



WEBINAR ATDI 12.05.20202

WEBINAR 5G coverage modeling and validation

HTZ: Radio Network Planning Tool

TODAY'S Speakers

ATDI Sydney office



Senior spectrum Engineer
Mr. Yahya Khaled
y.khaled@atdi-group.com

**Yahya
(Presenter)**

ATDI Sydney office



Senior RF Engineer
Mr. Farhad Sedghi
f.sedghi@atdi-group.com

**Farhad
(Moderator)**

TODAY'S AGENDA



Topics covered

- Network importation & antenna placement challenges in 3D environment
- Antenna and power modeling: broadcast beam and Beam-forming capabilities
- 5G numerology & link budget auto computation (RBs/SC)
- SS-RSRP coverage predictions and analysis

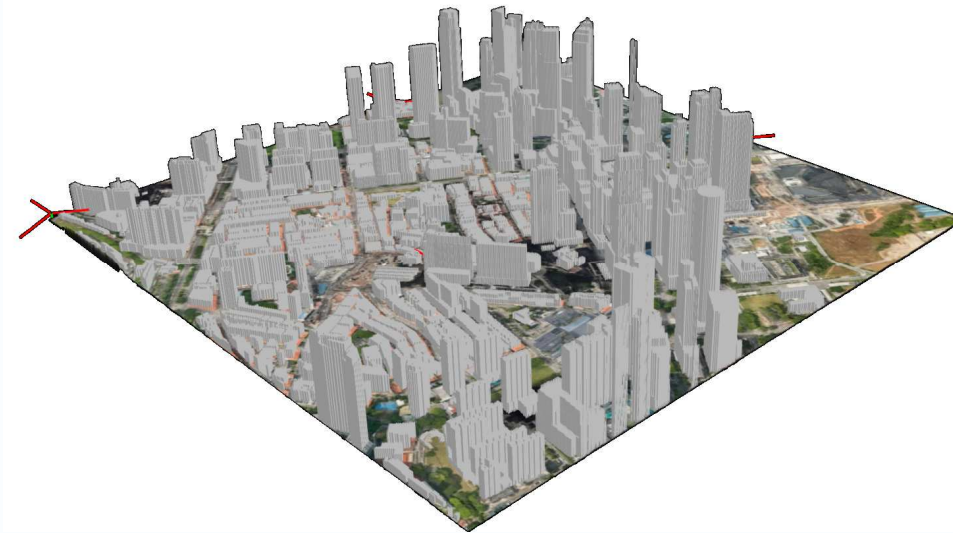


TODAY'S AGENDA

Topics covered

- Statistical analysis
- Throughput predictions, massive MIMO configuration and Carrier aggregation
- Neighbor planning and Handover maps
- Coverage exportation and online publishing

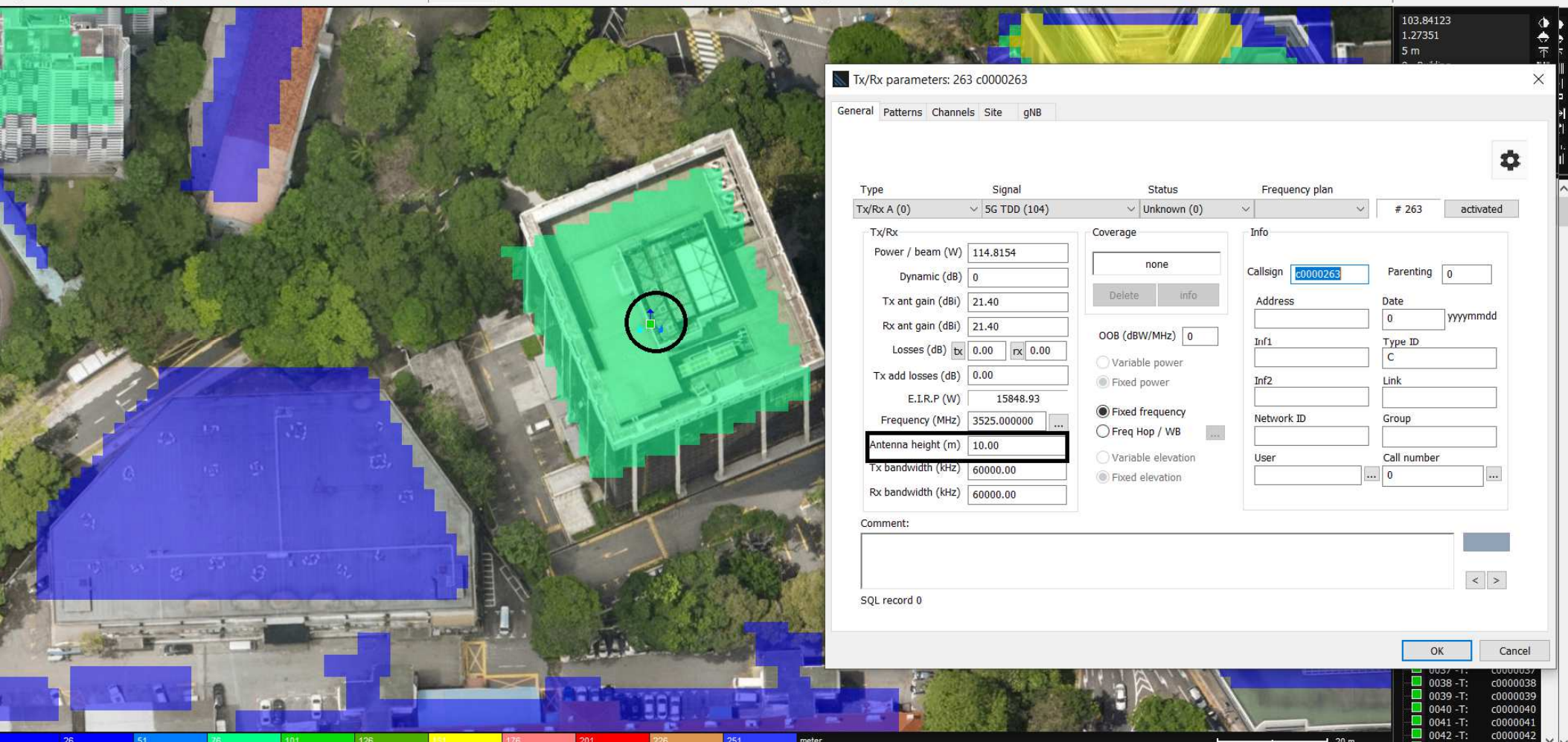
3D Antenna placement challenges



3D challenges

Antenna placement in 3D environment

.



Tx/Rx parameters: 263 c0000263

General Patterns Channels Site gNB

Type	Signal	Status	Frequency plan
Tx/Rx A (0)	5G TDD (104)	Unknown (0)	# 263 activated

Tx/Rx

Power / beam (W) 114.8154
Dynamic (dB) 0
Tx ant gain (dBi) 21.40
Rx ant gain (dBi) 21.40
Losses (dB) tx 0.00 rx 0.00
Tx add losses (dB) 0.00
E.I.R.P (W) 15848.93
Frequency (MHz) 3525.000000
Antenna height (m) 10.00
Tx bandwidth (kHz) 60000.00
Rx bandwidth (kHz) 60000.00

Coverage

none
Delete info

OOB (dBW/MHz) 0

Variable power
 Fixed power
 Fixed frequency
 Freq Hop / WB
 Variable elevation
 Fixed elevation

Info

Callsign c0000263 Parenting 0
Address Date 0 yyyy-mm-dd
Inf1 Type ID C
Inf2 Link
Network ID Group
User Call number 0

Comment:

SQL record 0

OK Cancel

103.84123
1.27351
5 m

0037 -T: c0000037
0038 -T: c0000038
0039 -T: c0000039
0040 -T: c0000040
0041 -T: c0000041
0042 -T: c0000042
0043 -T: c0000043

Challenges – antenna placement

❑ Inaccurate sector/antenna coordinates

- Both Vertical and horizontal planes
- Rough coordinates for new network
- Not necessarily maintained for existing networks
- Or maintained but over medium resolution model
- Minor discrepancies between 3D dataset and network parameters

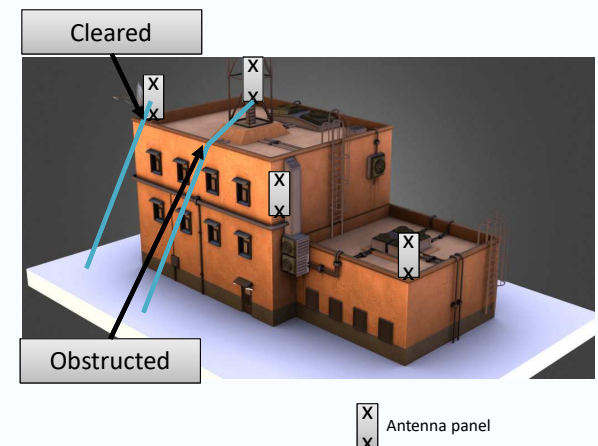
• Roof-top

- Is the antenna placed in the middle or at the Edge?
- Is the antenna elevated or sinking below the roof height?

• Building façade

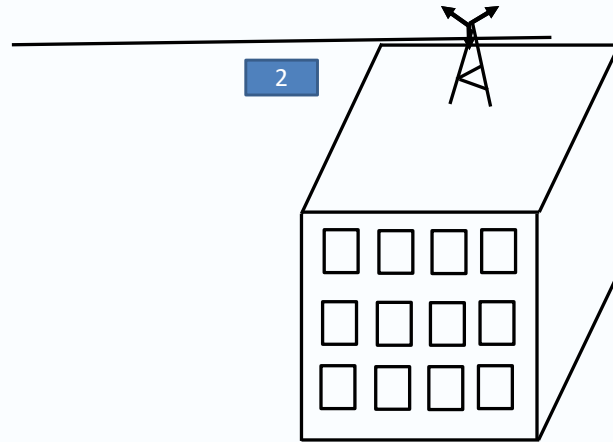
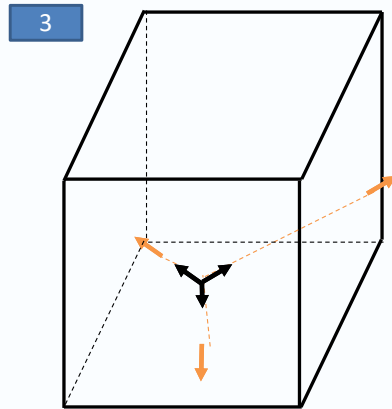
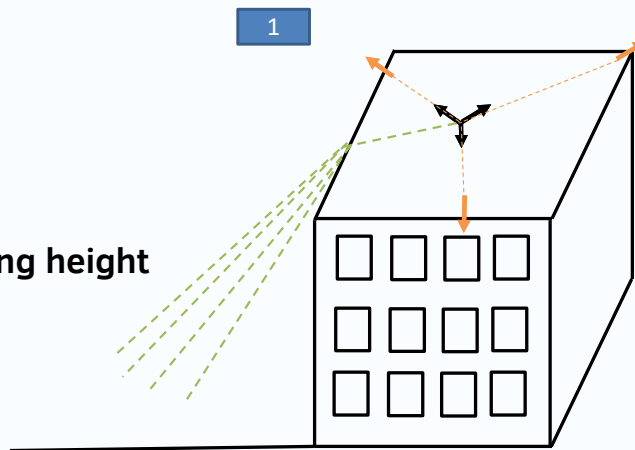
- If below roof-top height; is it on the façade?

Challenges

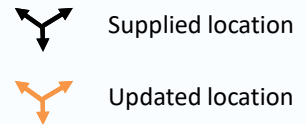


Challenges – antenna placement

- ❑ Exceeding building height?
 - Stay as is or push to the edge?
- ❑ Ant. height lower than building height
 - Push to the edge (Façade)



Challenges

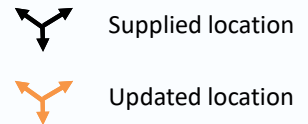
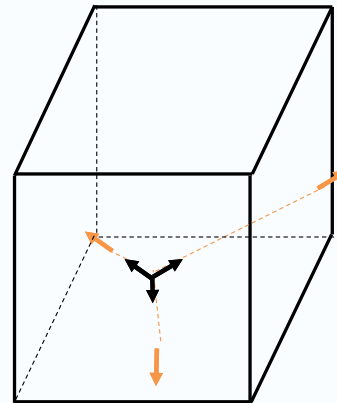


Challenges – antenna placement

Challenges

❑ Ant. height lower than building height

- Push to the edge (Façade)



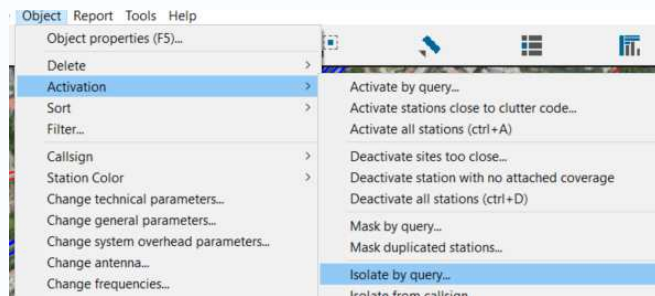
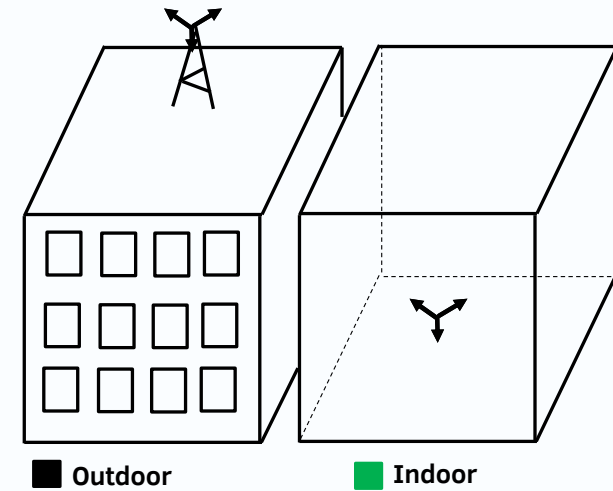
Challenges – antenna placement

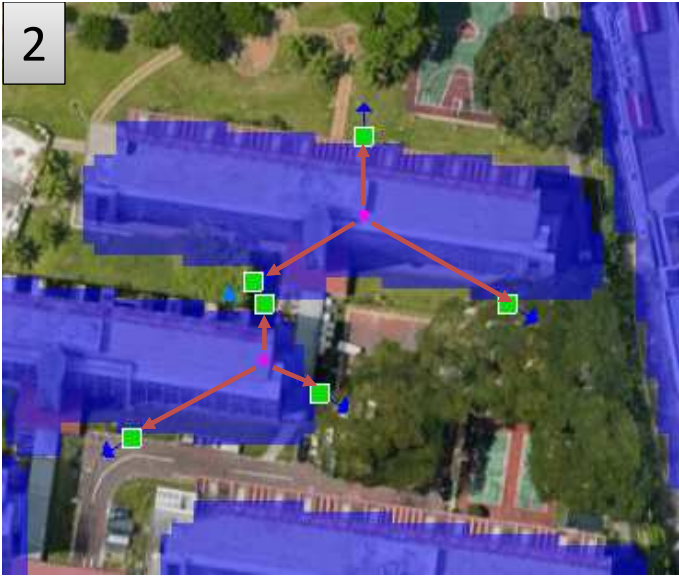
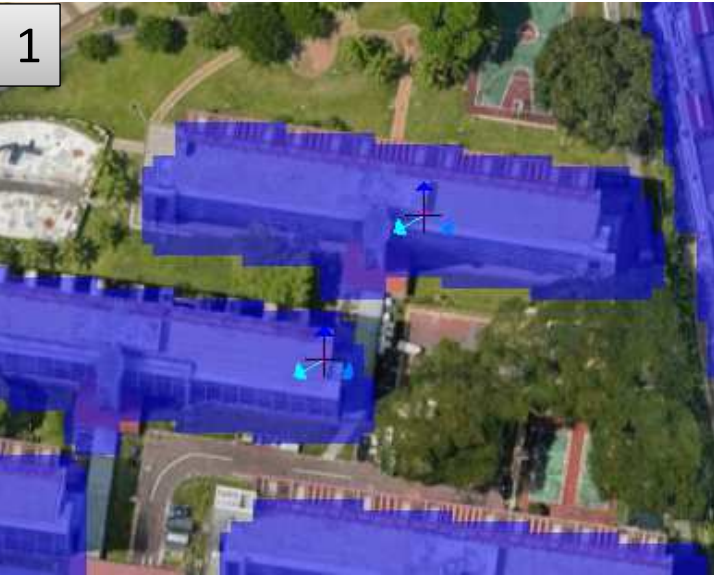
□ Identify those on Roof-top and façade?

- If site height > building height then outdoor
- If site height < building height then indoor



Challenges

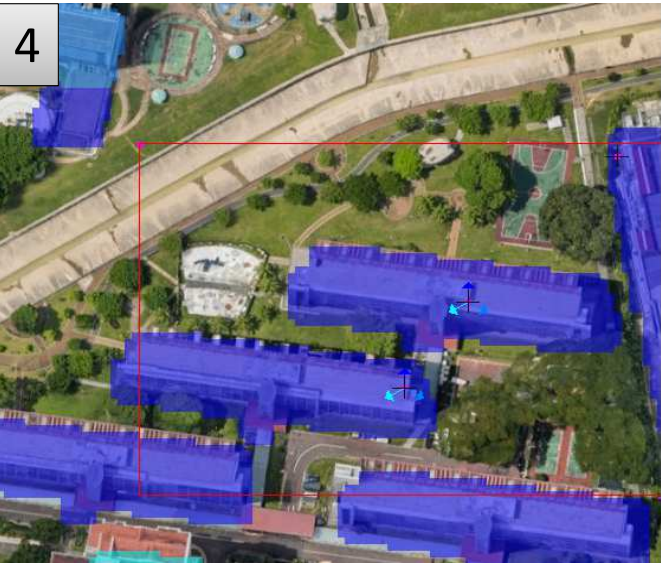




Break out site sectors

Maximum distance from initial location (m):	50
Move while altitude >= initial elevation (= 1, 0=all):	0
Move to nearest clutter code = 1 (0=no):	1
Move if current clutter code = 09 (=1):	1

OK Cancel



- Add comment...
- Stations >
- Subscribers >
- Vectors >
- Multilateration >
- Search site...
- Localize mobile...
- P2P correlation...
- Time of arrival - all servers...
- Uplink interference map...
- Downlink interference map...
- Reverse coverage...
- Spectrum...
- RRL data access...
- Intermodulation >
- 3D view (dynamic)...
- 3D coverage...
- 3D P2P...
- Modify clutter code...
- Fill clutter code...
- New clutter/building code...
- Modify building code...

- Generate stations...
- Deactivate stations
- Activate stations
- Isolate stations
- Isolate activated stations
- Delete stations
- Delete station links
- Move stations
- Copy/Paste activated stations
- Break out stations...
- Duplicate stations...
- Rotate station antenna...
- Multi-sectorial stations to splitted antenna station...
- Modify station frequencies...
- Rename stations...
- Station list...
- Assign Tx/Rx sector and distance
- Modify constraints
- Microwave link list...

❑ Break out feature

- Targeted: Those falling within building and under Roof-top height
- Precise
 - How far to push the antenna
 - When to stop (new clutter)
- Maintaining sector orientation



Break-out DEMO



5G antenna modeling

Smart antenna

Beamforming and broadcast beams



Antenna – Beam-forming

❑ NR, Type of beams:

- Broadcast (PBCH & SS) → Static
- Control (PUCCH, PDCCH) → Static
- Traffic (PUSCH/PDSCH) → Dynamic

❑ What is a beam?

- Synthesized (formed electronically) antenna radiation pattern
- Can be steered, resulting in pattern sweeping
- Supplied as antenna radiation pattern envelope (MSI/PLT/PLN/...)

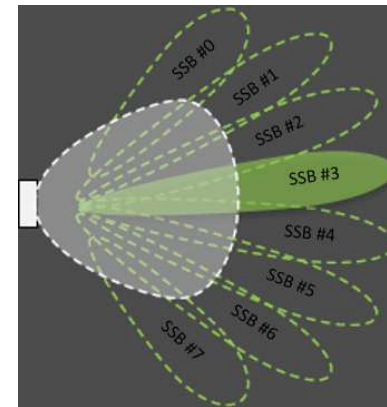
❑ Why broadcast beam pattern important for RF planning?

- Used for UE Initial Access Procedures
- Transmit “SS Block” carries the PSS, the SSS and the PBCH
- In IDLE mode the measurement is based on SS (Synchronization Signal)
- The UE transmits PRACH on a set of resources depending on the best SSB time index
- No broadcast beam reach → UEs can not connect → no coverage

Smart antenna

❑ How to predict NR coverage?

- Establish broadcast beam radiation pattern (Individual SSBs or composite)
- Capture the beam gain (dBi)
- Calculate coverage
- Analyse SS-RSRP



Single beam (~10 degrees beamwidth)

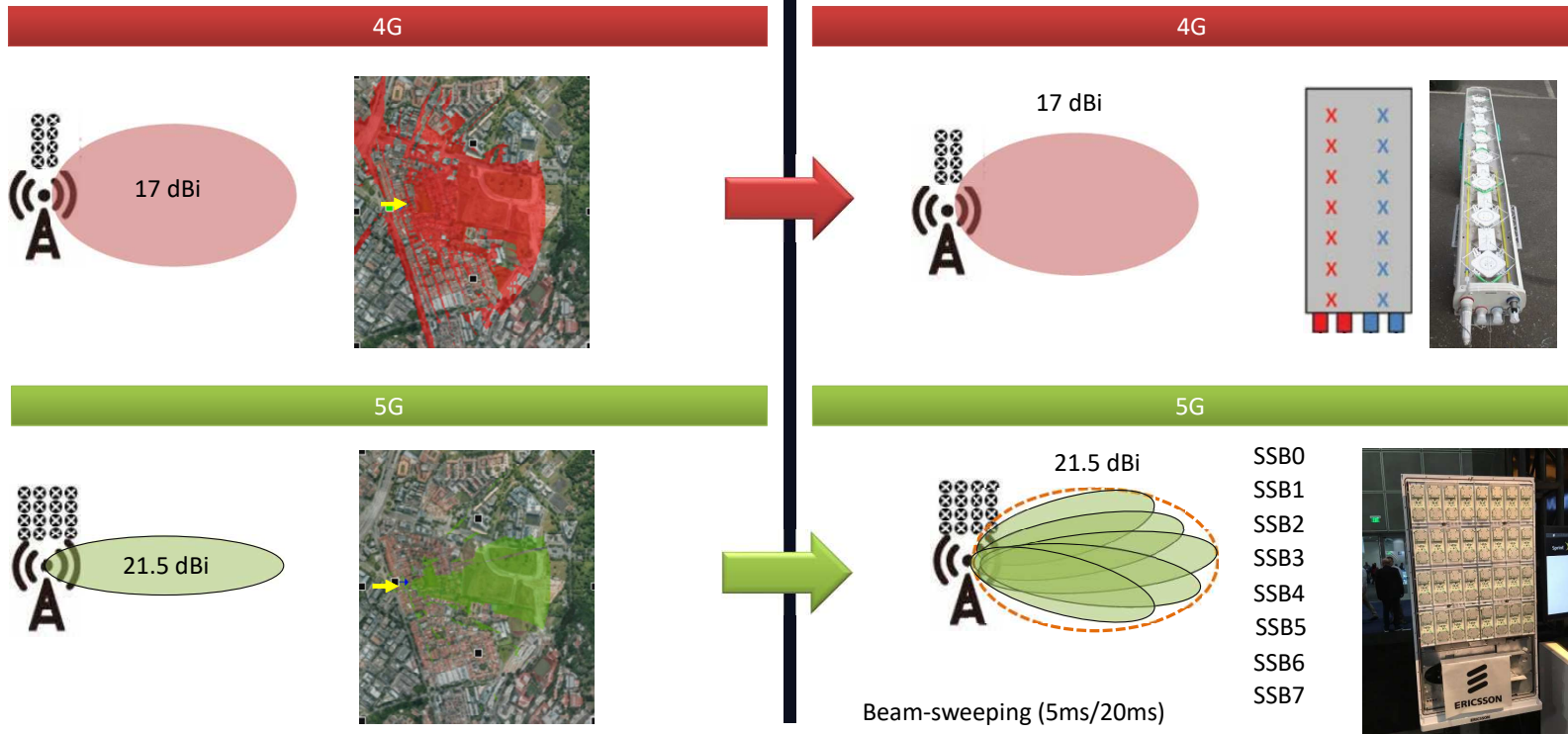
SSB: Synchronization Signal and PBCH Block (cell search)

SS-RSRP: Synchronization Signal reference signal received power

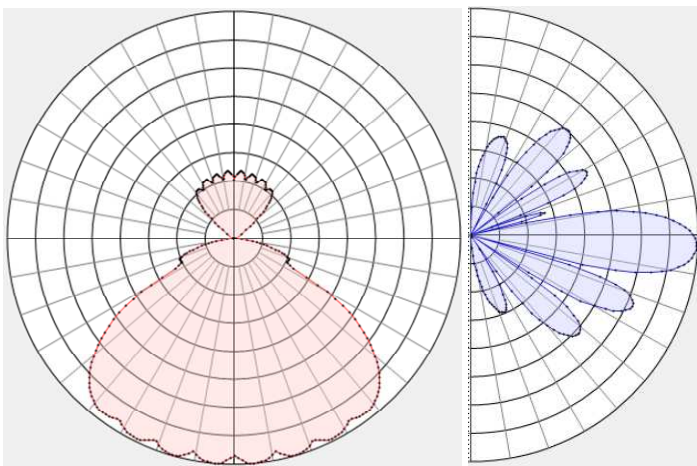
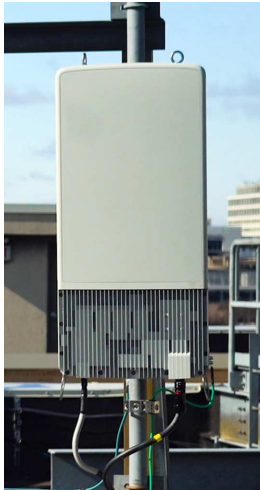
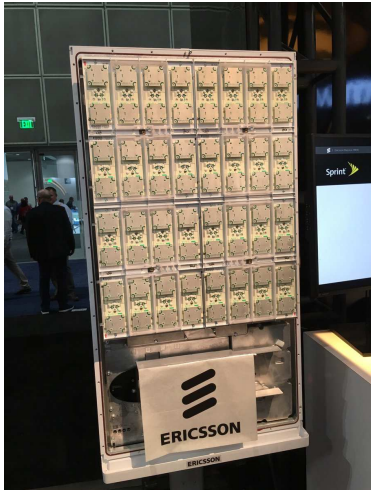
Antenna – Beam-forming

Smart antenna

□ 4G vs 5G antennas

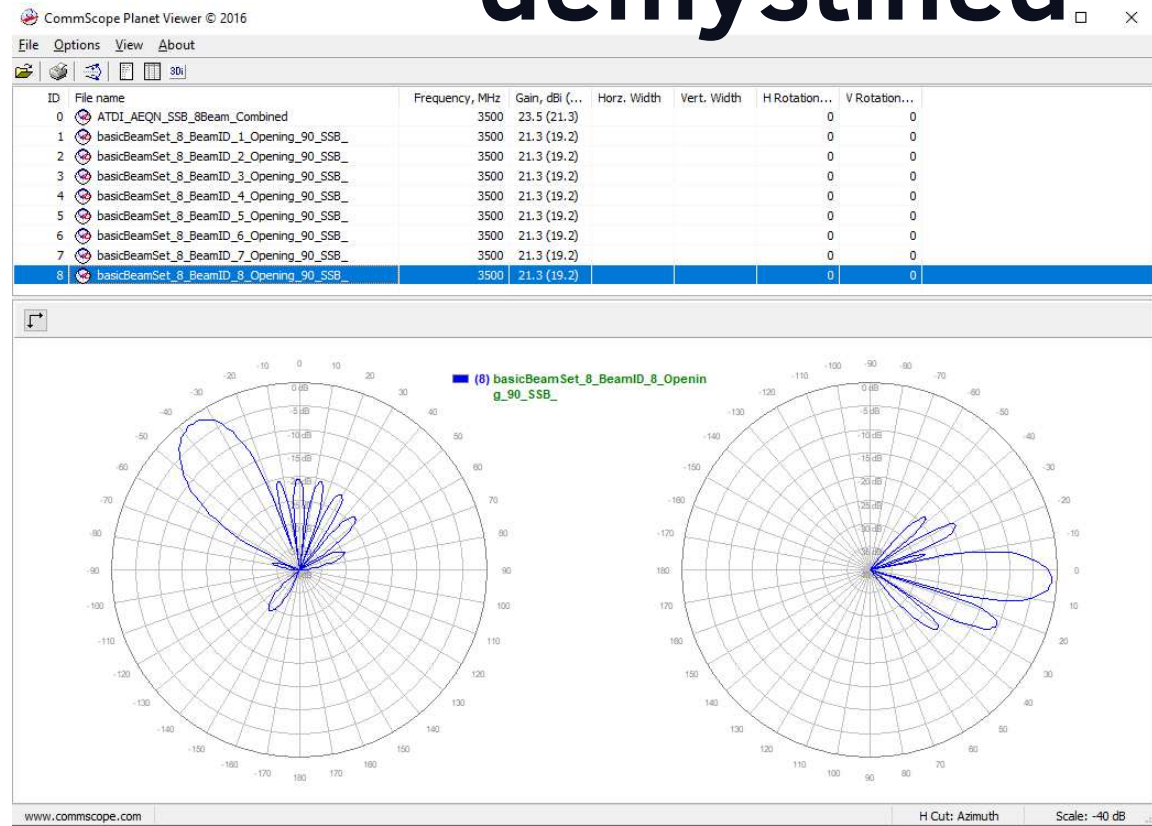


Broadcast beams demystified



8 beams (64T64R)

Beams at the edge operating at reduced gain



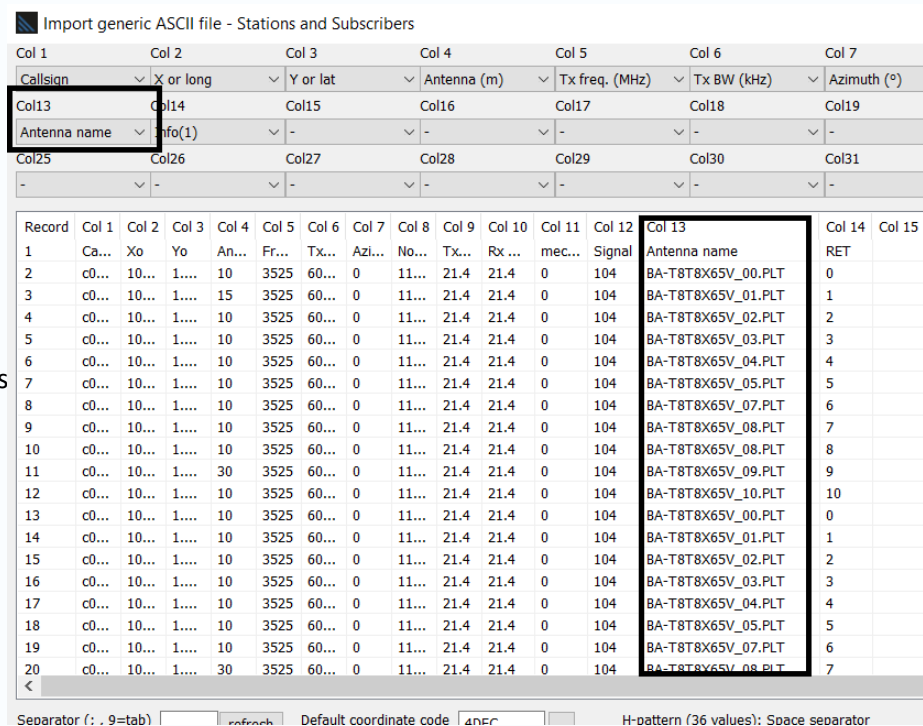
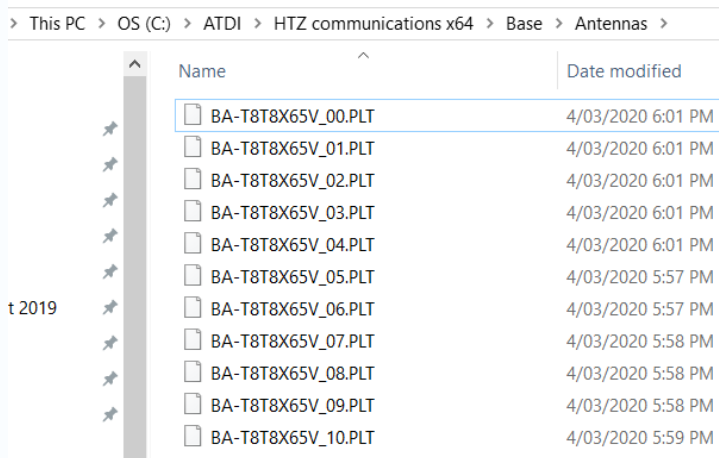
Managing Electrical & Mechanical tilt

❑ Dealing with mechanical tilt

- From T/R pattern tab

❑ Dealing with electrical tilt

- Preparing multiple radiation patterns during importation proces



Managing Electrical & Mechanical tilt

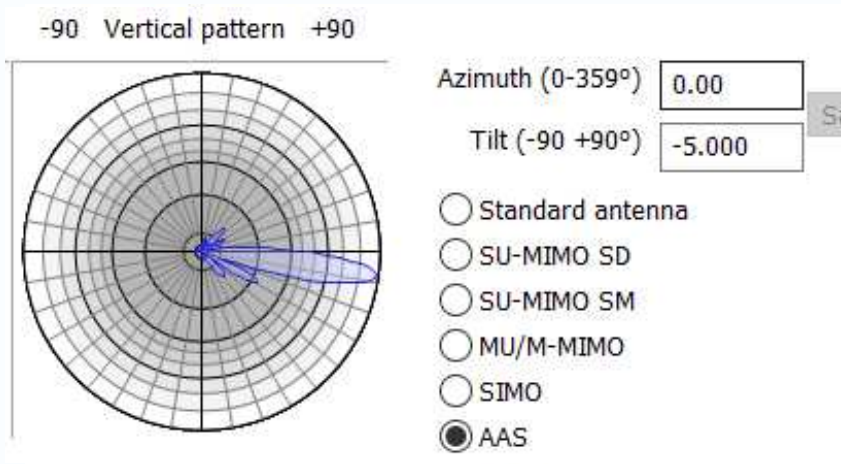


Electrical tilt

- Individual patterns supplied by vendor

Mechanical tilt

- Taken care of by HTZ directly





DEMO

(RET, Mechanical tilt)



5G Numerology

Tx/Rx parameters: 217 c0000217

General Patterns Channels Site gNB

Type (0) Signal (104) Modulation (0) NFD / TS-R1F

Tx/Rx A (0) 5G TDD (104) undefined (0) ...

Threshold

Cov. threshold (dBm) -87

Rx threshold (dBm) -102 upd...

KTBF (dBm) -91 calc...

Launch delay (us) 0

C/I req N=0/N=1 -127.0 / -127.0

Traffic

Max DL UE (kbps) 43337.23

Max UL UE (kbps) 46360.75

Tx bandwidth (kHz) 60000.00

Rx bandwidth (kHz) 60000.00

Options

Floor offset 0

Handover 0 dB

Neighbour list

RSI

PHY_CELL_ID 0

PHY_GRP_ID 0

PCIMODn 0

Activity (pc) 100 ul dl 100

Power channel settings

% Ref. signal 3.086

% xPDSCH 96.914

DL/UL ratio (pc) 0.00

Numerology

0: 15 kHz - 20 to 275 RBs

1: 30 kHz - 20 to 275 RBs

2: 60 kHz - 20 to 275 RBs

3: 120 kHz - 20 to 275 RBs

4: 240 kHz - 20 to 138 RBs

5: 480 kHz - 20 to 69 RBs

RB 162 SC 1944

OK Cancel

- RS allocation percentage
- Traffic allocation percentage
- Number of resource blocks
- Total number of sub-carriers

μ	Δf	$N_{RB}^{min,\mu}$	$N_{RB}^{max,\mu}$
0	15 kHz	20	275
1	30 kHz	20	275
2	60 kHz	20	275
3	120 kHz	20	275
4	240 kHz	20	138
5	480 kHz	20	69



DEMO **(5G numerology)**

Link budget calculator

❑ 5G Numerology added

❑ Resource allocation strategies updated

- User defined RBs: Dictate throughput and N_xRBs and the tool computes the SINR
- Lowest SNIR min RBs: Dictate throughput and tool computes min SINR then min RBs
- Available RBs : Use all RBs, find min SINR to meet the throughput

❑ Compute uplink-balanced RSRP

❑ SINR Vs throughput mapping (3GPP)

The screenshot shows the '4G/5G calculator' interface with the following data:

Item	Value
Reference frequency (MHz)	3525.000000
Bandwidth (MHz)	10.0000000
Probability to achieve (pc)	95.00 0 = not used
Standard deviation (dB)	3.00
Slow fading margin (dB)	4.9
TDD / FDD	DL/UL ratio 54.29
PDSCH (pc)	100.00

Numerology: 0 1 2 3 4 5 4G

Item	eNodeB	UE
Transmit power / port (dBm)	43.0	23.0
Tx gain (dB)	17.00	0.00
Rx gain (dB)	17.00	0.00
Tx losses (dB)	1.00	0.00
Rx losses (dB)	1.00	0.00
Tx gain mimo (dB)	3.00	0.00
Rx gain mimo (dB)	6.00	0.00

Item	Downlink	Uplink
Min throughput per user (kbps)	1000.0	1000.0
RBs available	50	50
SINR required for throughput (dB)	-5	-5
Noise figure (dB)	5.0	4.5
KTBF (dBm)	-99.46	-99.96
Coverage / Rx thresholds (dBm)	-99.56	-100.06
RSRQ required (dB)	-19	

Item	Downlink	Uplink
Max permissible pathloss (dB)	161.56	145.06
Planning thresholds: DL / UL (dBm)	-83.06	-100.06
Min RSRP (dBm)	-113.84	

Assign planning thresholds to activated eNodeB

Apply as global RSRP threshold

Strategy

- User defined RBs
- Lowest SNIR and min RBs
- Available RBs

Buttons: SNIR vs Throughput..., Stations..., Compute, OK, Cancel

SINR and throughput mapping

Attenuated and truncated form of the Shannon bound

Implementation losses

	DL	UL
Attenuation factor (a)	0.60	0.40
Max bits/Hz	8.00	6.00
Layers (0=from station)	auto	2 (1)

Throughput (bps/Hz) = a.S(SINR).Layer(s)
 $S(\text{SINR}) = \log_2(1+\text{SINR})$ bps/Hz
 a = implementation losses

GSM
 TETRA
 HSDPA TDD
 E-UTRA FDD
 E-UTRA TDD
 NR
 RPMA
 Adaptive Modulation and Coding
 Shannon bound

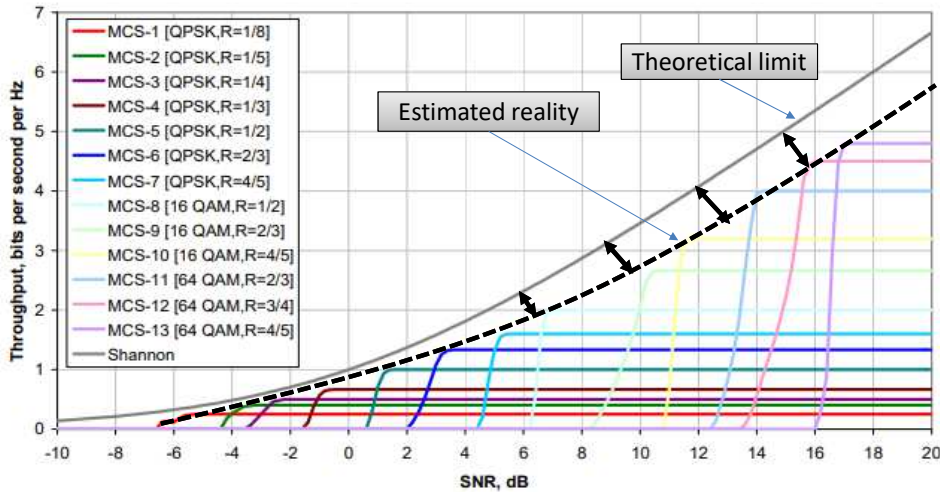
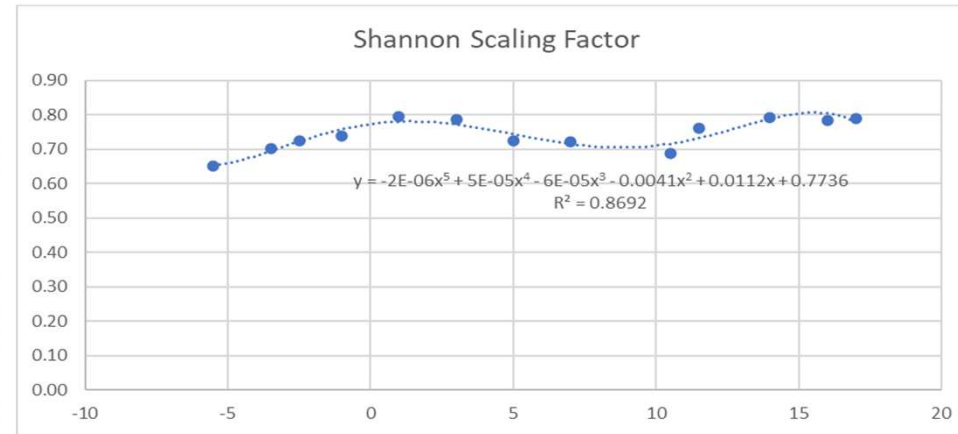


Figure A.4 Throughput of a set of Coding and Modulation Combinations, AWGN channels assumed



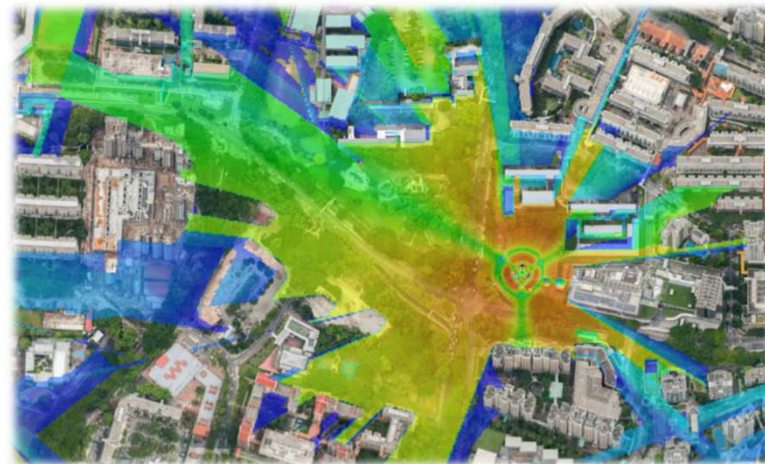
- $f(\text{SINR}) \rightarrow \text{Throughput}$
- $f(\text{Throughput}) \rightarrow \text{SINR required}$



DEMO **(Link budget)**



5G coverage predictions



SS-RSRP prediction

Using composed broadcast beam

.

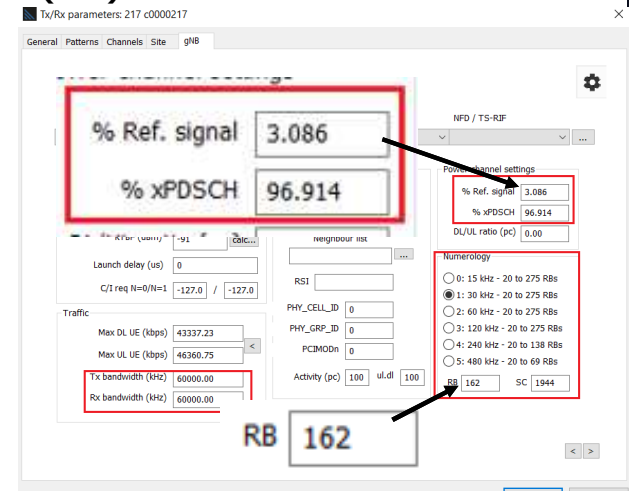
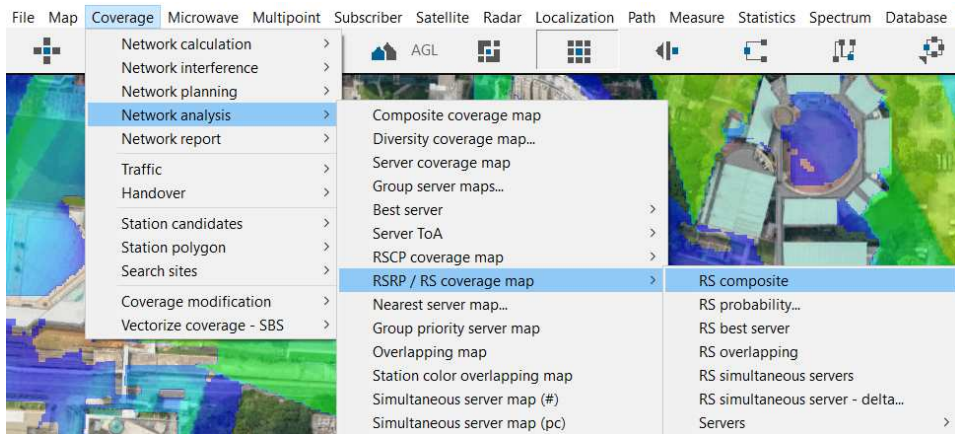
SS-RSRP

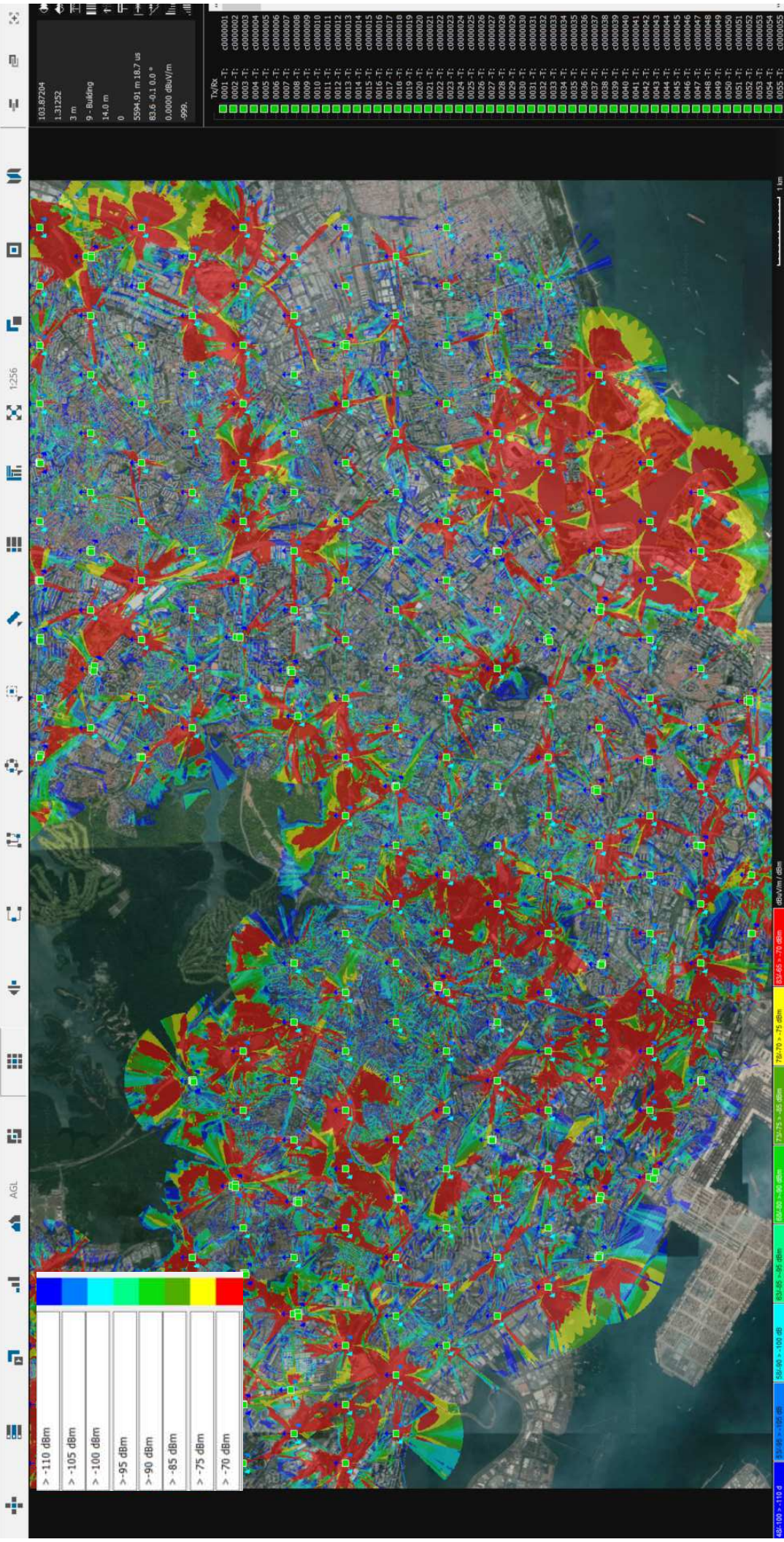
❑ SS-RSRP: secondary synchronization reference signal received power

- Carried by the SSS (middle 20 RBs)
- The only valid way to compare signal levels from individual cells and different operators
- Important for cell selection and handover
- Can be measured by drive-test tools – doesn't require connection with the cell

❑ Reference Signal Power (dBm) = Total Tx Power (dBm) – 10 x log (RB x 12)

❑ SS-RS RE EIRP (dBm) = Reference Signal Power (dBm) + SSB beam gain (dBi)

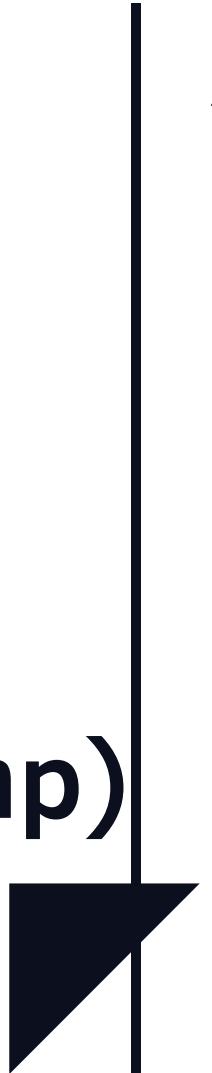






DEMO

(SS-RSRP prediction + Parallel comp)



Statistical analysis



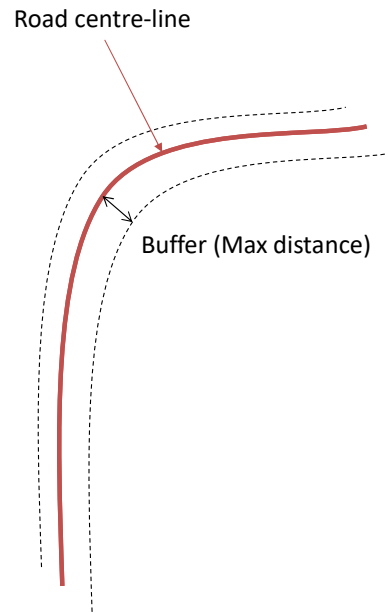
Outdoor reception analysis

Using GIS layer

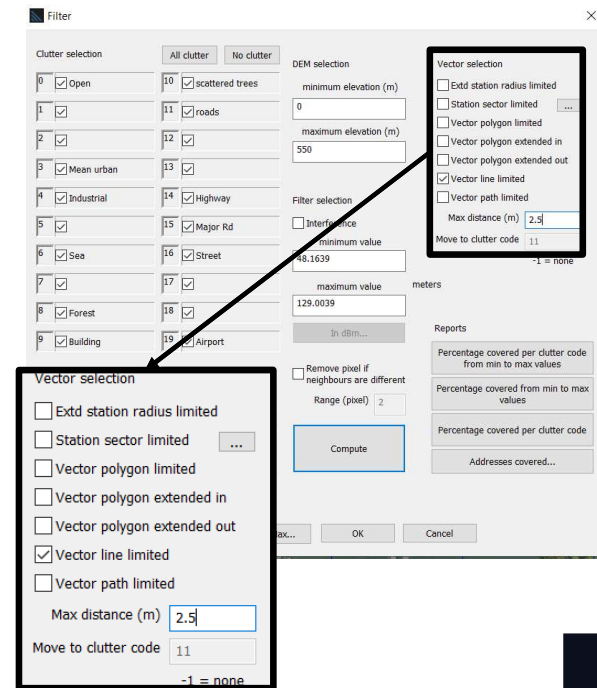
.

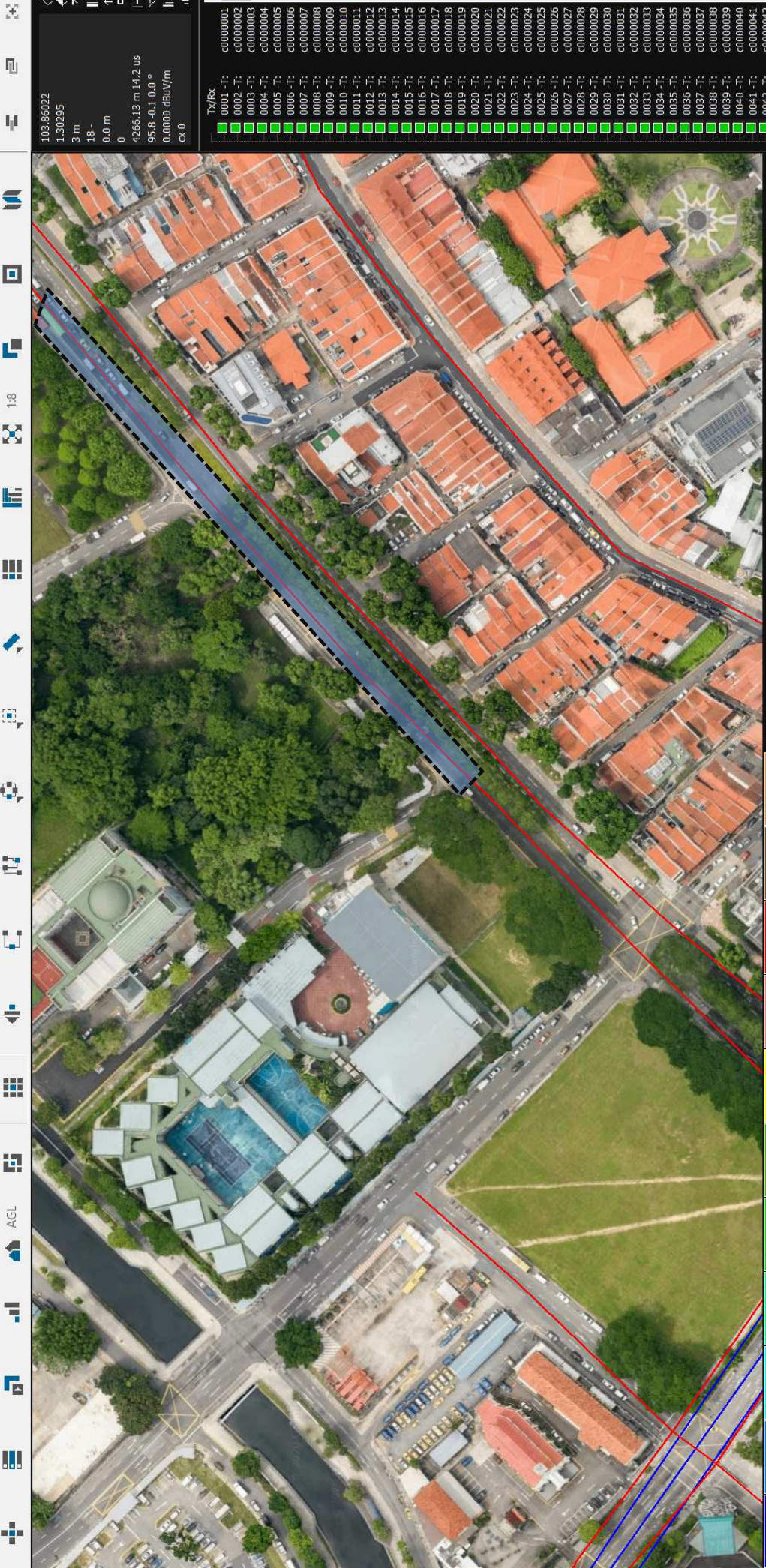
Outdoor coverage analysis

HTZ inbuilt GIS capabilities to manage vector data (points, polylines, polygons)



Map → Filter → General filter

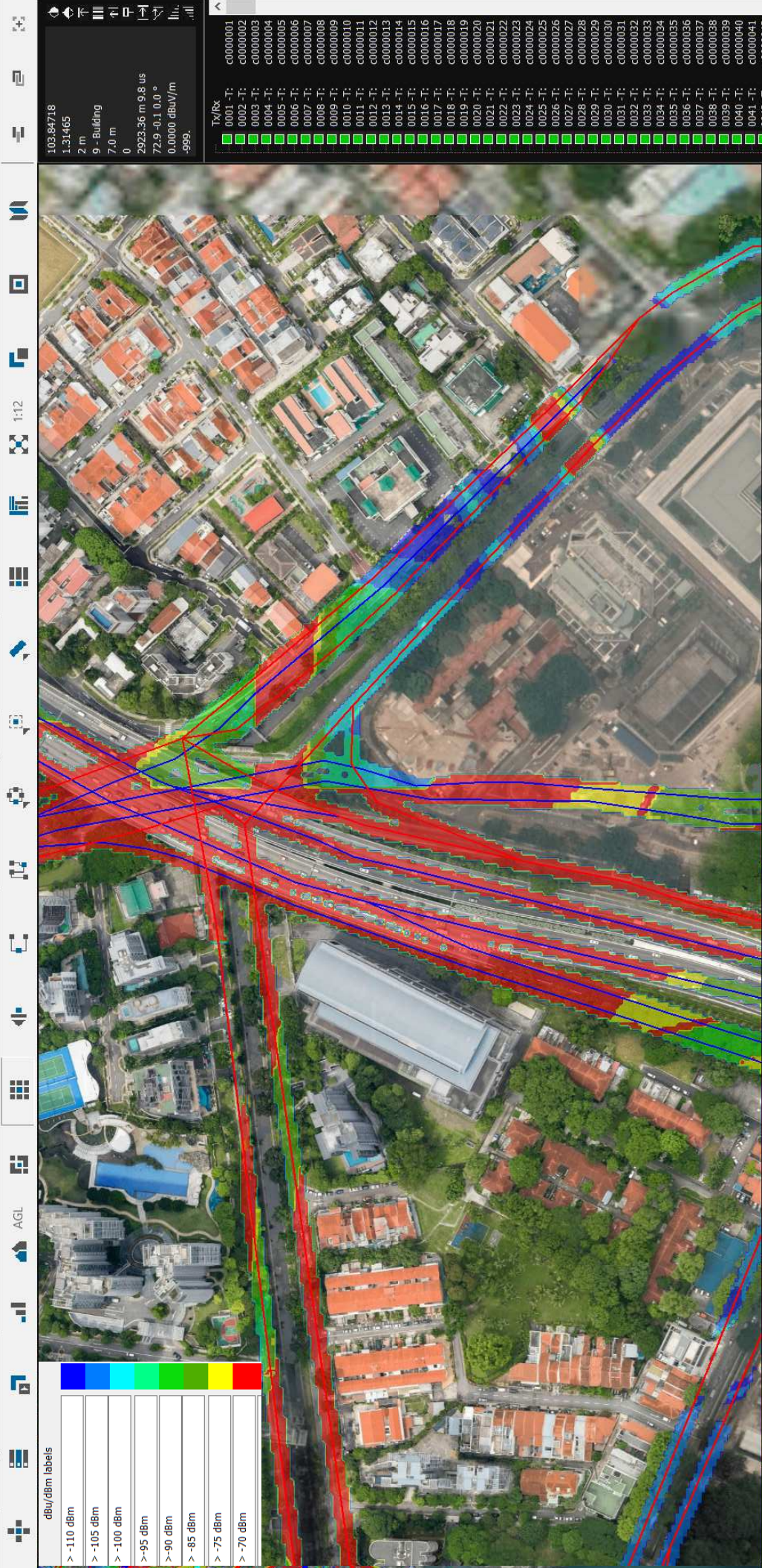




103.86022
1.30295
3 m
18 -
0.0 m
0
4266.13 m 14.2 us
95.8 -0.1 0.0 °
0.0000 dBuV/m
cx 0

Tx/Rx
c0000001
0001-T
c0000002
0002-T
c0000003
0003-T
c0000004
0004-T
c0000005
0005-T
c0000006
0006-T
c0000007
0007-T
c0000008
0008-T
c0000009
0009-T
c0000010
0010-T
c0000011
0011-T
c0000012
0012-T
c0000013
0013-T
c0000014
0014-T
c0000015
0015-T
c0000016
0016-T
c0000017
0017-T
c0000018
0018-T
c0000019
0019-T
c0000020
0020-T
c0000021
0021-T
c0000022
0022-T
c0000023
0023-T
c0000024
0024-T
c0000025
0025-T
c0000026
0026-T
c0000027
0027-T
c0000028
0028-T
c0000029
0029-T
c0000030
0030-T
c0000031
0031-T
c0000032
0032-T
c0000033
0033-T
c0000034
0034-T
c0000035
0035-T
c0000036
0036-T
c0000037
0037-T
c0000038
0038-T
c0000039
0039-T
c0000040
0040-T
c0000041
0041-T
c0000042
0042-T
c0000043
0043-T

auto CPU 12 SF 1 L 15



dBu/dBm labels
> -110 dBm
> -105 dBm
> -100 dBm
> -95 dBm
> -90 dBm
> -85 dBm
> -75 dBm
> -70 dBm

103.84218
 1.31465
 2 m
 9 - Building
 7.0 m
 0
 2923.36 m 9.8 us
 72.9 -0.1 0.0 °
 0.0000 dBuV/m
 -999.

Tx/Rx	Color
C0000001	Green
C0000002	Green
C0000003	Green
C0000004	Green
C0000005	Green
C0000006	Green
C0000007	Green
C0000008	Green
C0000009	Green
C0000010	Green
C0000011	Green
C0000012	Green
C0000013	Green
C0000014	Green
C0000015	Green
C0000016	Green
C0000017	Green
C0000018	Green
C0000019	Green
C0000020	Green
C0000021	Green
C0000022	Green
C0000023	Green
C0000024	Green
C0000025	Green
C0000026	Green
C0000027	Green
C0000028	Green
C0000029	Green
C0000030	Green
C0000031	Green
C0000032	Green
C0000033	Green
C0000034	Green
C0000035	Green
C0000036	Green
C0000037	Green
C0000038	Green
C0000039	Green
C0000040	Green
C0000041	Green
C0000042	Green
C0000043	Green
C0000044	Green



DEMO **(RSRP filter analysis)**

MIMO

Massive MIMO and throughput

Throughput predictions, massive MIMO configuration and
Carrier aggregation

NR Smart Antenna MIMO

❑ Per cell MIMO configuration

❑ Arrays: Number arrays for traffic beams

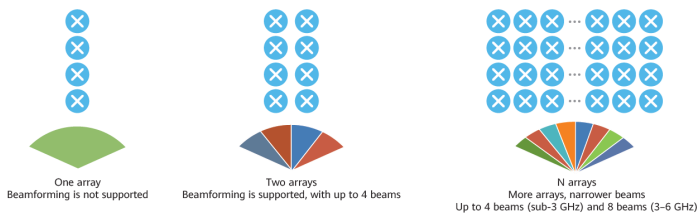
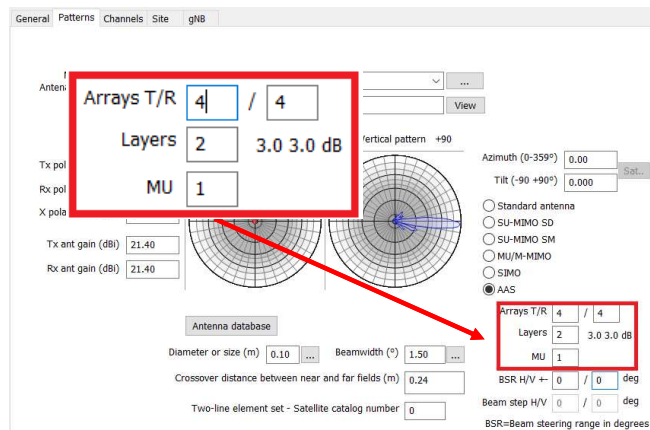
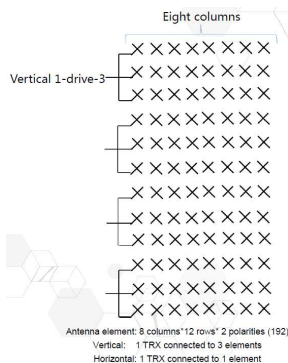
- Up to 4 for 32x32 Antenna
- Up to 8 for 64x64 antenna

❑ Layers: Number of spatial layers per UE

- Same frequency & time but different antenna elements

❑ MU: Number of concurrent users (Multi-User MIMO)

- Same frequency & time but different spatial beam



File Map Coverage Microwave Multipoint Subscriber Satellite Radar Localization Path Measure Statistics Spectrum Database Object Report Tools Help

- Network calculation
- Network interference
 - C/I mode...
 - IRF mode...
 - W/CDMA maps...
 - Network planning
 - Network analysis
 - Eb/NO reverse map...
 - Network report
 - Traffic
 - Handover
 - Station candidates
 - Station polygon
 - Search sites
 - Coverage modification
 - Vectorize coverage - SBS
- RSRQ maps...
- Scrambling code pollution...
- SNIR maps...
- RSRQ maps...
- SFN / MFN synchro...
- CODM...
- COFDM batch mode...
- COFDM LP map...
- Server frequency reuse conflicts...
- Create links between neighbour stations...
- Create polygons from neighbour stations...

4G / 5G SNIR maps

Action

- SNIR (AFDSCM)
- SNIR (PDSCH)
- SNIR (PDSCH)
- SNIR (PDSCH)
- SNIR (PDSCH)
- RS-SNR
- RSRQ

Normal dither %:

Throughput map

Carrier aggregation...

SNIR to QCI map

Unwanted = activated

Unwanted = de-activated and activated

Server = activated/deactivated stations

Display best server if SNIR >= dB

Max server latency (0=inf, a) (us)

KTBF (1) dBm

Rx gain dB

Effective arrays

MIMO adaptive switching modes (AAS):

- Spatial Multiplexing
- MU/M-MIMO (Multi-user / Massive MIMO)
- Tx Div (Transmit Diversity) - MISO
- Single Antenna Port (SSD or SIMO)

Attenuated and truncated form of the Shannon bound

Implementation losses

DL UL

Attenuation factor (a)

Max bits/Hz

Layers (0=from station) (1)

Throughput (bps/Hz) = a.S(SNIR).Layer(s)

S(SNIR) = log2(1+SNIR) bps/Hz

a = implementation losses

Layers: GSM TETRA HSDPA TDD E-UTRA FDD E-UTRA TDD NR RPMA Adaptive Modulation and Coding Shannon bound

OK Cancel

Save... Options...

N=8 50 used N=9 50 used Use mask as filter

BRF from tables (ETSI/ITU/IEEE)

CHC-DMRC61 CHC-DMRC64 FCC

BRF from TXRX-C/I

BRF from HFD / TS-RF

Global XPD dB CH or V: 3 dB

Traffic load factor (Interferer) protection except if global XPD=0

Remaining traffic load factor (Server)

Smart antenna discrimination

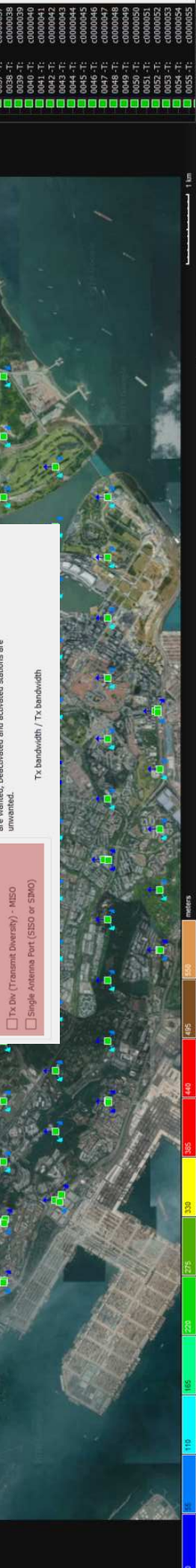
Thresholds: dBm RS / auto dB

ICG enhancement dB

Rx ant. discr: None 419/GE OET69 User

DL SNIR (FSSCA) map according to the floor of a receiver on each part of the terrain. Activated stations are wanted. Deactivated and activated stations are unwanted.

Tx bandwidth / Tx bandwidth



NR Throughput

☐ Massive MIMO configuration available

- Beam-forming (traffic channels)
- Transmission diversity (spatial)
- Spatial multiplexing
- User multiplexing

Massive MIMO

4G / 5G SNIR maps

Action

SNIR (xPDSCH)
 SNIR (PDSCH)
 SNIR (PDCCH)
 SNIR (PBCH)
 RS-SNIR
 RSRQ

Normal distrib % stddev (dB) 5.5
 Throughput map
 Carrier aggregation...
 SNIR to QCI map
 Unwanted = activated
 Unwanted = de-activated and activated
 Server = activated/deactivated stations
 Display best server if SNIR >= -6 dB
Max server latency (0=n.a) (us) 0
KTBF (1) -87 dBm
Rx gain 0.00 dB
Effective arrays 4

MIMO adaptive switching modes (AAS):

Spatial Multiplexing
 MU/M-MIMO (Multi-user / Massive MIMO)
 Tx Div (Transmit Diversity) - MISO
 Single Antenna Port (SISO or SIMO)

IRF mask (dB)

N=0	0	<input checked="" type="checkbox"/> used	N=10	50	<input type="checkbox"/> used
N=1	20	<input type="checkbox"/> used	N=11	50	<input type="checkbox"/> used
N=2	30	<input type="checkbox"/> used	N=12	50	<input type="checkbox"/> used
N=3	40	<input type="checkbox"/> used	N=13	50	<input type="checkbox"/> used
N=4	50	<input type="checkbox"/> used	N=14	50	<input type="checkbox"/> used
N=5	50	<input type="checkbox"/> used	N=15	50	<input type="checkbox"/> used
N=6	50	<input type="checkbox"/> used			
N=7	50	<input type="checkbox"/> used			
N=8	50	<input type="checkbox"/> used			
N=9	50	<input type="checkbox"/> used			

IRF from tables (ETSI/ITU/IEEE)
 CNC-DNRc61 CNC-DNRc54 FCC
 IRF from Tx/Rx C/I
 IRF from NFD / TS-RJF
 Global XPD 0 dB C/H or V: 3 dB protection except if global XPD=0
 Traffic load factor (Interferer)
 Remaining traffic load factor (Server)
 Smart antenna discrimination

Thresholds: -100 dBm RS / auto
ICIC enhancement 0 dB

DL SNIR (PDSCH) map according to the Noise floor of a receiver on each point of the terrain. Activated stations are wanted, Deactivated and activated stations are unwanted.

Tx bandwidth / Tx bandwidth

(1) 0 = from station parameter KTBF
(AAS) BS antenna must be set to AAS

Rx ant discr
 None
 419/GE
 OET69
 User

OK
Cancel
Palette...
Station list...
Load...
Save...
Options...

Attenuated and truncated form of the Shannon bound

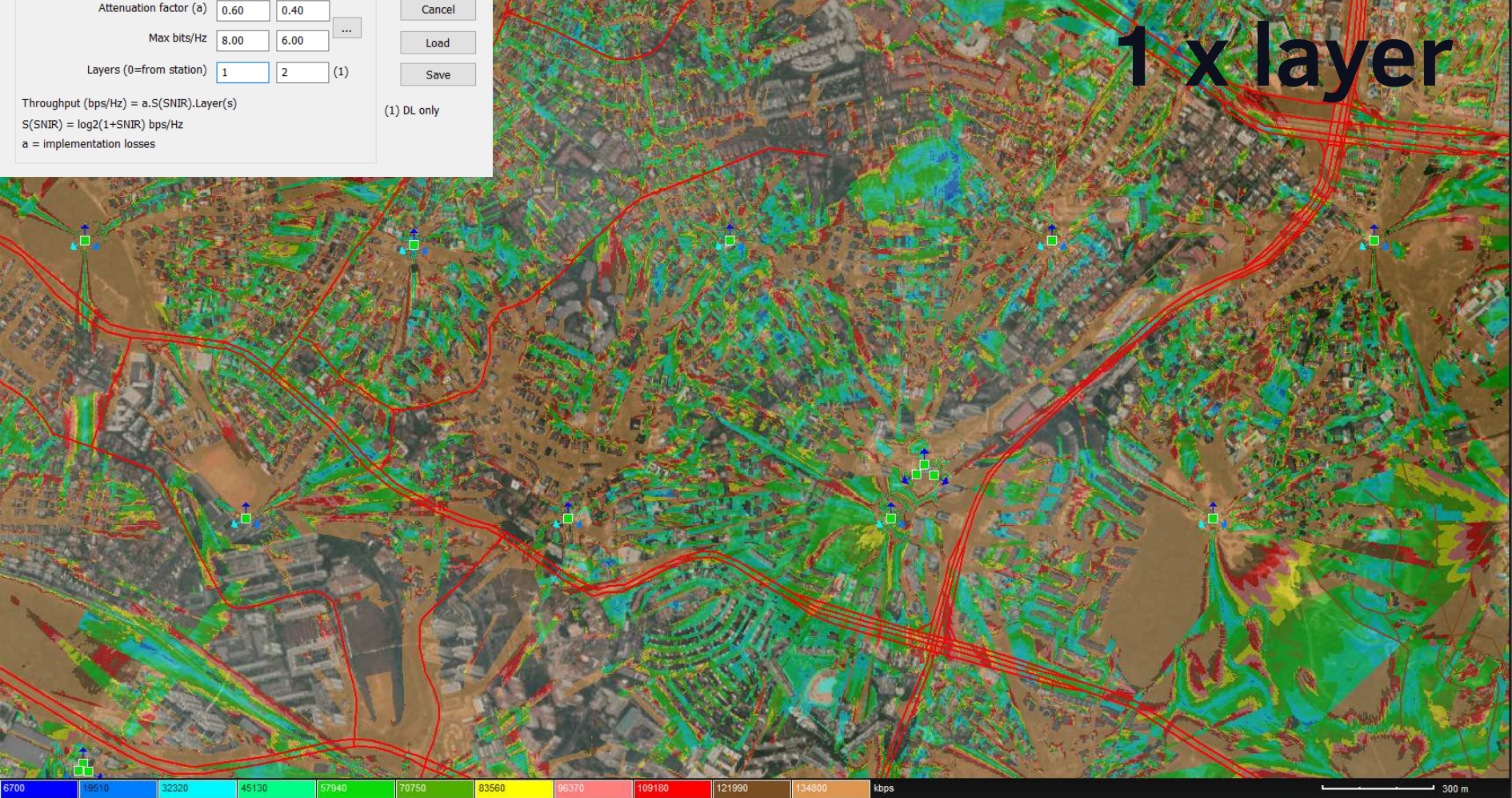
Implementation losses

	DL	UL
Attenuation factor (a)	0.60	0.40
Max bits/Hz	8.00	6.00
Layers (0=from station)	1	2 (1)

Throughput (bps/Hz) = a.S(SNIR).Layer(s)
S(SNIR) = log2(1+SNIR) bps/Hz
a = implementation losses

(1) DL only

OK Cancel Load Save



103.81724
1.31648
8 m
11 - roads
0.0 m
0
1192.28 m 4.0 us
333.2 -0.0 0.0 °
123300.0000 kbps
cx 0

Tx/Rx		
0001 -T-	<input type="checkbox"/>	c0000001
0002 -T-	<input type="checkbox"/>	c0000002
0003 -T-	<input type="checkbox"/>	c0000003
0004 -T-	<input type="checkbox"/>	c0000004
0005 -T-	<input type="checkbox"/>	c0000005
0006 -T-	<input type="checkbox"/>	c0000006
0007 -T-	<input type="checkbox"/>	c0000007
0008 -T-	<input type="checkbox"/>	c0000008
0009 -T-	<input type="checkbox"/>	c0000009
0010 -T-	<input type="checkbox"/>	c0000010
0011 -T-	<input type="checkbox"/>	c0000011
0012 -T-	<input type="checkbox"/>	c0000012
0013 -T-	<input type="checkbox"/>	c0000013
0014 -T-	<input type="checkbox"/>	c0000014
0015 -T-	<input type="checkbox"/>	c0000015
0016 -T-	<input type="checkbox"/>	c0000016
0017 -T-	<input type="checkbox"/>	c0000017
0018 -T-	<input type="checkbox"/>	c0000018
0019 -T-	<input type="checkbox"/>	c0000019
0020 -T-	<input type="checkbox"/>	c0000020
0021 -T-	<input type="checkbox"/>	c0000021
0022 -T-	<input type="checkbox"/>	c0000022
0023 -T-	<input type="checkbox"/>	c0000023
0024 -T-	<input type="checkbox"/>	c0000024
0025 -T-	<input type="checkbox"/>	c0000025
0026 -T-	<input type="checkbox"/>	c0000026
0027 -T-	<input type="checkbox"/>	c0000027
0028 -T-	<input type="checkbox"/>	c0000028
0029 -T-	<input type="checkbox"/>	c0000029
0030 -T-	<input type="checkbox"/>	c0000030
0031 -T-	<input checked="" type="checkbox"/>	c0000031
0032 -T-	<input type="checkbox"/>	c0000032
0033 -T-	<input type="checkbox"/>	c0000033
0034 -T-	<input type="checkbox"/>	c0000034
0035 -T-	<input type="checkbox"/>	c0000035
0036 -T-	<input type="checkbox"/>	c0000036
0037 -T-	<input type="checkbox"/>	c0000037
0038 -T-	<input type="checkbox"/>	c0000038
0039 -T-	<input type="checkbox"/>	c0000039
0040 -T-	<input type="checkbox"/>	c0000040
0041 -T-	<input type="checkbox"/>	c0000041
0042 -T-	<input type="checkbox"/>	c0000042
0043 -T-	<input type="checkbox"/>	c0000043

Attenuated and truncated form of the Shannon bound

Project.PRO | DTM: 5G-Project | PRM: 5G-Project | EWF: 3- CoverageCalculated | SF1 | U3

alization Path Measure Statistics Spectrum Database Object Report Tools Help

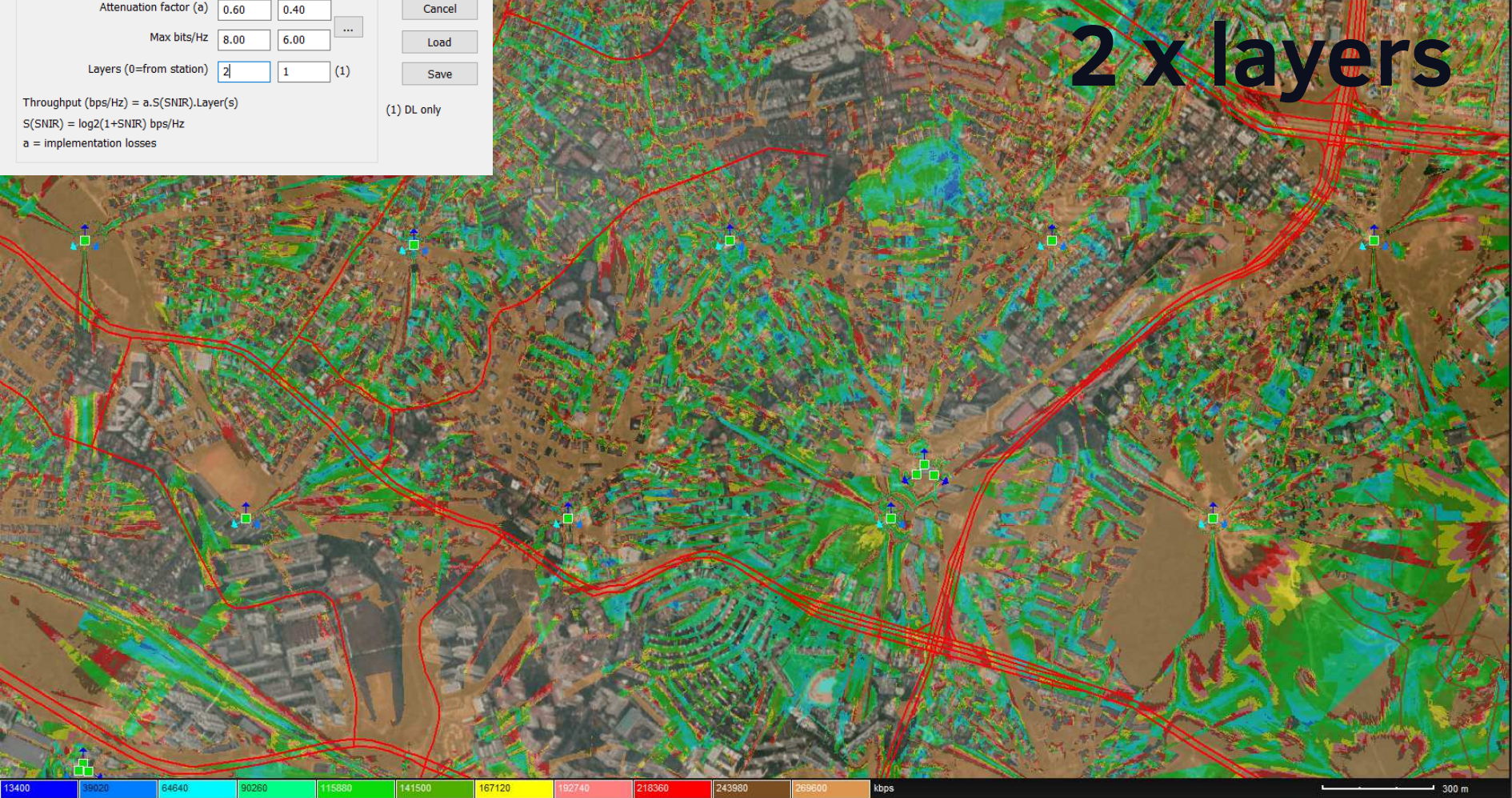
Implementation losses

	DL	UL
Attenuation factor (a)	0.60	0.40
Max bits/Hz	8.00	6.00
Layers (0=from station)	2	1 (1)

Throughput (bps/Hz) = a.S(SNIR).Layer(s)
S(SNIR) = log2(1+SNIR) bps/Hz
a = implementation losses

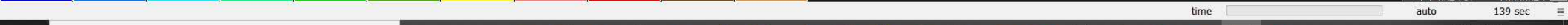
OK
Cancel
Load
Save

(1) DL only



103.81747
1.31509
8 m
16 - Street
0.0 m
0
1044.15 m 3.5 us
330.6 -0.0 0.0 °
235600.0000 kbps
cx 0

Tx/Rx		
0001 -T-	<input type="checkbox"/>	c0000001
0002 -T-	<input type="checkbox"/>	c0000002
0003 -T-	<input type="checkbox"/>	c0000003
0004 -T-	<input type="checkbox"/>	c0000004
0005 -T-	<input type="checkbox"/>	c0000005
0006 -T-	<input type="checkbox"/>	c0000006
0007 -T-	<input type="checkbox"/>	c0000007
0008 -T-	<input type="checkbox"/>	c0000008
0009 -T-	<input type="checkbox"/>	c0000009
0010 -T-	<input type="checkbox"/>	c0000010
0011 -T-	<input type="checkbox"/>	c0000011
0012 -T-	<input type="checkbox"/>	c0000012
0013 -T-	<input type="checkbox"/>	c0000013
0014 -T-	<input type="checkbox"/>	c0000014
0015 -T-	<input type="checkbox"/>	c0000015
0016 -T-	<input type="checkbox"/>	c0000016
0017 -T-	<input type="checkbox"/>	c0000017
0018 -T-	<input type="checkbox"/>	c0000018
0019 -T-	<input type="checkbox"/>	c0000019
0020 -T-	<input type="checkbox"/>	c0000020
0021 -T-	<input type="checkbox"/>	c0000021
0022 -T-	<input type="checkbox"/>	c0000022
0023 -T-	<input type="checkbox"/>	c0000023
0024 -T-	<input type="checkbox"/>	c0000024
0025 -T-	<input type="checkbox"/>	c0000025
0026 -T-	<input type="checkbox"/>	c0000026
0027 -T-	<input type="checkbox"/>	c0000027
0028 -T-	<input type="checkbox"/>	c0000028
0029 -T-	<input type="checkbox"/>	c0000029
0030 -T-	<input type="checkbox"/>	c0000030
0031 -T-	<input checked="" type="checkbox"/>	c0000031
0032 -T-	<input type="checkbox"/>	c0000032
0033 -T-	<input type="checkbox"/>	c0000033
0034 -T-	<input type="checkbox"/>	c0000034
0035 -T-	<input type="checkbox"/>	c0000035
0036 -T-	<input type="checkbox"/>	c0000036
0037 -T-	<input type="checkbox"/>	c0000037
0038 -T-	<input type="checkbox"/>	c0000038
0039 -T-	<input type="checkbox"/>	c0000039
0040 -T-	<input type="checkbox"/>	c0000040
0041 -T-	<input type="checkbox"/>	c0000041
0042 -T-	<input type="checkbox"/>	c0000042
0043 -T-	<input type="checkbox"/>	c0000043



Attenuated and truncated form of the Shannon bound

Implementation losses

	DL	UL
Attenuation factor (a)	0.60	0.40
Max bits/Hz	8.00	6.00
Layers (0=from station)	4	1 (1)

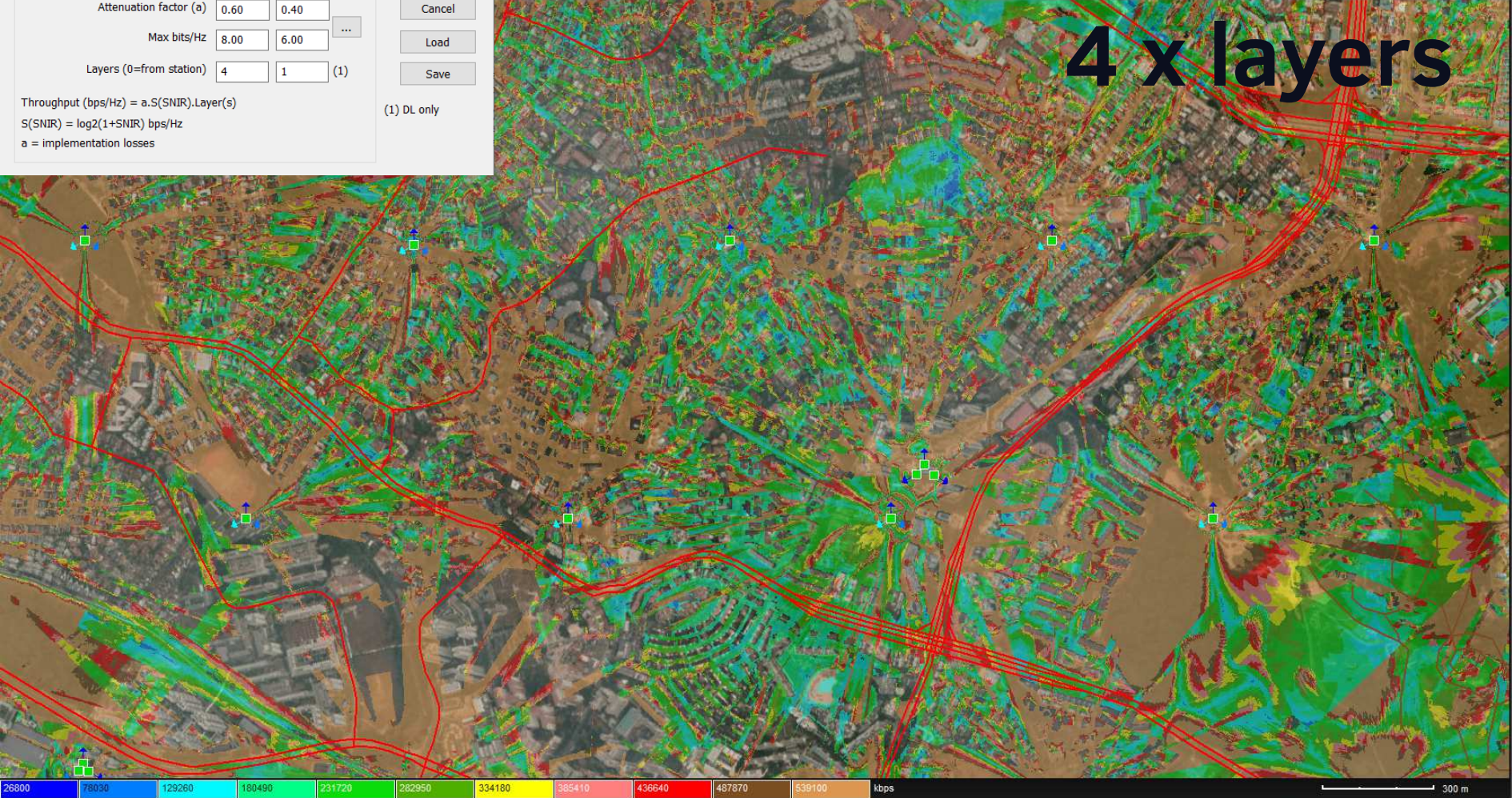
Throughput (bps/Hz) = a.S(SNIR).Layer(s)
 S(SNIR) = log2(1+SNIR) bps/Hz
 a = implementation losses

(1) DL only

OK Cancel Load Save

Project.PRO | DTM: 5G-Project | PRM: 5G-Project | EWF: 3- CoverageCalculated | SF1 | U3
 alization Path Measure Statistics Spectrum Database Object Report Tools Help

Navigation toolbar with icons for pan, zoom, and other map functions. Scale: 1:64.



103,81740
 1.31286
 10 m
 0 - Open
 0.0 m
 0
 843.38 m 2.8 us
 321.9 0.1 0.0 °
 539100.0000 kbps
 cx 0

Tx/Rx		
<input type="checkbox"/>	0001 -T-	c0000001
<input type="checkbox"/>	0002 -T-	c0000002
<input type="checkbox"/>	0003 -T-	c0000003
<input type="checkbox"/>	0004 -T-	c0000004
<input type="checkbox"/>	0005 -T-	c0000005
<input type="checkbox"/>	0006 -T-	c0000006
<input type="checkbox"/>	0007 -T-	c0000007
<input type="checkbox"/>	0008 -T-	c0000008
<input type="checkbox"/>	0009 -T-	c0000009
<input type="checkbox"/>	0010 -T-	c0000010
<input type="checkbox"/>	0011 -T-	c0000011
<input type="checkbox"/>	0012 -T-	c0000012
<input type="checkbox"/>	0013 -T-	c0000013
<input type="checkbox"/>	0014 -T-	c0000014
<input type="checkbox"/>	0015 -T-	c0000015
<input type="checkbox"/>	0016 -T-	c0000016
<input type="checkbox"/>	0017 -T-	c0000017
<input type="checkbox"/>	0018 -T-	c0000018
<input type="checkbox"/>	0019 -T-	c0000019
<input type="checkbox"/>	0020 -T-	c0000020
<input type="checkbox"/>	0021 -T-	c0000021
<input type="checkbox"/>	0022 -T-	c0000022
<input type="checkbox"/>	0023 -T-	c0000023
<input type="checkbox"/>	0024 -T-	c0000024
<input type="checkbox"/>	0025 -T-	c0000025
<input type="checkbox"/>	0026 -T-	c0000026
<input type="checkbox"/>	0027 -T-	c0000027
<input type="checkbox"/>	0028 -T-	c0000028
<input type="checkbox"/>	0029 -T-	c0000029
<input type="checkbox"/>	0030 -T-	c0000030
<input checked="" type="checkbox"/>	0031 -T-	c0000031
<input type="checkbox"/>	0032 -T-	c0000032
<input type="checkbox"/>	0033 -T-	c0000033
<input type="checkbox"/>	0034 -T-	c0000034
<input type="checkbox"/>	0035 -T-	c0000035
<input type="checkbox"/>	0036 -T-	c0000036
<input type="checkbox"/>	0037 -T-	c0000037
<input type="checkbox"/>	0038 -T-	c0000038
<input type="checkbox"/>	0039 -T-	c0000039
<input type="checkbox"/>	0040 -T-	c0000040
<input type="checkbox"/>	0041 -T-	c0000041
<input type="checkbox"/>	0042 -T-	c0000042
<input type="checkbox"/>	0043 -T-	c0000043

Throughput

❑ Massive MIMO configuration available

- Beam-forming (traffic channels)
- Transmission diversity (spatial)
- Spatial multiplexing
- User multiplexing

❑ Multi-carrier aggregation

- Master-slave relation-ship
- Master sites, pilot channel checked
- Slave sites, belong to same Group as master

Multi-carrier aggregation

Tx/Rx parameters: 69 c0000069

General | Patterns | Channels | Site | gNB

Type: Tx/Rx A (0) | Signal: 5G TDD (104) | Status: Unknown (0) | Frequency plan: # 69 | activated

Tx/Rx:
Power / beam (W): 114.8154
Dynamic (dB): 0
Tx ant gain (dBi): 21.40
Rx ant gain (dBi): 21.40
Losses (dB) tx: 0.00 rx: 0.00
Tx add losses (dB): 0.00
E.I.R.P (W): 15848.93
Frequency (MHz): 3525.000000
Antenna height (m): 10.00
Tx bandwidth (kHz): 60000.00
Rx bandwidth (kHz): 60000.00

Coverage:
ITU525
Delete info
OOB (dBW/MHz): 0
 Variable power
 Fixed power
 Fixed frequency
 Freq Hop / WB
 Variable elevation
 Fixed elevation

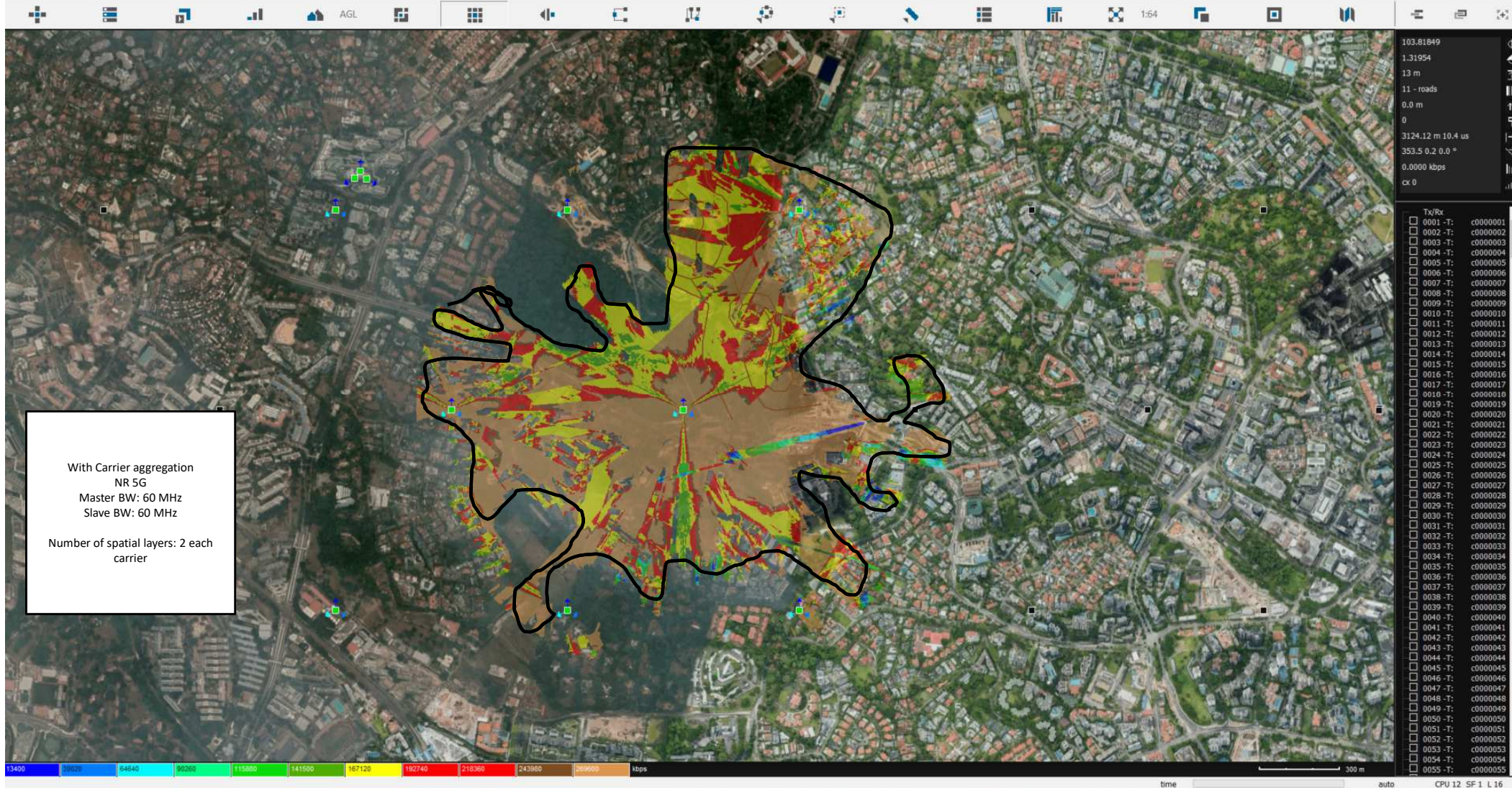
Info:
Call sign: c0000069 | Parenting: 0
Address: | Date: | yyyymmdd
Inf1: | Type ID: C
Inf2: | Link: |
Network ID: Group 842-840
User: | Call number: 0

Tx/Rx parameters: 69 c0000069

General | Patterns | Channels | Site | gNB

Transmitting:
no. ch: 1 | Loss (dB): 0
Pilot 3525.000000 | 0.000000

Receiving:
no. ch: 1 | TD (dB): 0.0
3525.000000 | 0.000000

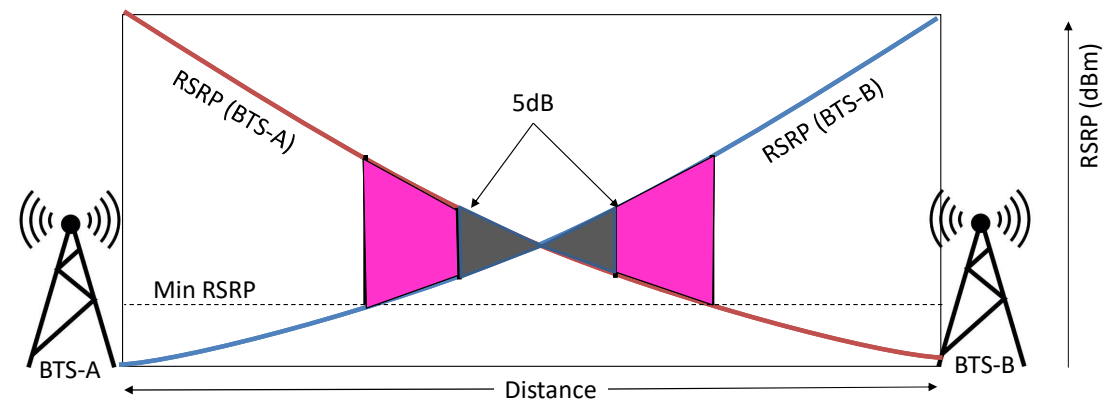
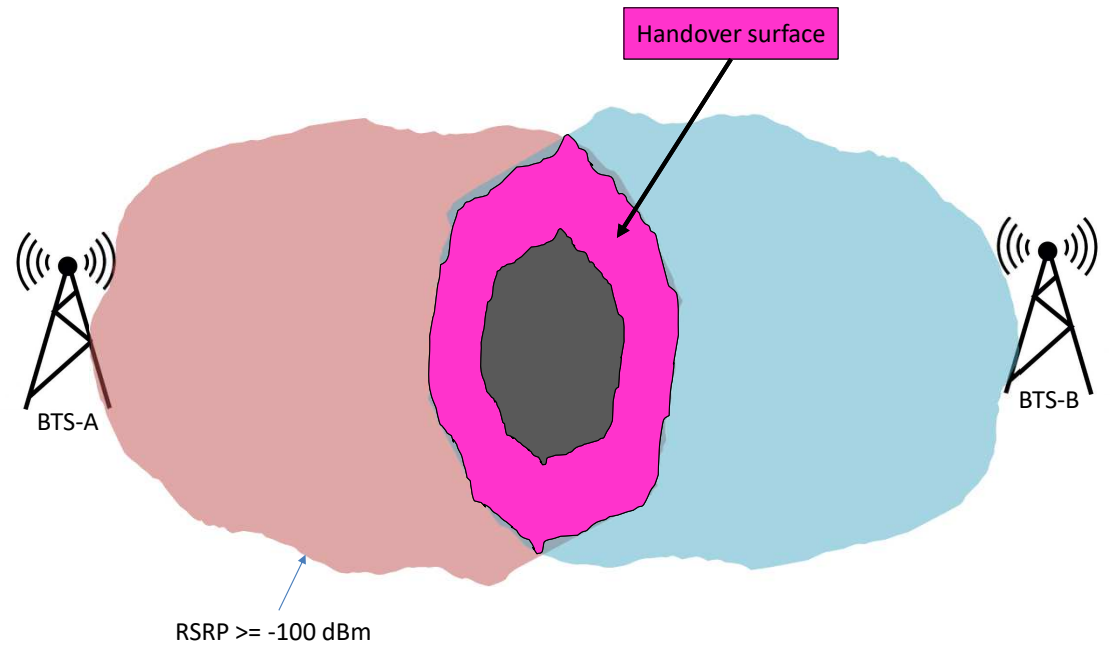
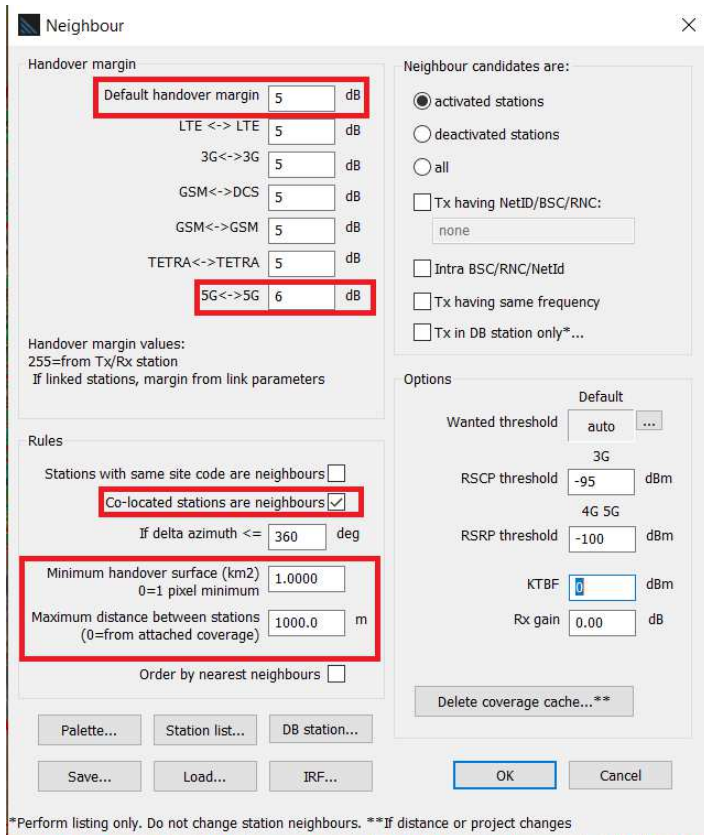


With Carrier aggregation
NR 5G
Master BW: 60 MHz
Slave BW: 60 MHz
Number of spatial layers: 2 each carrier

Neighbor planning

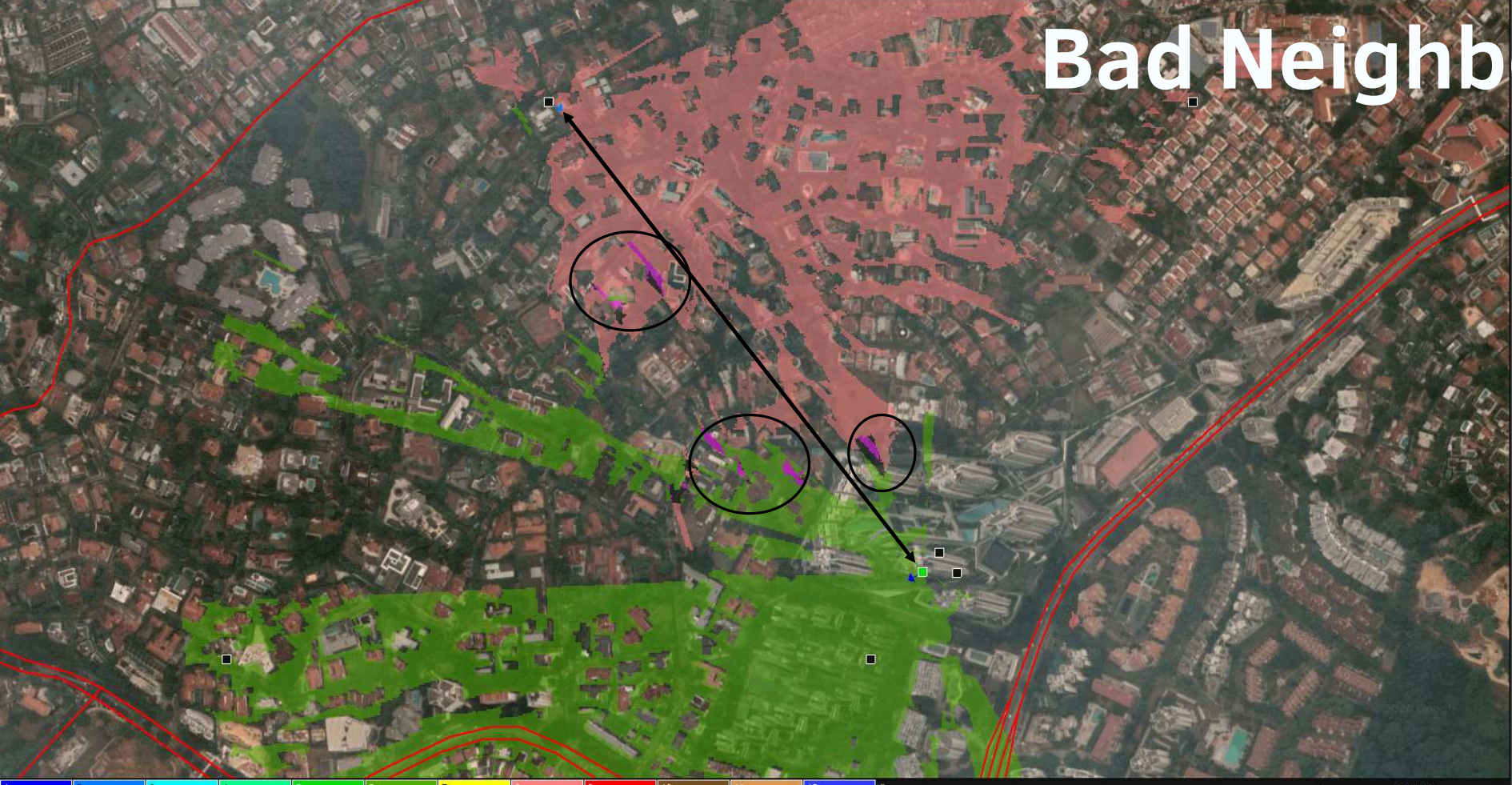
Auto Neighbor Planning

Neighbor map and neighbor list generation.



Handover area:

- $RSRP_1 \ \&\& \ RSRP_2 \geq \text{threshold} \ \&\&$
- $|RSRP_1 - RSRP_2| \geq 5\text{dB}$



Bad Neighbor

103.80976
1.31606
1706.82 m 5.7 us
306.6 0.2 0.0 °
0.0000 #
cx 0

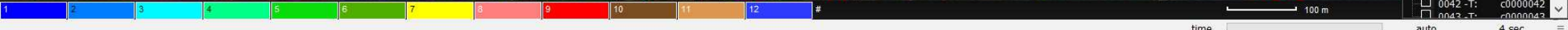
	Tx/Rx
<input type="checkbox"/>	0001 -T: c0000001
<input type="checkbox"/>	0002 -T: c0000002
<input type="checkbox"/>	0003 -T: c0000003
<input type="checkbox"/>	0004 -T: c0000004
<input type="checkbox"/>	0005 -T: c0000005
<input type="checkbox"/>	0006 -T: c0000006
<input type="checkbox"/>	0007 -T: c0000007
<input type="checkbox"/>	0008 -T: c0000008
<input type="checkbox"/>	0009 -T: c0000009
<input type="checkbox"/>	0010 -T: c0000010
<input type="checkbox"/>	0011 -T: c0000011
<input type="checkbox"/>	0012 -T: c0000012
<input type="checkbox"/>	0013 -T: c0000013
<input type="checkbox"/>	0014 -T: c0000014
<input type="checkbox"/>	0015 -T: c0000015
<input type="checkbox"/>	0016 -T: c0000016
<input type="checkbox"/>	0017 -T: c0000017
<input type="checkbox"/>	0018 -T: c0000018
<input type="checkbox"/>	0019 -T: c0000019
<input type="checkbox"/>	0020 -T: c0000020
<input type="checkbox"/>	0021 -T: c0000021
<input type="checkbox"/>	0022 -T: c0000022
<input type="checkbox"/>	0023 -T: c0000023
<input type="checkbox"/>	0024 -T: c0000024
<input type="checkbox"/>	0025 -T: c0000025
<input type="checkbox"/>	0026 -T: c0000026
<input type="checkbox"/>	0027 -T: c0000027
<input type="checkbox"/>	0028 -T: c0000028
<input type="checkbox"/>	0029 -T: c0000029
<input type="checkbox"/>	0030 -T: c0000030
<input type="checkbox"/>	0031 -T: c0000031
<input type="checkbox"/>	0032 -T: c0000032
<input type="checkbox"/>	0033 -T: c0000033
<input type="checkbox"/>	0034 -T: c0000034
<input type="checkbox"/>	0035 -T: c0000035
<input type="checkbox"/>	0036 -T: c0000036
<input type="checkbox"/>	0037 -T: c0000037
<input type="checkbox"/>	0038 -T: c0000038
<input type="checkbox"/>	0039 -T: c0000039
<input type="checkbox"/>	0040 -T: c0000040
<input type="checkbox"/>	0041 -T: c0000041
<input type="checkbox"/>	0042 -T: c0000042
<input type="checkbox"/>	0043 -T: c0000043



Good Neighbor

103.80598
1.31845
16.1
2201.73 m 7.3 us
305.6 0.1 0.0 °
0.0000 #
cx 0

	Tx/Rx	
<input type="checkbox"/>	0001 -T:	c0000001
<input type="checkbox"/>	0002 -T:	c0000002
<input type="checkbox"/>	0003 -T:	c0000003
<input type="checkbox"/>	0004 -T:	c0000004
<input type="checkbox"/>	0005 -T:	c0000005
<input type="checkbox"/>	0006 -T:	c0000006
<input type="checkbox"/>	0007 -T:	c0000007
<input type="checkbox"/>	0008 -T:	c0000008
<input type="checkbox"/>	0009 -T:	c0000009
<input type="checkbox"/>	0010 -T:	c0000010
<input type="checkbox"/>	0011 -T:	c0000011
<input type="checkbox"/>	0012 -T:	c0000012
<input type="checkbox"/>	0013 -T:	c0000013
<input type="checkbox"/>	0014 -T:	c0000014
<input type="checkbox"/>	0015 -T:	c0000015
<input type="checkbox"/>	0016 -T:	c0000016
<input type="checkbox"/>	0017 -T:	c0000017
<input type="checkbox"/>	0018 -T:	c0000018
<input type="checkbox"/>	0019 -T:	c0000019
<input type="checkbox"/>	0020 -T:	c0000020
<input type="checkbox"/>	0021 -T:	c0000021
<input type="checkbox"/>	0022 -T:	c0000022
<input type="checkbox"/>	0023 -T:	c0000023
<input type="checkbox"/>	0024 -T:	c0000024
<input type="checkbox"/>	0025 -T:	c0000025
<input type="checkbox"/>	0026 -T:	c0000026
<input type="checkbox"/>	0027 -T:	c0000027
<input type="checkbox"/>	0028 -T:	c0000028
<input type="checkbox"/>	0029 -T:	c0000029
<input type="checkbox"/>	0030 -T:	c0000030
<input type="checkbox"/>	0031 -T:	c0000031
<input type="checkbox"/>	0032 -T:	c0000032
<input type="checkbox"/>	0033 -T:	c0000033
<input type="checkbox"/>	0034 -T:	c0000034
<input type="checkbox"/>	0035 -T:	c0000035
<input type="checkbox"/>	0036 -T:	c0000036
<input type="checkbox"/>	0037 -T:	c0000037
<input type="checkbox"/>	0038 -T:	c0000038
<input type="checkbox"/>	0039 -T:	c0000039
<input type="checkbox"/>	0040 -T:	c0000040
<input type="checkbox"/>	0041 -T:	c0000041
<input type="checkbox"/>	0042 -T:	c0000042
<input type="checkbox"/>	0043 -T:	c0000043



File Ma Coverage Microwave Multipoint Subscriber Satellite Radar Localization Pattern Assurance Spectrum Database Object Report Tools Help

Network calculation
 Network interference
 Network planning
 Network analysis
 Network report
 Traffic

Handover
 Station candidates
 Neighbour

Neighbour calculation...
 Handover map...

Handover margin

Default handover margin

LTE <-> LTE 5 dB
 3G <-> 3G 5 dB
 GSM <-> DCS 5 dB
 GSM <-> GSM 5 dB
 TETRA <-> TETRA 5 dB
 5G <-> 5G 6 dB

Handover margin values:
 255=from Tx/Rx station
 If linked stations, margin from link parameters

Rules

Stations with same site code are neighbours
 Co-located stations are neighbours
 If delta azimuth <= 360 deg

Minimum handover surface (km2)
 0=1 pixel minimum 0.5000
 Maximum distance between stations
 (0=from attached coverage) 1200.0 m

Order by nearest neighbours

Neighbour candidates are:
 activated stations
 deactivated stations
 all
 Tx having NetID/BSC/RNC:
 none
 Intra BSC/RNC/NetId
 Tx having same frequency
 Tx in DB station only*...

Options

Default auto
 Wanted threshold 3G
 RSCP threshold -95 dbm
 4G 5G
 RSRP threshold -100 dbm

KTBF 0 dbm
 Rx gain 0.00 db

Delete coverage cache***

OK Cancel

Tx/Rx parameters: 778 c0000778

General Patterns Channels Site gNB

Type (0) Signal (104) Modulation (0) NFD / TS
 Tx/Rx A (0) 5G TDD (104) undefined (0)

Threshold

Cov. threshold (dbm) -87
 Rx threshold (dbm) -102
 KTFB (dbm) -91
 Launch delay (us) 0
 C/I req N=0/N=1 -127.0 / -127.0

Options

Floor offset 0
 Handover 0 dB
 Neighbour list 125.257.258.776.779.
 RSI

Power chan

% Ref. % xF
 DL/UL rat
 Numerology
 0: 15 kHz
 1: 30 kHz

Neighbour list

125	c0000125	-1	-1
257	c0000257	-1	-1
258	c0000258	-1	-1
776	c0000776	-1	-1
779	c0000779	-1	-1
-1	none	-1	-1
-1	none	-1	-1
-1	none	-1	-1
-1	none	-1	-1

Listing... Close

0039 -T: c0000039
 0040 -T: c0000040
 0041 -T: c0000041
 0042 -T: c0000042
 0043 -T: c0000043

103.75978
 1.36978
 60 m
 0 - Open
 0.0 m
 9820.33 m 324.8 us

1 min 2 km

12:46 AM 11/05/2020

Perform listing only. Do not change station neighbours. ***If distance or project changes

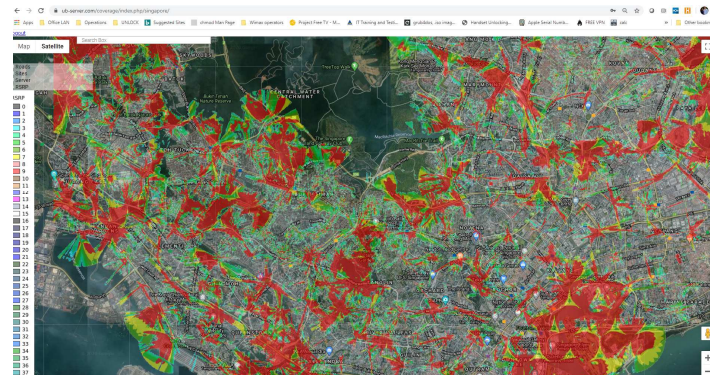
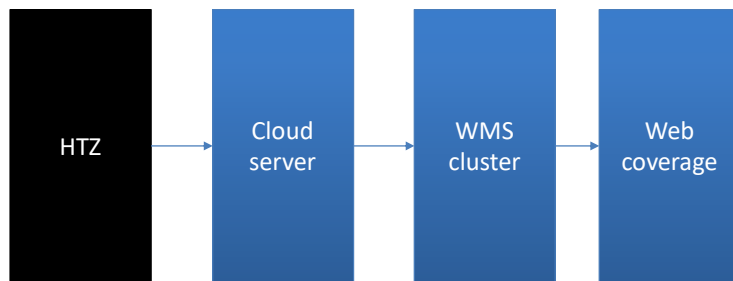
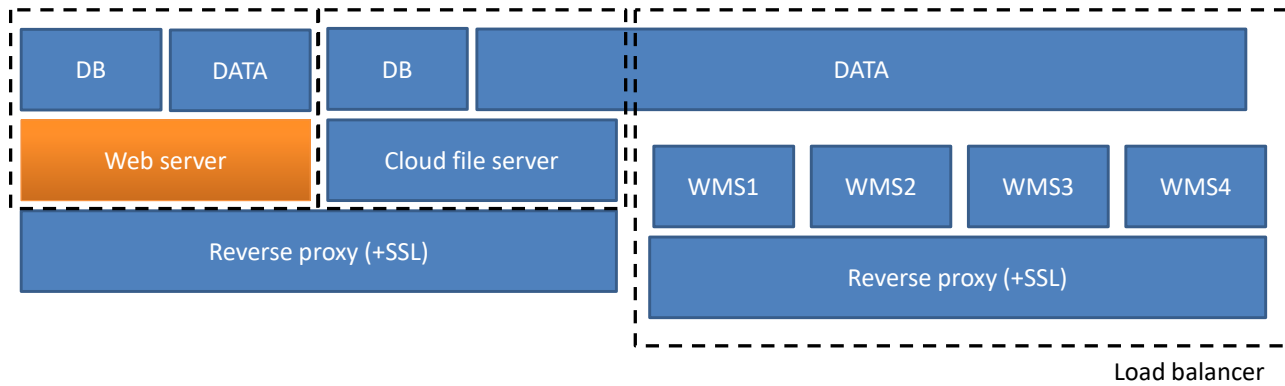
Palette... Station list... DB station...
 Save... Load... IRF...
 OK Cancel

Coverage on the web

Online or intranet coverage publishing

WMS service

Coverage on the web





ATDI

Sydney (APAC)

+61 298 897 306
12A, 33 Waterloo Road,
Macquarie Park NSW 2113

Paris

+33 1 53 30 81 41
11 Boulevard Malesherbes
75008 Paris – France

Other offices

Poland, England, Spain,
Russia, Israel, Ukraine,
Latin America, Germany



<https://atdi-group.com/contact/>



HQ ADDRESS

11 Boulevard Malesherbes
75008 Paris – France

PHONE NUMBER

+33 1 53 30 81 41

E-MAIL ADDRESS

contact@atdi-group.com

sales@atdi-group.com

support@atdi-group.com

website: www.atdi-group.com

THANK YOU

ATDI TEAM

