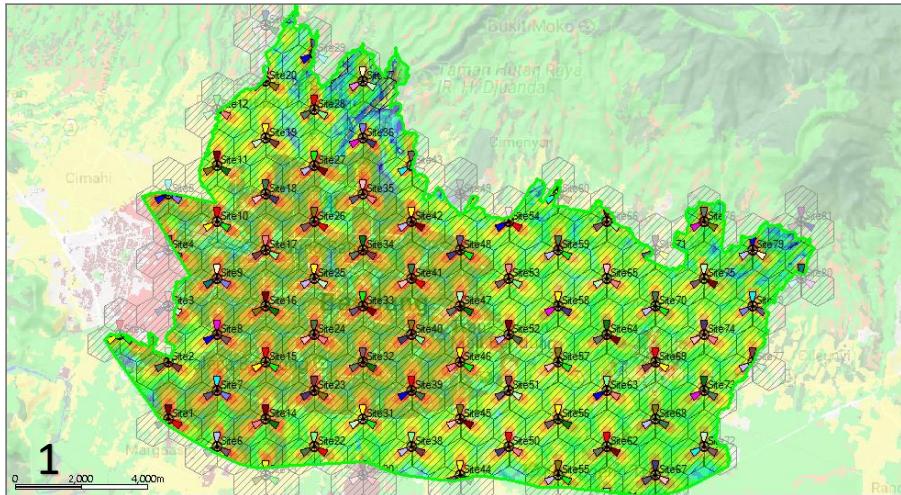
1. Right click Transmitter → Cells → Open Table
  2. Your frequency already allocated

# Coverage Simulation [1]



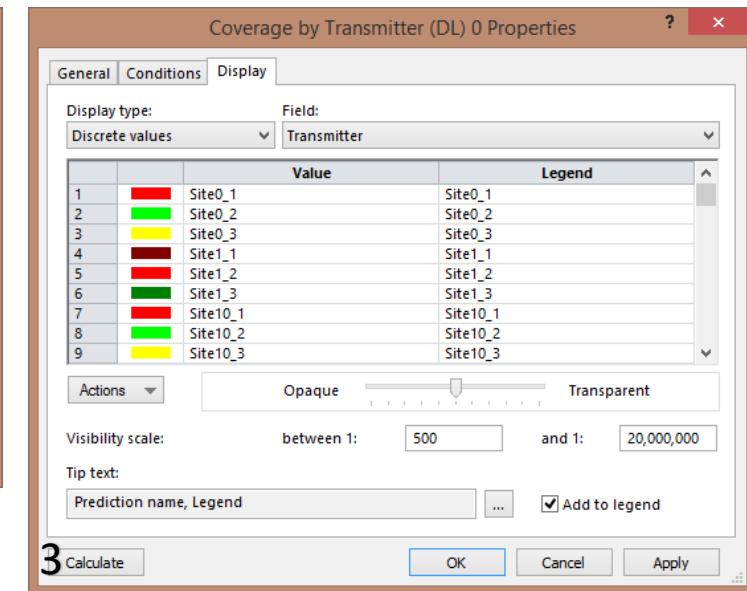
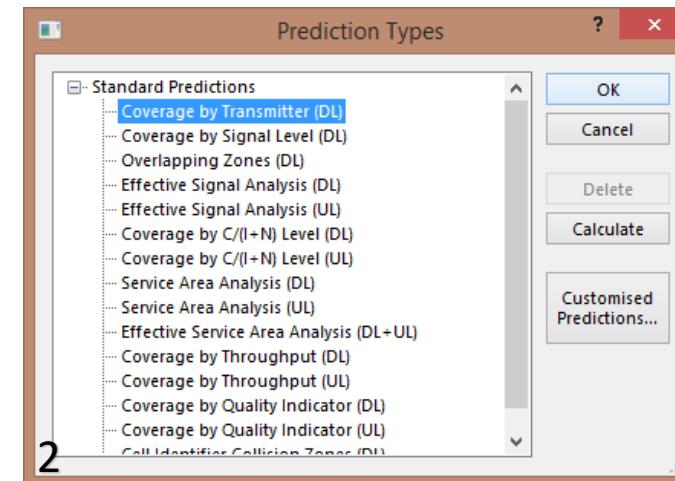
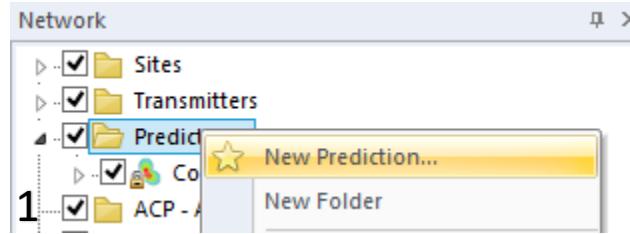
1. Right click Prediction → New Prediction
2. Select Prediction Types → OK
3. In Display Tab, click Calculate

# Coverage Simulation [2]

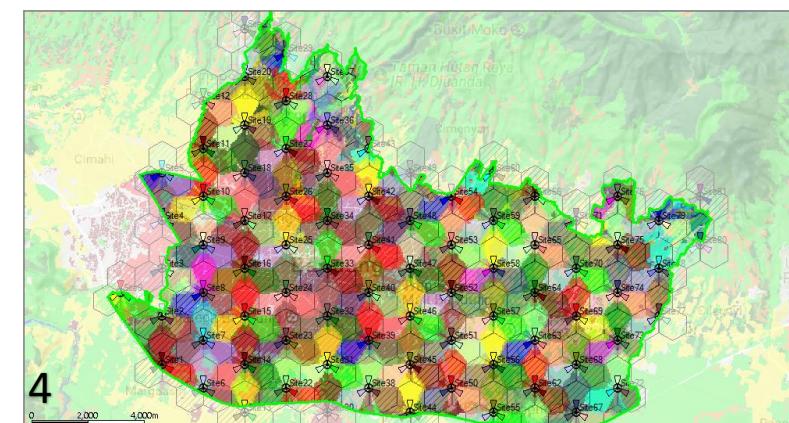


1. Prediction result
2. Right click Coverage prediction → Histogram
3. Histogram result

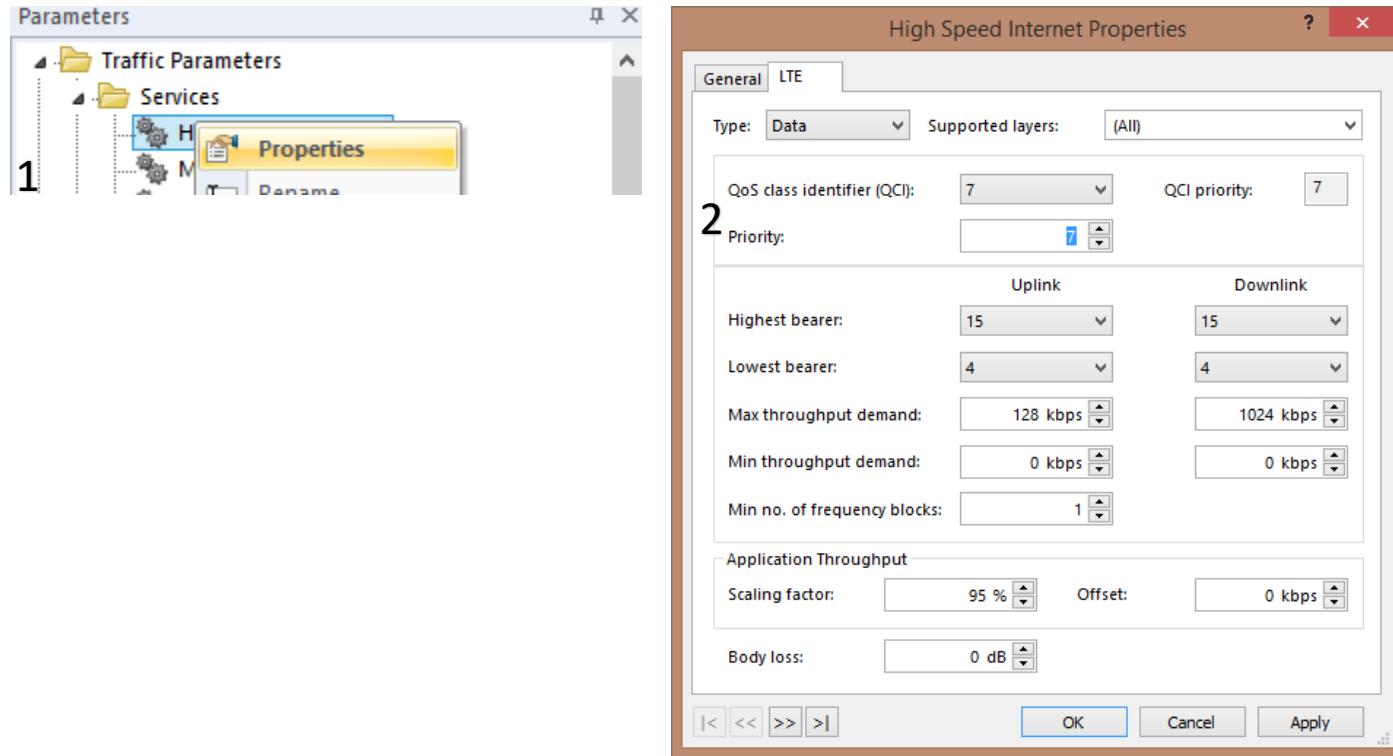
# Coverage by Transmitter



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

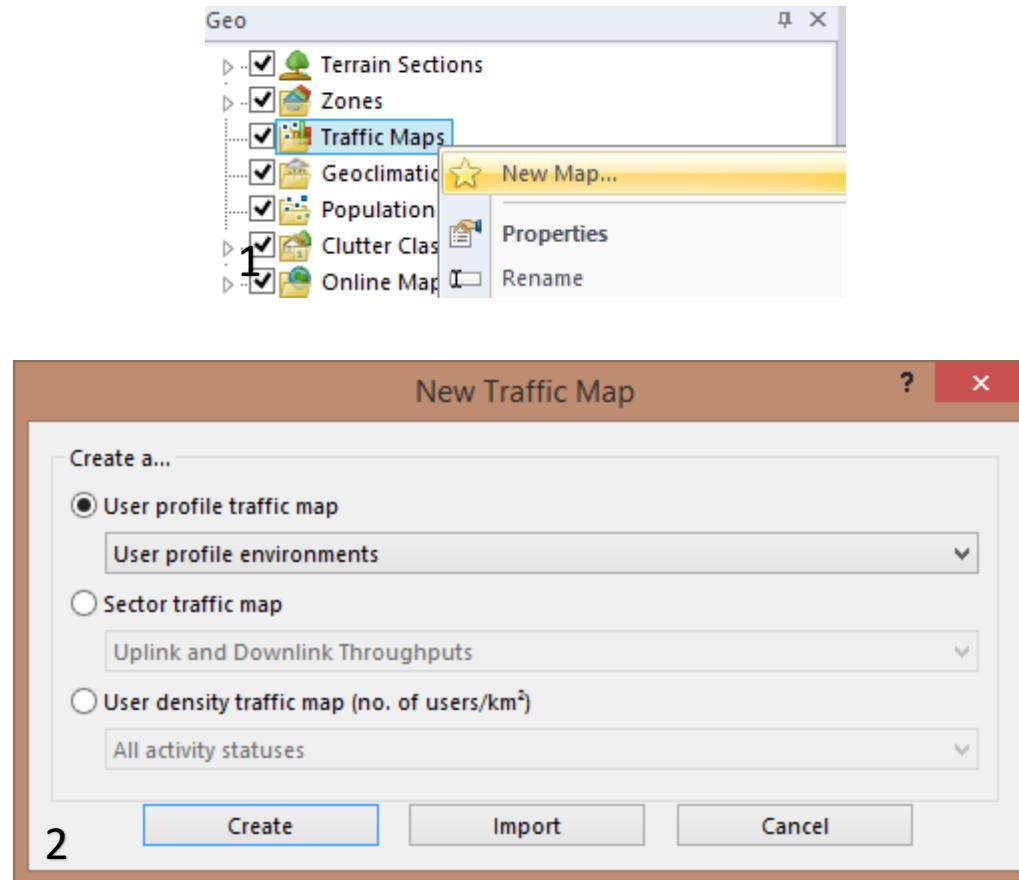


# Traffic & QOS Simulation [1]



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

# Traffic & QOS Simulation [2]

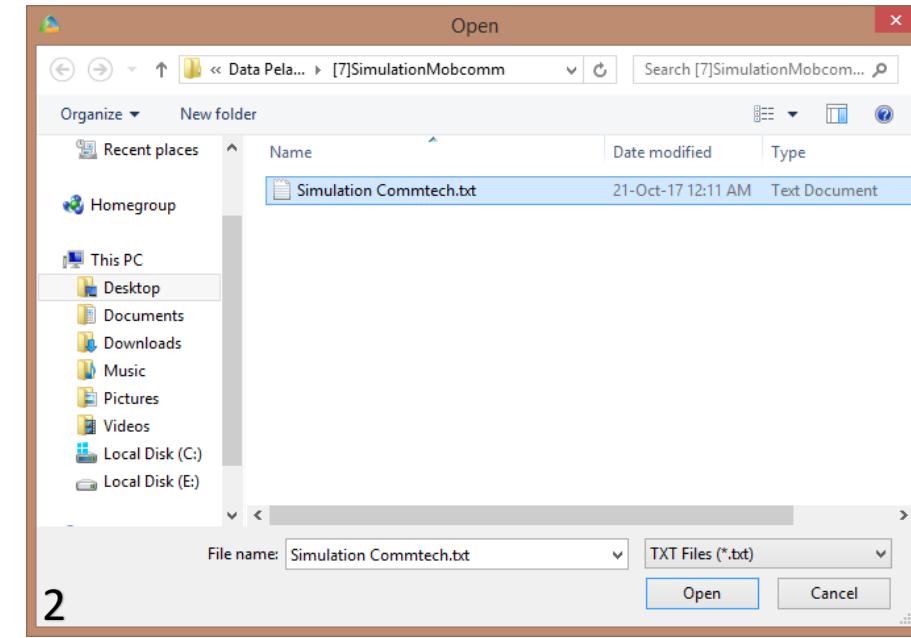
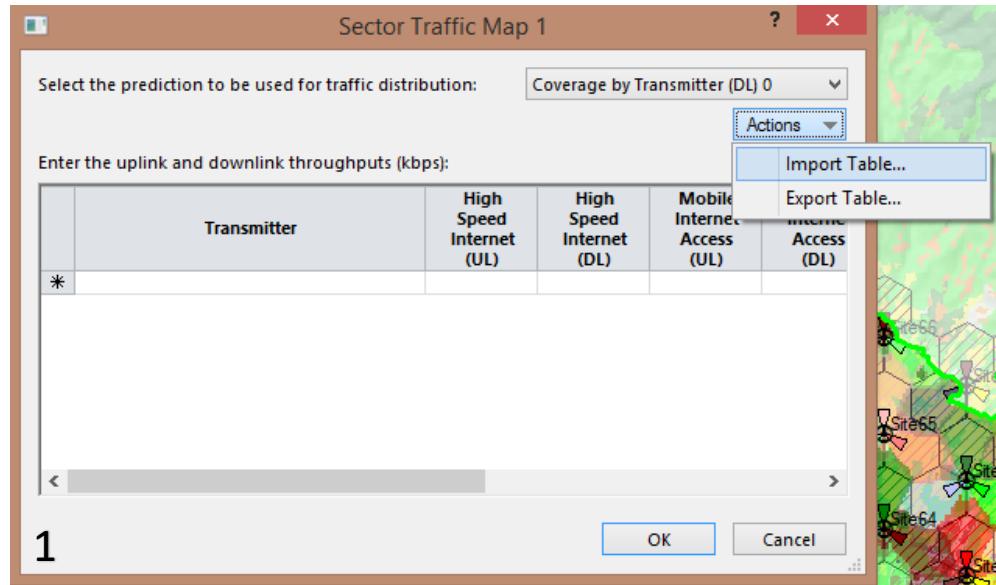


1. Go to Traffic Maps → New Map

2. Explanation

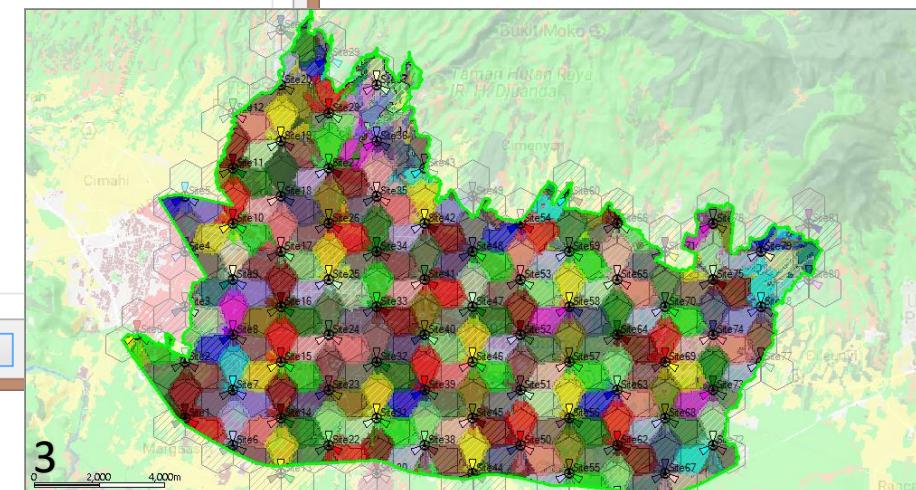
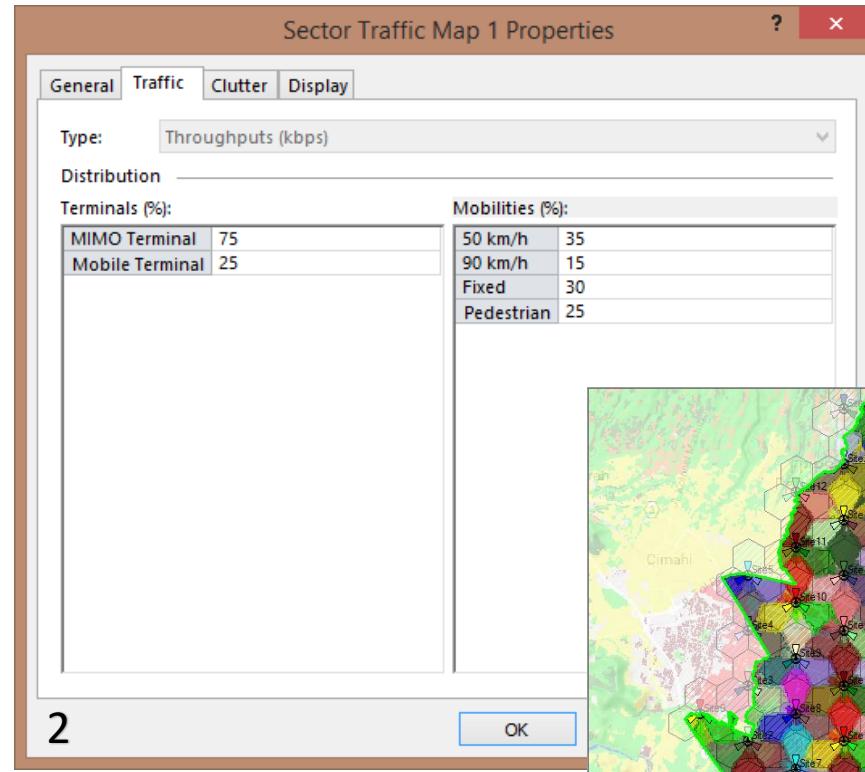
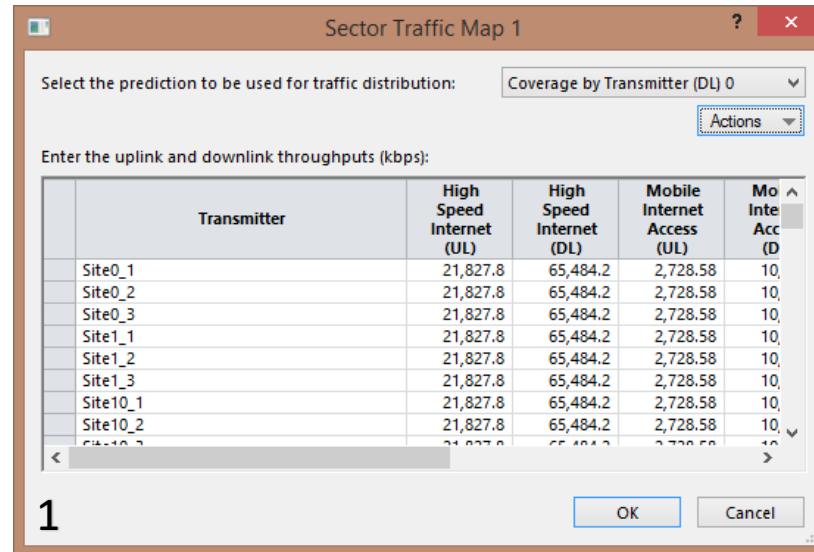
- User Profile Traffic Map: Describes user densities with user profiles, mobility type, and user profile environment based traffic map
- Sector traffic Map: describes spread of traffic over coverage area of each transmitter
- User Density Traffic Map: Provides the number of connected users per unit of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

# Traffic & QOS Simulation [3]



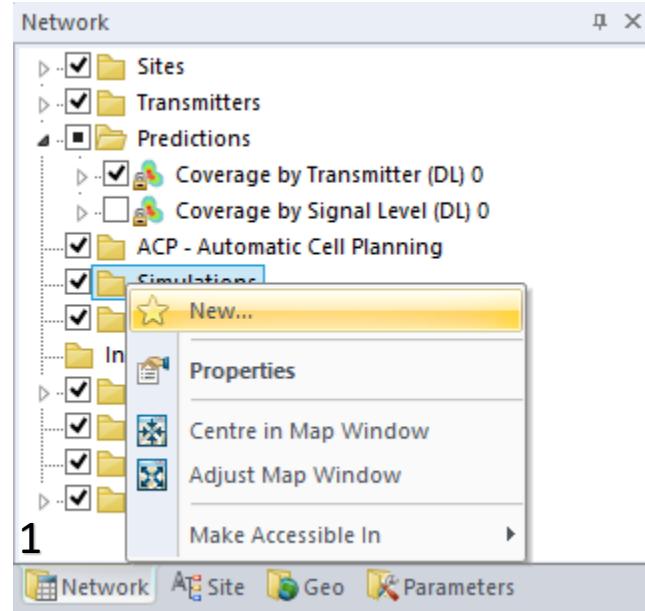
1. Right click Actions → Import Table
2. Choose your file → Open

# Traffic & QOS Simulation [4]

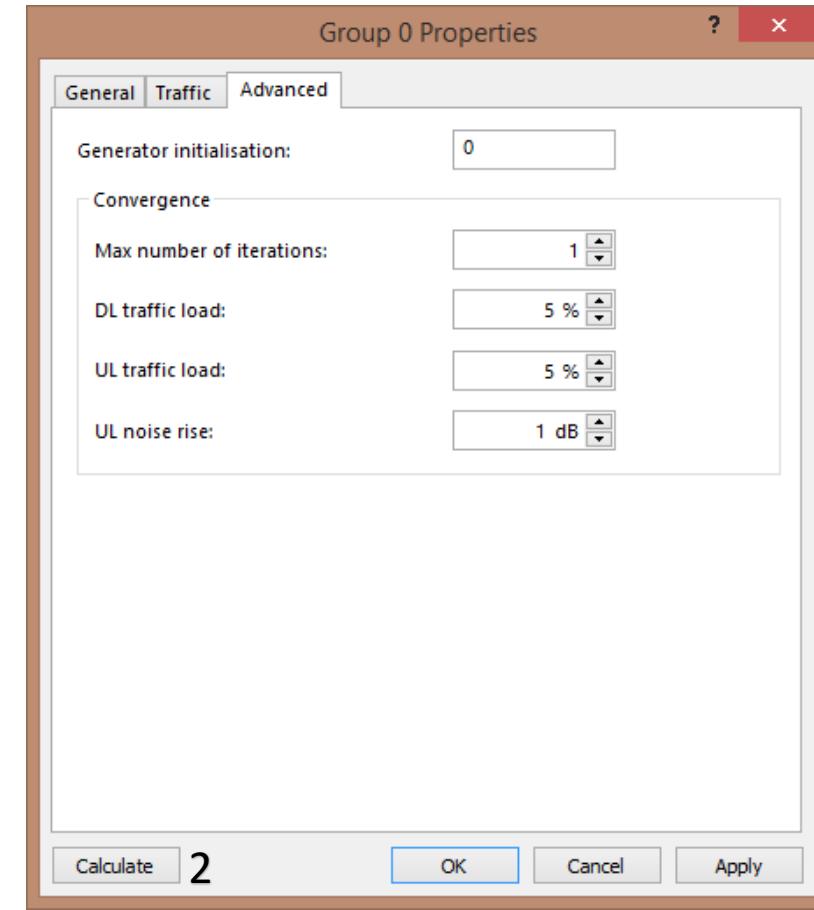


1. Click OK
2. Fill the Terminals and Mobility → OK
3. Result

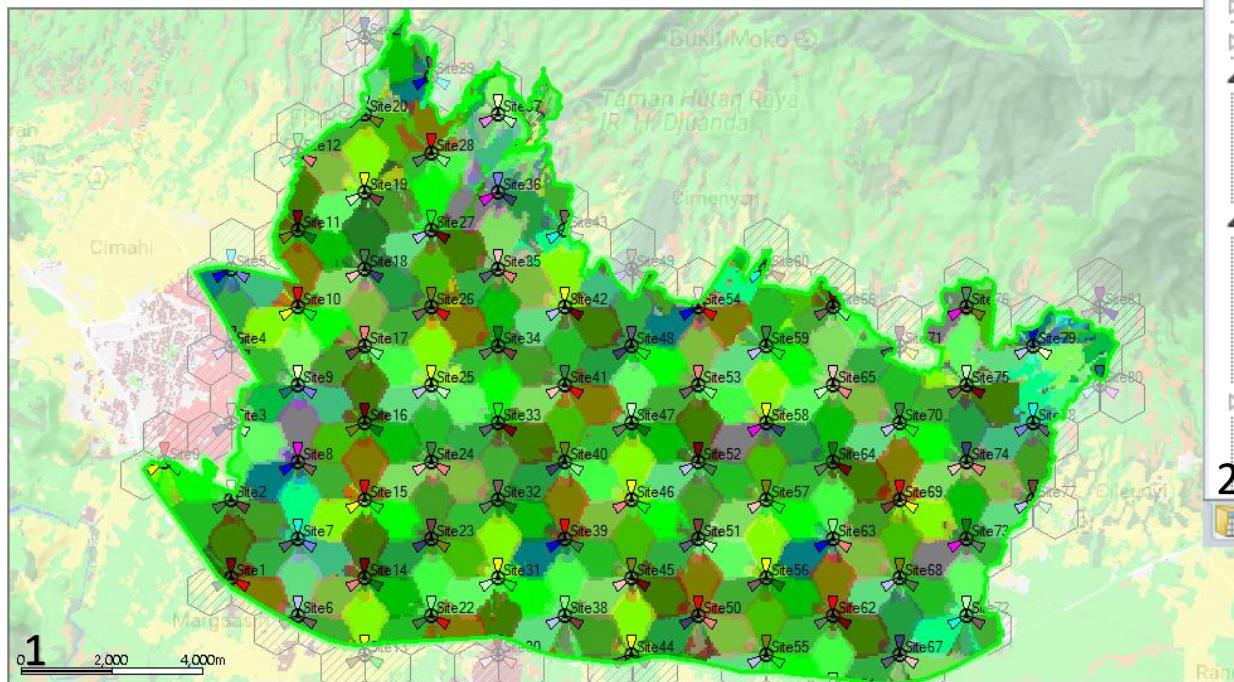
# Traffic & QOS Simulation [5]



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



# Traffic & QOS Simulation [E]



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

1

2

3

Network

Sites

Transmitters

Predictions

- Coverage by Transmitter (DL) 0
- Coverage by Signal Level (DL) 0

ACP - Automatic Cell Planning

Simulations

- Group 0
- Simulation 0

Properties

Simulation 0 Properties

Statistics Sites Cells Mobiles Initial Conditions

Demand:

Total number of users trying to connect  
Users: 270,735  
Active: Downlink: 36,965 Uplink: 117,670 Downlink + Uplink: 103,221  
Inactive: 12,879  
DL:  
Max Throughput Demand (DL): 69,102.59 Mbps  
Min Throughput Demand (DL): 3,658.94 Mbps  
UL:  
Max Throughput Demand (UL): 23,184.89 Mbps  
Min Throughput Demand (UL): 1,698.33 Mbps

Results:

The simulation did not converge:  
Number of Iterations: 1

Total number of users not connected (rejected): 10,845 (4%)  
No Coverage: 17  
No Service: 10,828  
Scheduler Saturation: 0  
Resource Saturation: 0  
Backhaul Saturation: 0

Close