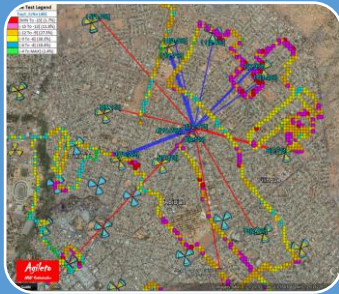


MOBILE RADIO NETWORK OPTIMIZATION



PoC (Proof of Concept)
Benchmark



PoC (Proof of Concept) - Benchmark

- This **PoC** for the **Benchmark** is applicable to the Drive Test performance evaluation for the **comparison purpose**.
- It has the aim to provide the Benchmark (**evaluation / comparison / difference**) between a reference metric and a similar new one (on each drive test point) collected at the same or different times.
- It may be used to compare the performance between **different mobile operators** or for the same operator on a metric taken at different times (ex swap or rollout).
- The comparison is performed on each drive test point and the (input) **drive tests may be performed simultaneously or they may be performed at different times** (ex: swap or different mobile operators).
- If the input **drive tests routes are not identically then the benchmark is performed just on the common routes detected automatically** (on both input drive tests).

The examples used on this presentation are from a swap project where the reference metric was **After (POST)** the swap and the new metric was **Before (PRE)** the swap, so the benchmark difference was **After-Before (POST-PRE)**.

Notice: ***This PoC process is similar for all technologies (2G/3G/4G/5G)*** although this presentation may use as example data from a specific technology.

Agenda

- Introduction: Context, Inputs and Deliverables
- Geo-spatial representation of the Network/Cluster
- Benchmark POST – PRE swap (analysis and presentation)

Inputs and deliverable

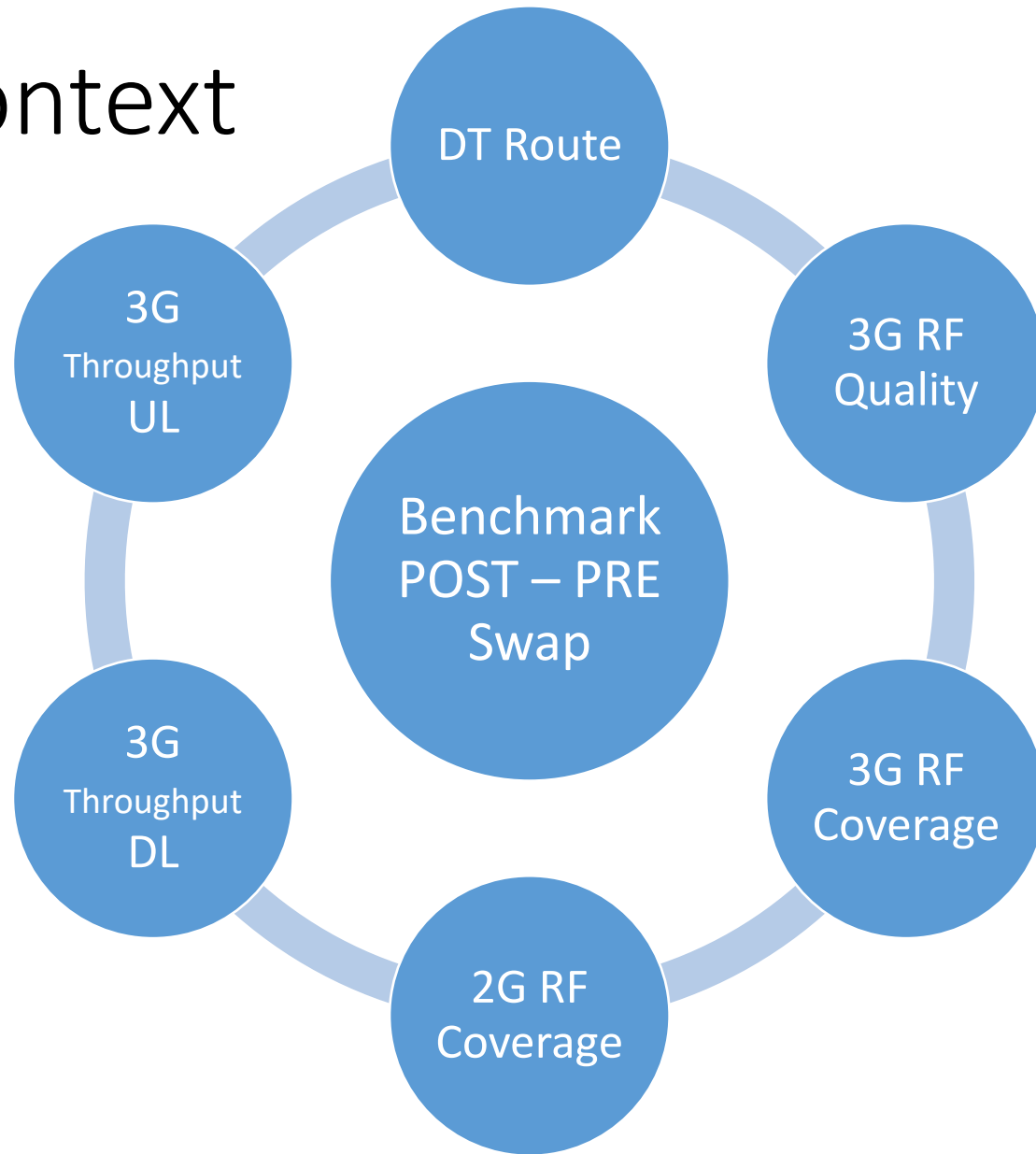
Inputs:

- Geodatabase of network encompassing the cluster under study:
 - Sites/Cells Coordinates in WGS 84 in CSV or tabular format
 - Antenna configurations per technology (2G, 3G, 4G & 5G) : height, azimuth, tilt (mech + elec)...
- Drive test log files (**PRE-Swap**) on time period from **10.10.202X** to **11.10.202X**
(Scanner 3G + Scanner 2G + Datacard FTP UL + Datacard FTP DL)
- Drive test log files (**POST-Swap**) on time period from **27.10.202X** to **28.10.202X**
(Scanner 3G + Scanner 2G + Datacard FTP UL + Datacard FTP DL)

Outputs:

- GIS representation of the 2G, 3G, 4G & 5G clusters in MapInfo & Google earth formats
- Drive Test route and analysis presentations in MapInfo & Google earth formats
- Benchmarks (POST-PRE swap) for the following metrics:
 - 3G RF Quality (EcNo)
 - 3G RF Coverage (RSCP)
 - 2G RF Coverage (RxLev)
 - 3G Throughput DL (HSDPA)
 - 3G Throughput UL (HSUPA)

Project context



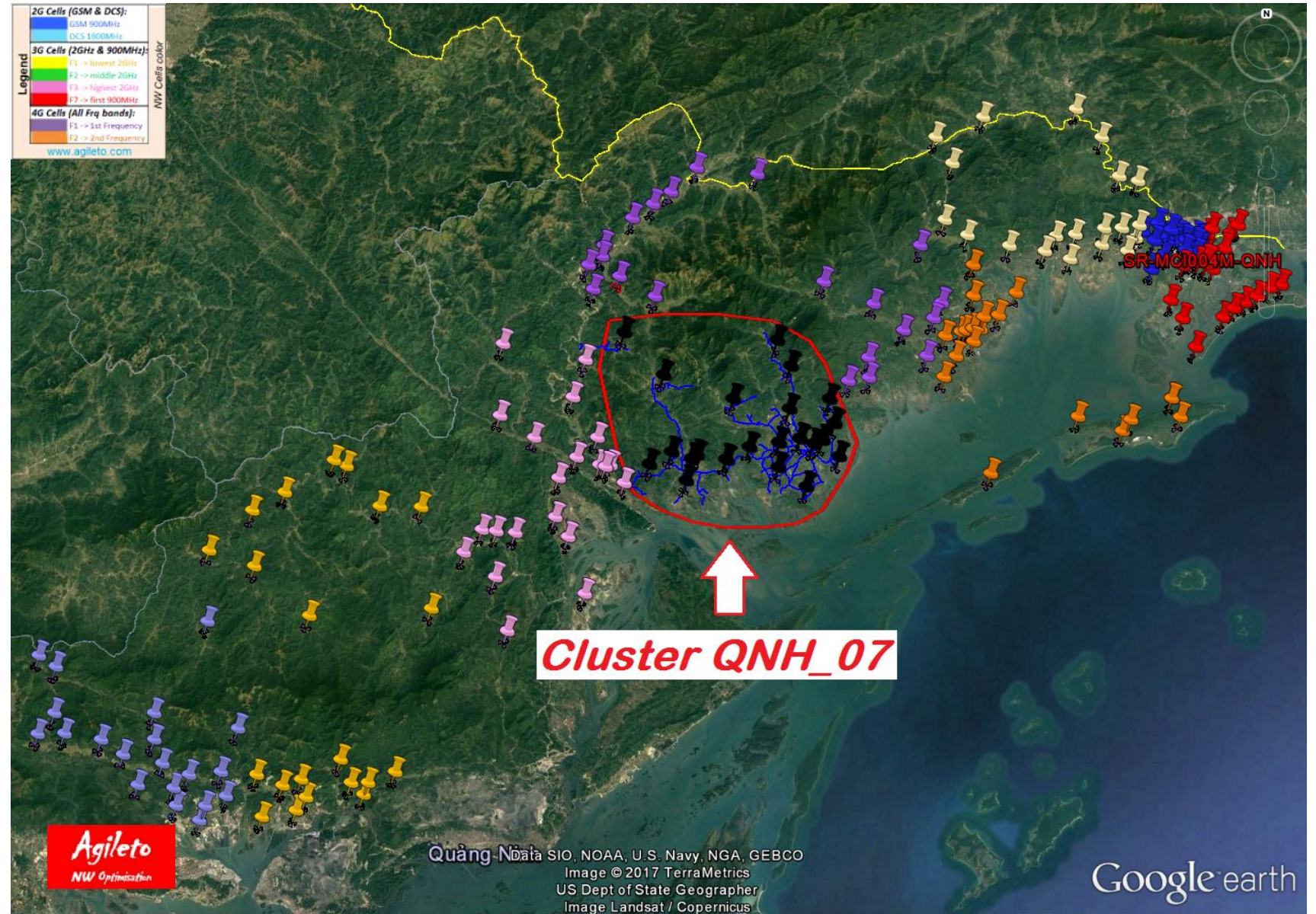
Agenda

- Introduction: Context, Inputs and Deliverables
- Geo-spatial representation of the Network/Cluster
- Benchmark POST – PRE swap (analysis and presentation)

Geographical cluster distribution

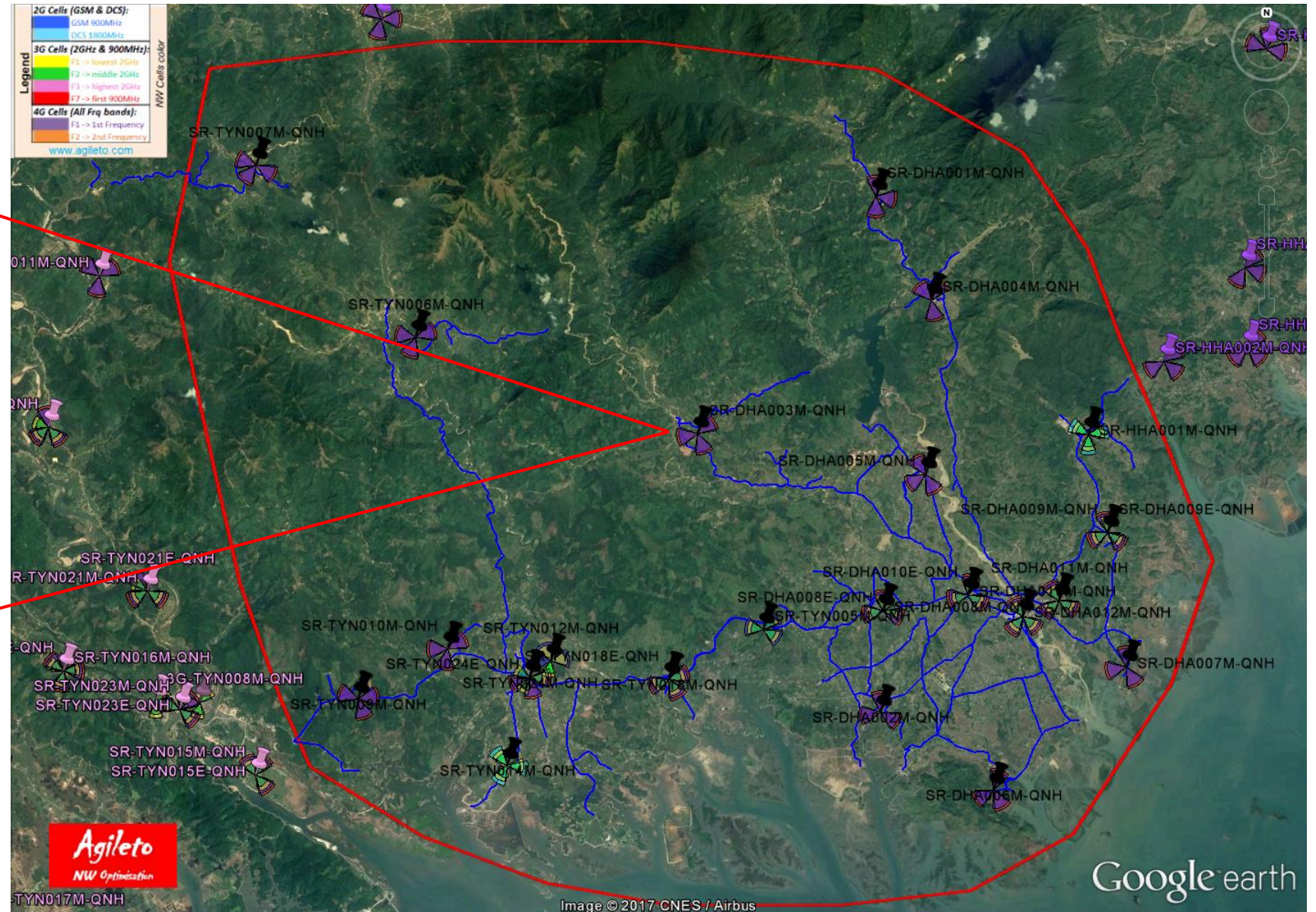
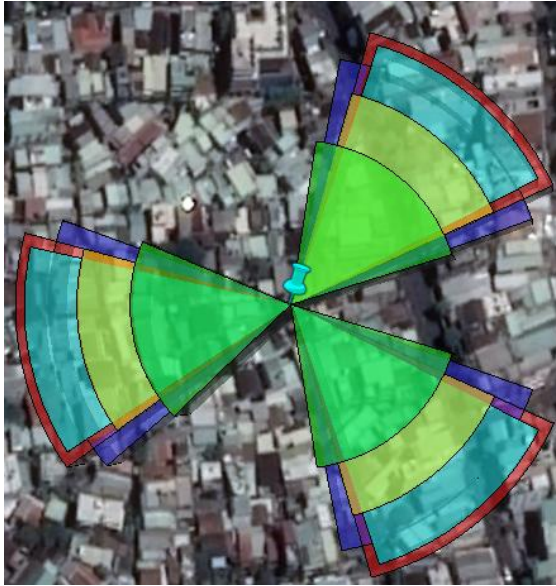
Cluster QNH_07

General Overview



Geographical cluster distribution

➤ Geographical distribution of the 2G, 3G cells related to the cluster



Layers color Legend:

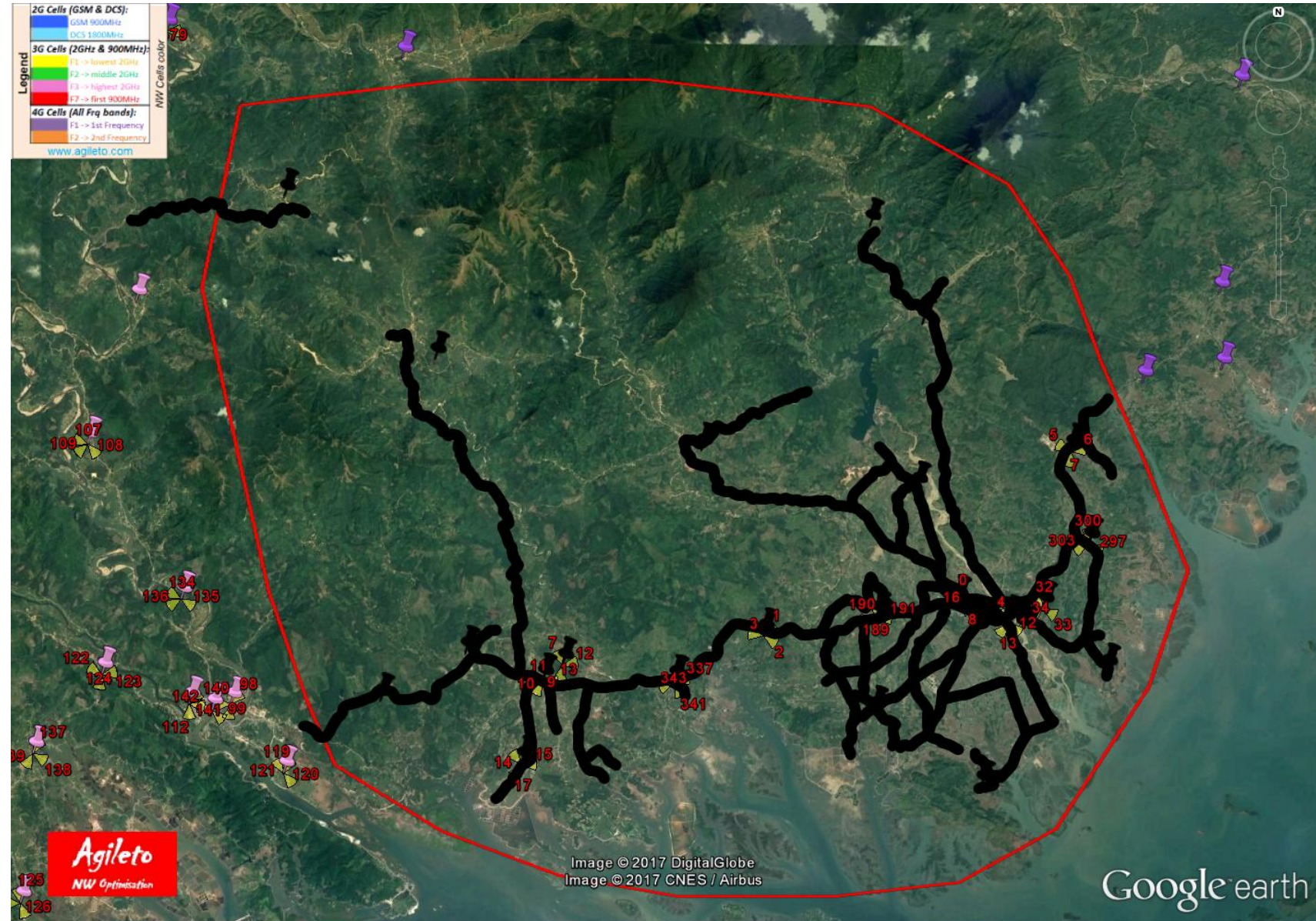
3G: **F1**, **F2** (2100MHz)

3G: **F7** (900MHz)

2G: **900**, **1800**

Route of the DT cluster

- The same route has been used to perform specific Drive Tests protocols during PRE and POST swap moments.
- The DT covers ~ **182 Km** (without counting repetitive routes)



Agenda

- Introduction: Context, Inputs and Deliverables
- Geo-spatial representation of the Network/Cluster
- Benchmark POST – PRE swap (analysis and presentation)

Benchmark POST – PRE swap (analysis and presentation)

Agileto [M4.1|V5.18] => Network Optimisation based on Drive Tests (*.csv)

Please select below the desired option and its associated parameters as appropriate

Drive Test Analysis
 Drive Test Optimisation

Preview of the Drive Test data file [2]: DT 1st File DT 2nd File

GPS Latitude WGS84 ---> Latitude
 GPS Longitude WGS84 -> Longitude
 Time Stamp ---> Time Stamp
 Spatial bin size [m] ----> 10 Perform Spatial Binning

Drive Test Analysis

Drive Test Parameter Header Selection:

Parameter Selected -> RxLev_B
 Parameter Name ----> RxLev_A-B

General (point) aggregation ----> Average Minimum Occurances
 Sum Maximum **Difference**

Legend Parameter values:

Legend ascending <- OR -> Legend descending

Value <= V_1 =	-3	---	Red
V_1 < Value <= V_2 =	-1	---	Pink
V_2 < Value <= V_3 =	-0.5	---	Orange
V_3 < Value <= V_4 =	0.5	---	Yellow
V_4 < Value <= V_5 =	1	---	Cyan
Value > V_5 =	1	---	Green

Time Stamp	Longitude	Latitude	RxLev_B
13:00:00	-82.76132322	27.88480401	-73.6
13:00:01	-82.76134535	27.8848327	-73.1
13:00:02	-82.76135421	27.88487443	-72.6
13:00:03	-82.76135732	27.88491913	-72.1
13:00:04	-82.76135937	27.88496432	-71.5
13:00:05	-82.76138085	27.88500589	-71
13:00:06	-82.76141971	27.8850339	-70.5
13:00:07	-82.7614555	27.8850565	-70
13:00:08	-82.76150356	27.88507457	-69.6
13:00:09	-82.76155264	27.8850836	-69.1
13:00:10	-82.7616099	27.88509354	-72
13:00:11	-82.76168147	27.88510438	-74.9
13:00:12	-82.761751	27.88510618	-79.7
13:00:13	-82.76183382	27.88510708	-74.6
13:00:14	-82.76191051	27.88510797	-77.3
13:00:15	-82.7619872	27.88510435	-80.4
13:00:16	-82.76205775	27.88510886	-83.2
13:00:17	-82.76214364	27.88510615	-86.1
13:00:18	-82.76220496	27.88512479	-89
13:00:19	-82.76223323	27.88514978	-92
13:00:20	-82.76225727	27.8852035	-92
13:00:21	-82.76226858	27.88525098	-97.6
13:00:22	-82.76227283	27.8853097	-95.2
13:00:23	-82.76227425	27.88538091	-92.8
13:00:24	-82.7622785	27.88544838	-90.3
13:00:25	-82.76228275	27.8855221	-87.9
13:00:26	-82.76229123	27.88558832	-85.6
13:00:27	-82.76229124	27.88565579	-83.2
13:00:28	-82.76229691	27.885737	-80.8
13:00:29	-82.76229974	27.8858307	-78.4
13:00:30	-82.76229834	27.8859369	-75.9
13:00:31	-82.76229835	27.8860506	-73.5
13:00:32	-82.76229695	27.88618429	-71.1
13:00:33	-82.76228849	27.88631048	-80.8
13:00:34	-82.76228426	27.88643167	-90.3
13:00:35	-82.76227862	27.88656536	-100

Generate Google Earth files
 GE points have the same size -> 0.5
 Generate MapInfo files
 Export Bin Data

Drive Test 1st File: DEMO_RxLev_A.csv
 Drive Test 2nd File: DEMO_RxLev_B.csv

Cancel OK

Benchmark **POST** – **PRE** Swap

For the selected RF signals (metrics) there will be presented and emphasized on the map the **Difference = POST - PRE** values for the following three cases:

A) Difference = POST - PRE < -3 [dB] -> (worst)

The values in POST swap are with minimum 3dB less then the values in PRE swap, that means the signal in PRE swap is more than double against the signal in POST swap.

B) -3 [dB] < Difference = POST - PRE < 3 [dB] -> (comparable)

The values in POST swap are comparable with the values in PRE swap within 3 [dB] range interval that means from single to double values.

C) Difference = POST - PRE > 3 [dB] -> (better)

The values in POST swap are with minimum 3dB greater then the values in PRE swap, that mean the signal in POST swap is more than double against the signal in PRE swap.

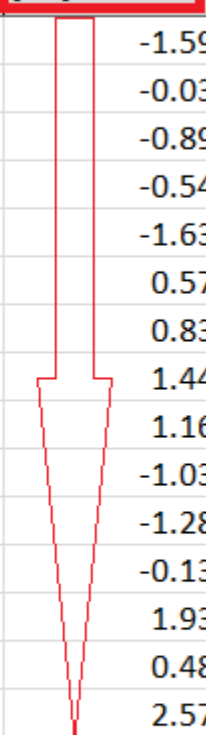
3G RF Quality (EcNo)

Quality: EcNo Difference **POST** - **PRE** Swap (3G_F1 -> 2100MHz)

Grace to Agileto's (M4.1) special feature it is evaluated on the common detected drive test routes on each bin the difference between the metrics detected during **POST** swap respective **PRE** swap (Diff=**POST-**PRE****).

On the right side there are presented the results in the table format (like it is provided by Agileto tool) which includes for each drive test point all cases (**POST** / **PRE** / **POST-**PRE****) related to the measured metric (**EcNo** [dB]).

Pt_Nr	Time_Stamp	Latitude_WGS84	Longitude_WGS84	EcNo_F1 POST [dB]	EcNo_F1 PRE [dB]	EcNo_F1 POST-PRE [dB]
4839	9:16:29.033	26.35736	101.58884	-8.36	-6.77	-1.59
4840	9:16:29.619	26.35745	101.58884	-8.21	-8.18	-0.03
4841	9:16:30.634	26.35754	101.58875	-7.9	-7.01	-0.89
4842	9:16:31.820	26.35763	101.58865	-8.39	-7.85	-0.54
4843	9:16:33.115	26.35772	101.58855	-8.52	-6.89	-1.63
4844	9:16:35.258	26.35781	101.58846	-8.86	-9.43	0.57
4845	9:16:35.726	26.35781	101.58836	-8.56	-9.39	0.83
4846	9:16:36.527	26.3579	101.58826	-6.9	-8.34	1.44
4847	9:16:37.621	26.3579	101.58817	-7.56	-8.72	1.16
4848	9:16:38.641	26.35799	101.58807	-8.64	-7.61	-1.03
4849	9:16:41.182	26.35808	101.58788	-7.24	-5.95	-1.28
4850	9:16:43.213	26.35817	101.58778	-5.96	-5.83	-0.13
4851	9:16:47.102	26.35826	101.58768	-6.52	-8.45	1.93
4852	9:16:51.817	26.35826	101.58759	-9.25	-9.73	0.48
4853	9:16:57.918	26.35835	101.58749	-8.6	-11.17	2.57
4854	9:17:01.829	26.35835	101.58739	-7.6	-10.68	3.08
4855	9:17:03.723	26.35835	101.5873	-8.4	-10.9	2.51
4856	9:17:03.913	26.35844	101.5873	-8.18	-9.85	1.67
4857	9:17:05.346	26.35844	101.5872	-6.51	-9.23	2.72
4858	9:17:06.755	26.35844	101.58711	-6.61	-8.52	1.91



Quality: EcNo Difference **POST** - **PRE** Swap (3G_F1 -> 2100MHz)

Grace to Agileto's (M4.1) special feature it is evaluated on the common drive test routes on each bin the difference between the metrics detected during POST swap respective PRE swap (Diff=**POST**-**PRE**) and the results are plot back on the map.

There are three main cases:

POST worst than PRE (double)

POST- $PRE \leq -3$ dB

■ **19.5 %**

POST comparable PRE

-3 dB \leq POST- $PRE < 3$ dB

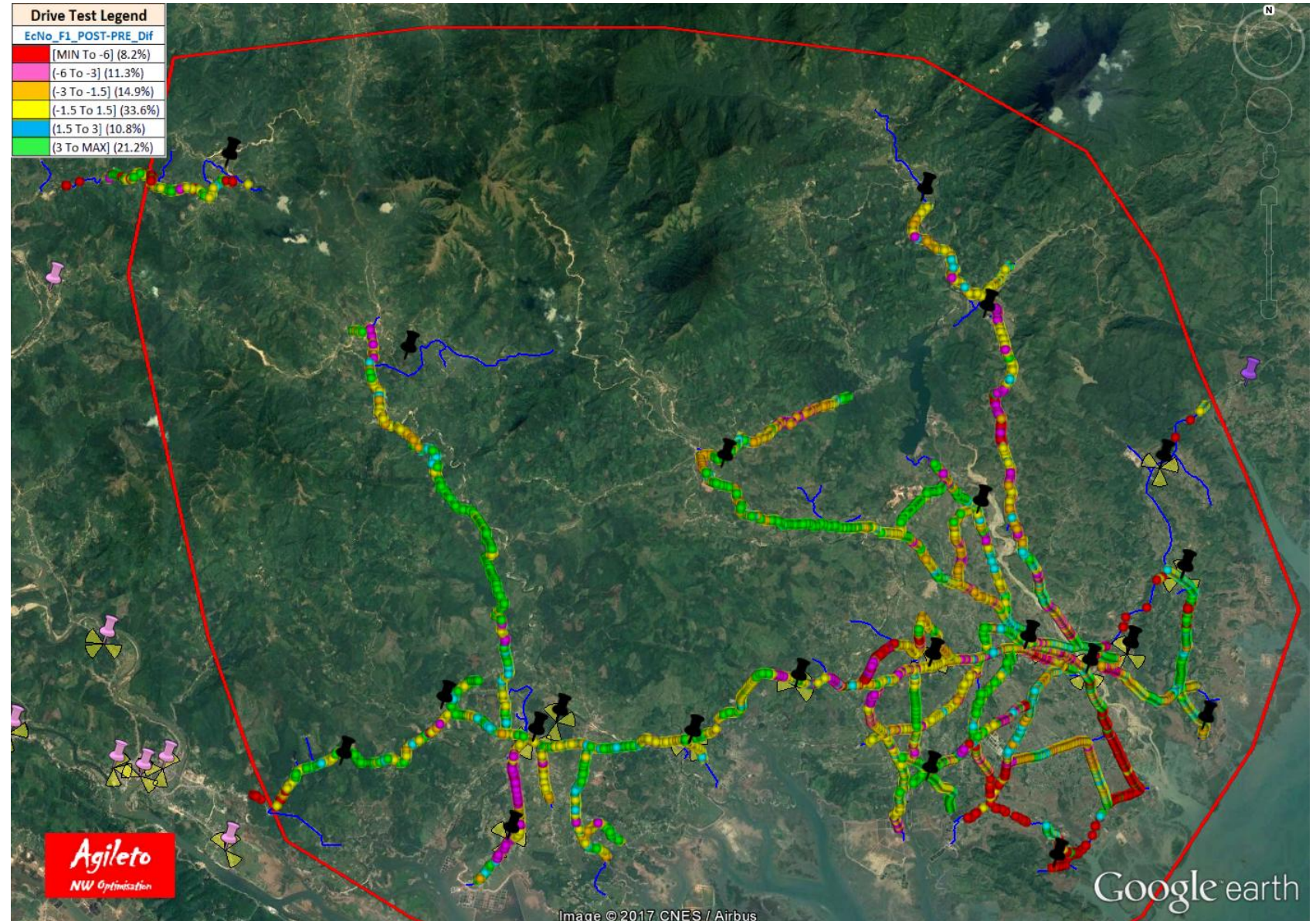
■ **59.3 %**

POST better than PRE (double)

POST- $PRE \geq 3$ dB

■ **21.2 %**

(Overall POST is **better** than PRE)

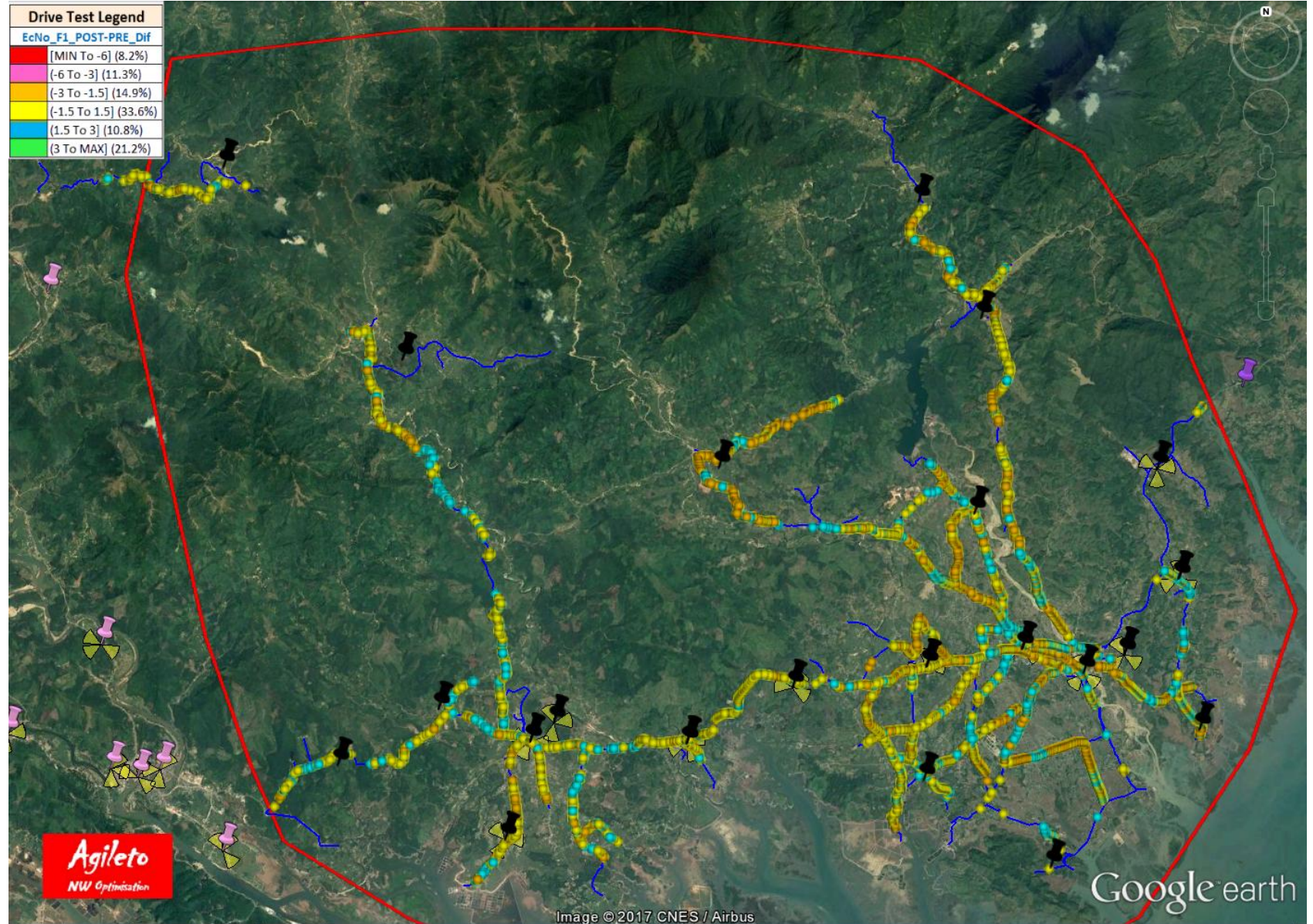


Quality: EcNo Difference **POST** - **PRE** Swap (3G_F1 -> 2100MHz)

POST-PRE swap
(comparable locations)

POST comparable PRE
 $-3\text{dB} \leq \text{POST-PRE} < 3\text{dB}$

■ **59.3 %**



Quality: EcNo Difference **POST** - **PRE** Swap (3G_F1 -> 2100MHz)

POST-PRE swap

(one is 3dB better than other)

POST worst than PRE (double)

POST-PRE $\leq -3\text{dB}$

■ **19.5 %**

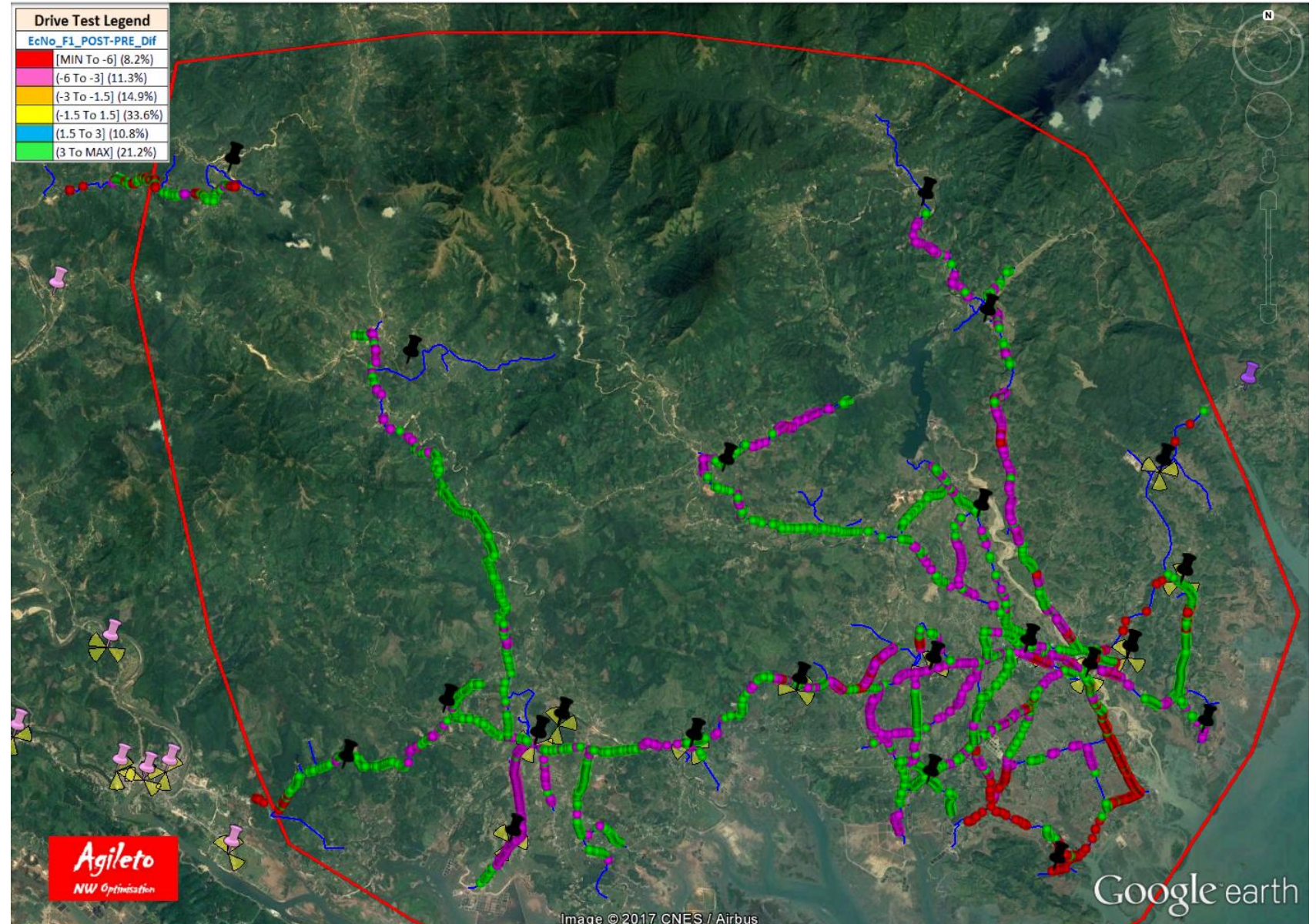
POST better then PRE (double)

POST-PRE $\geq 3\text{dB}$

■ **21.2 %**

Obs.

It is easy to locate places where we have **better** / **worst** performance POST swap comparing with PRE swap.



3G RF Coverage (RSCP)

Coverage: RSCP Difference **POST** - **PRE** Swap (3G_F1 -> 2100MHz)

Grace to Agileto's (M4.1) special feature it is evaluated on the common drive test routes on each bin the difference between the metrics detected during POST swap respective PRE swap (Diff=**POST-PRE**) and the results are plot back on the map.

There are three main cases:

POST worst than PRE (double)

POST-PRE \leq -3dB

■ **16.4 %**

POST comparable PRE

-3dB \leq POST-PRE < 3dB

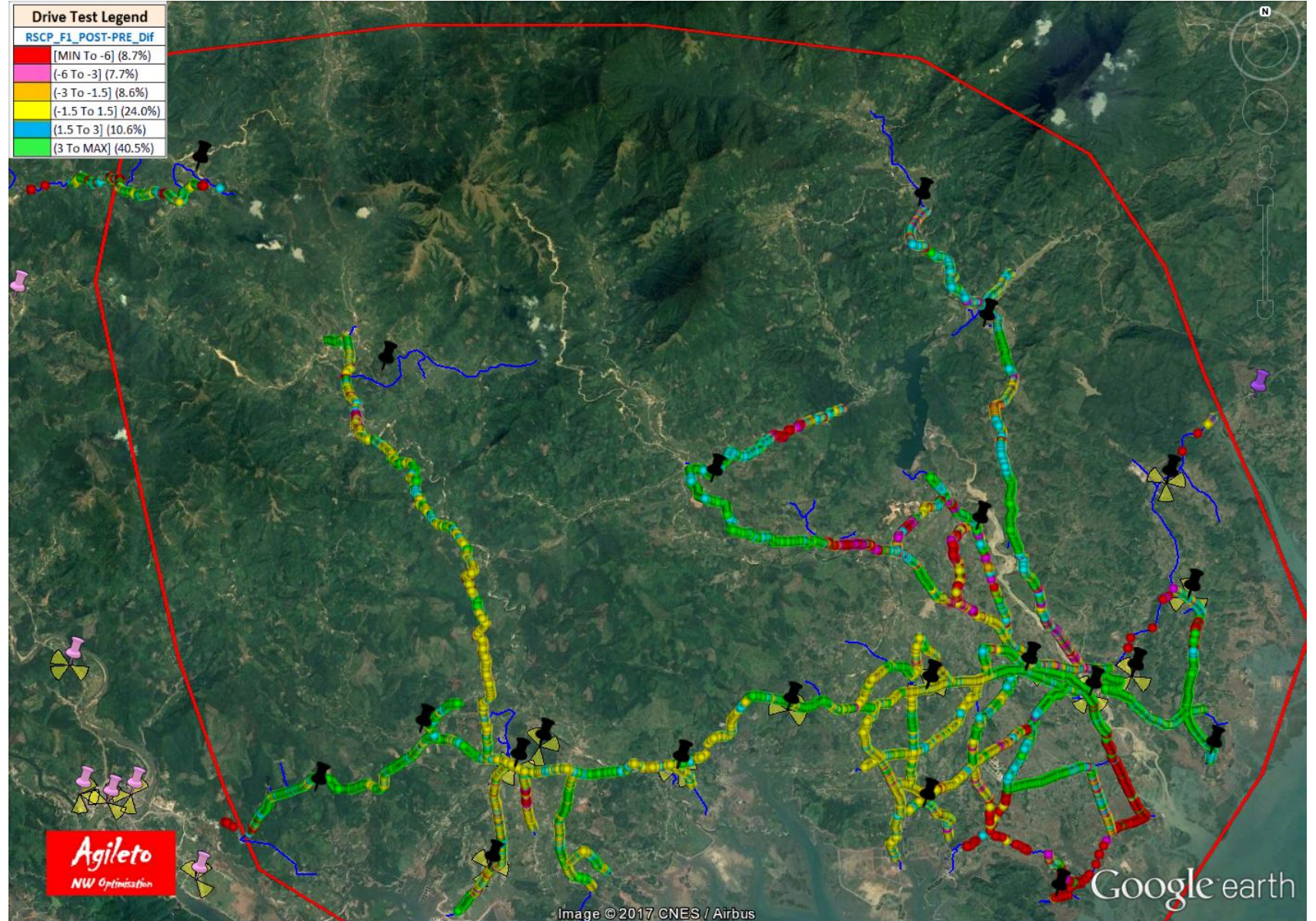
■ **43.1 %**

POST better than PRE (double)

POST-PRE \geq 3dB

■ **40.5 %**

(Overall POST is **better** than PRE)

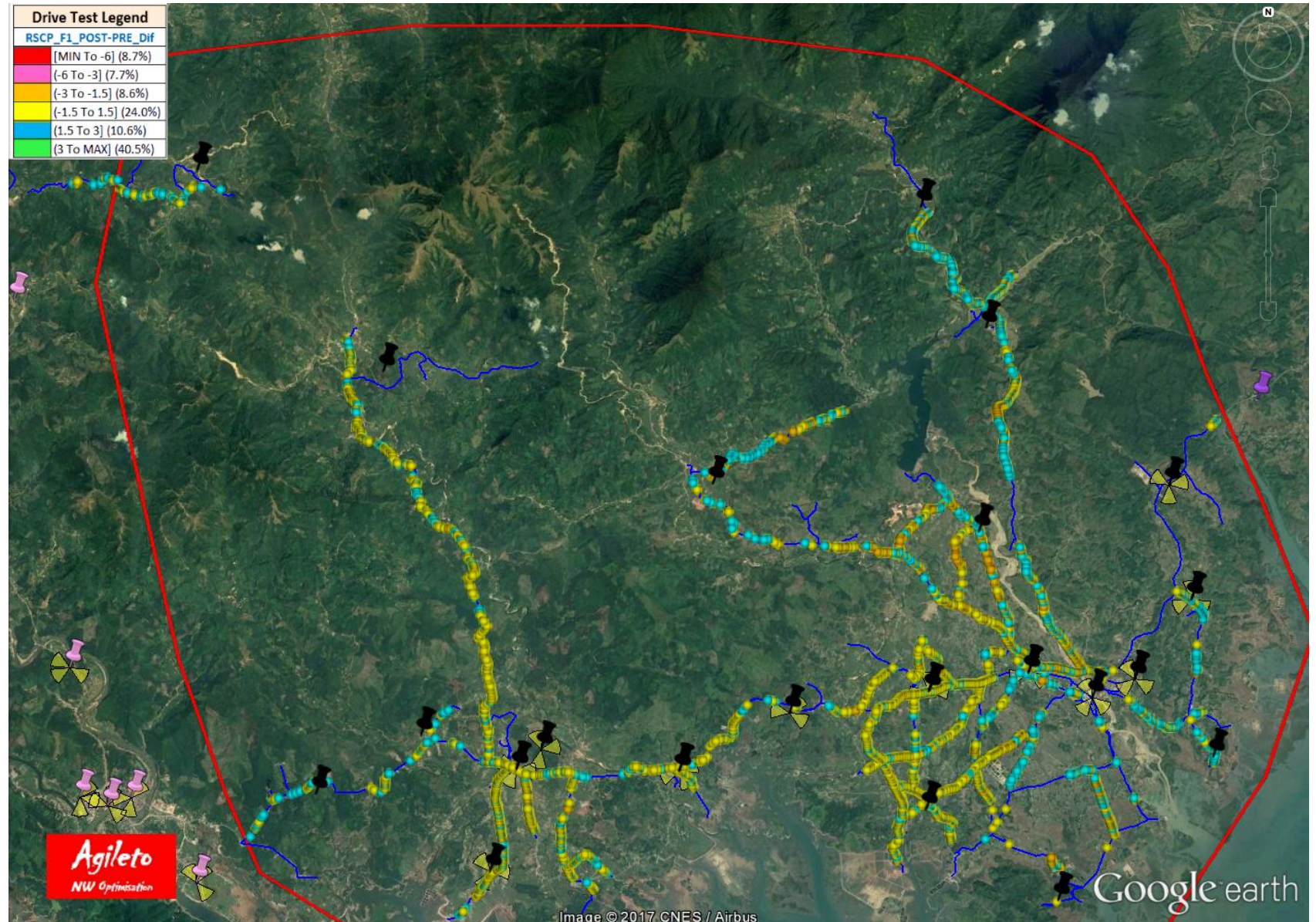


Coverage: RSCP Difference **POST** - **PRE** Swap (3G_F1 -> 2100MHz)

POST-PRE swap
(comparable locations)

POST comparable PRE
 $-3\text{dB} \leq \text{POST-PRE} < 3\text{dB}$

■ **43.1 %**



Coverage: RSCP Difference **POST** - **PRE** Swap (3G_F1 -> 2100MHz)

POST-PRE swap

(one is 3dB better than other)

POST worst than PRE (double)

POST-PRE \leq -3dB

■ **16.4 %**

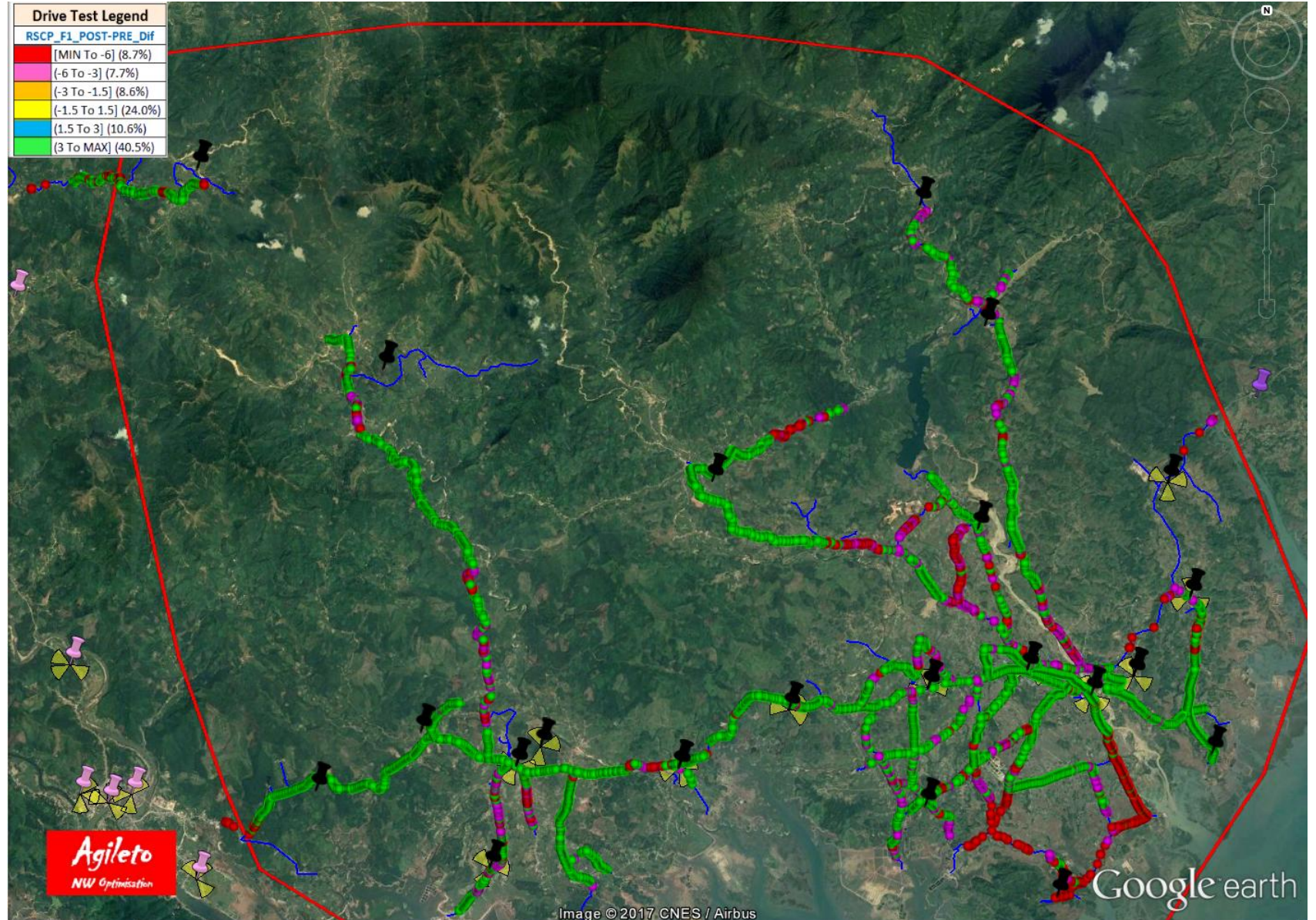
POST better then PRE (double)

POST-PRE \geq 3dB

■ **40.5 %**

Obs.

It is easy to locate places where we have **better** / **worst** performance POST swap comparing with PRE swap.



2G RF Coverage (RxLev)

Coverage: 2G RxLev Difference POST - PRE Swap

Grace to Agileto's (M4.1) special feature it is evaluated on the common drive test routes on each bin the difference between the metrics detected during POST swap respective PRE swap (Diff=**POST-PRE**) and the results are plot back on the map.

There are three main cases:

POST worst than PRE (double)

POST-PRE \leq -3dB

■ **23.0 %**

POST comparable PRE

-3dB \leq POST-PRE < 3dB

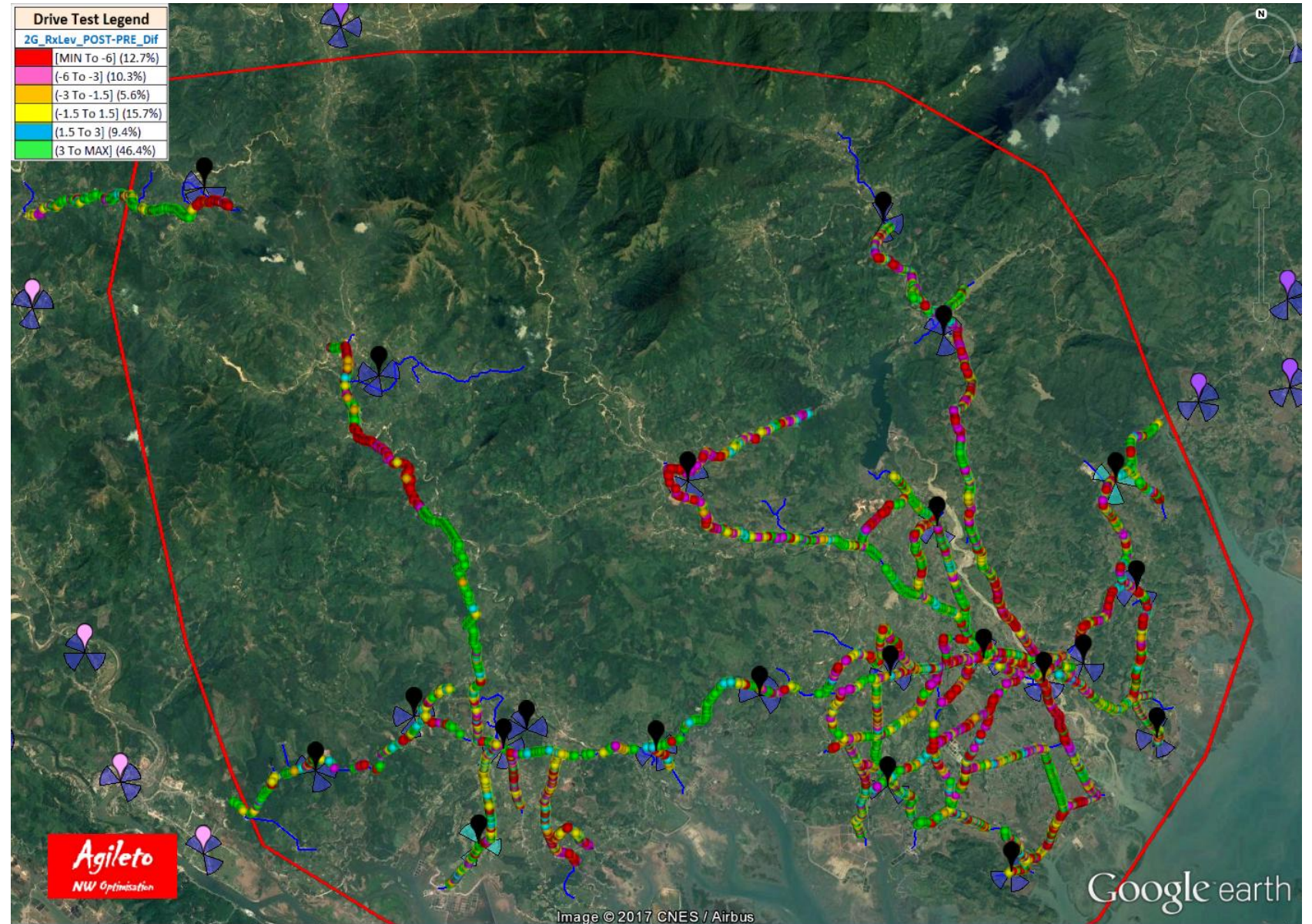
■ **30.6 %**

POST better than PRE (double)

POST-PRE \geq 3dB

■ **46.4 %**

(Overall POST is **better** than PRE)

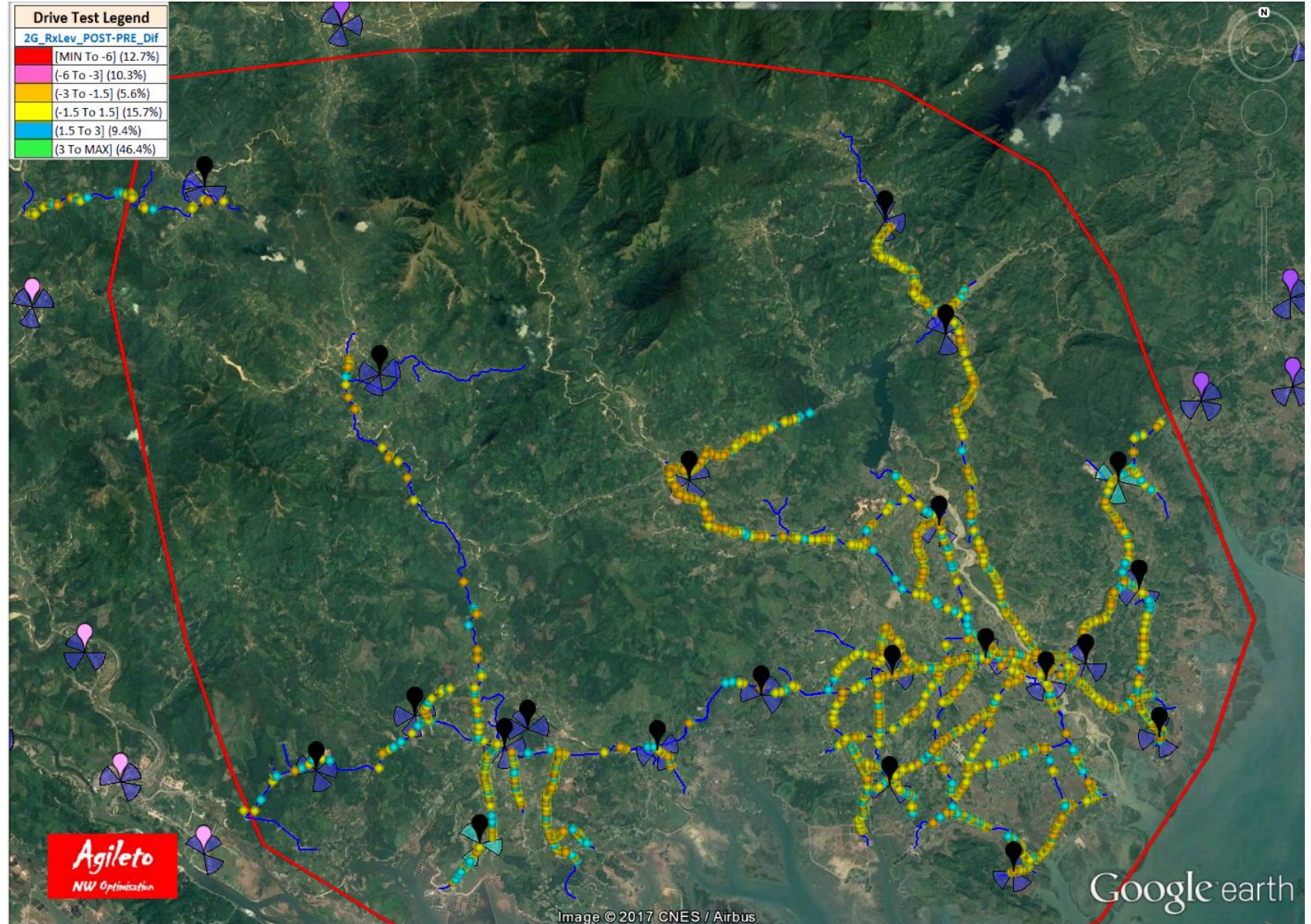


Coverage: 2G RxLev Difference **POST** - **PRE** Swap

POST-PRE swap
(comparable locations)

POST comparable PRE
 $-3\text{dB} \leq \text{POST-PRE} < 3\text{dB}$

■ **30.6 %**



Coverage: 2G RxLev Difference **POST** - **PRE** Swap

POST-PRE swap

(one is 3dB better than other)

POST worst than PRE (double)

POST-PRE \leq -3dB

■ **23.0 %**

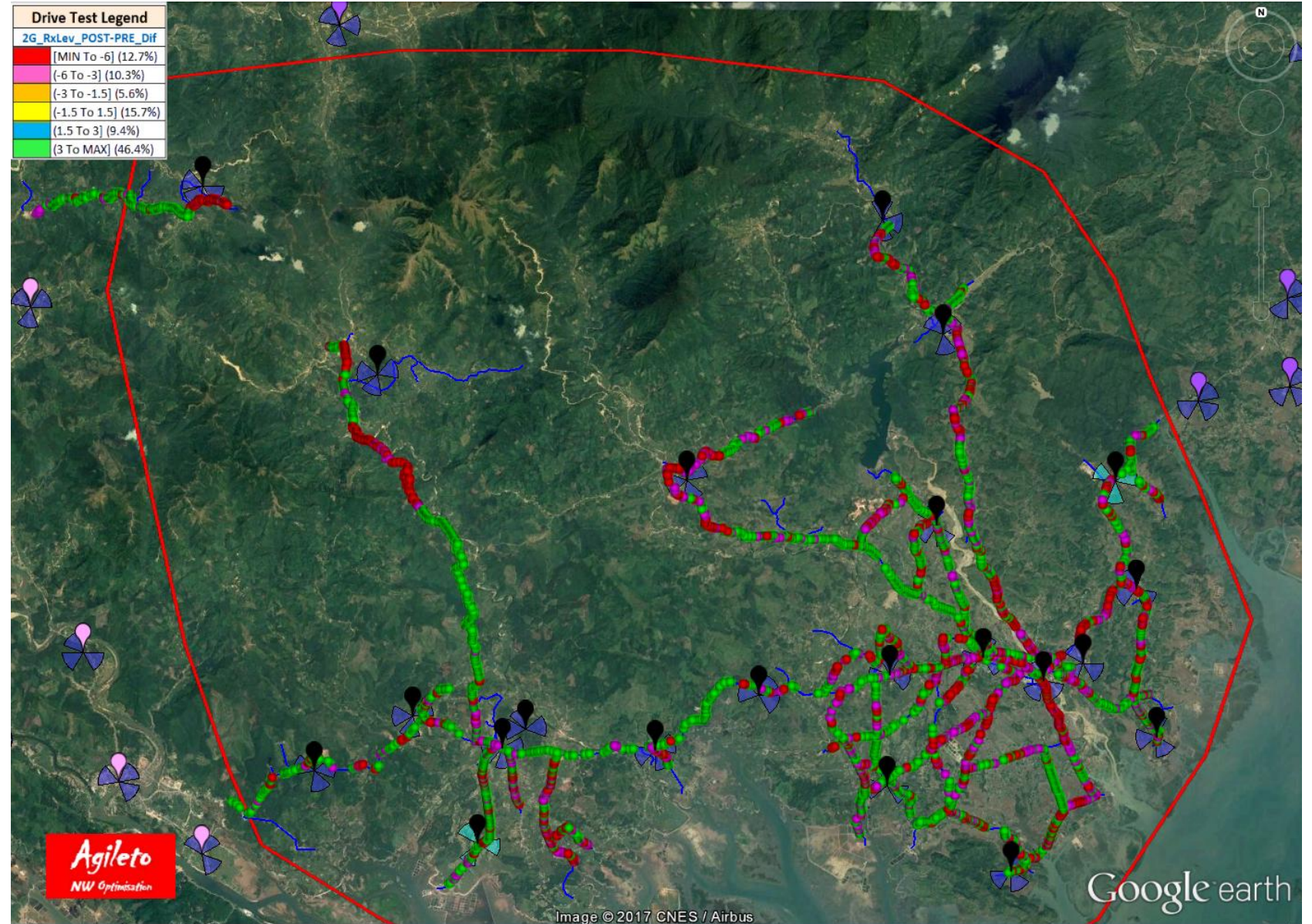
POST better then PRE (double)

POST-PRE \geq 3dB

■ **46.4 %**

Obs.

It is easy to locate places where we have **better** / **worst** performance POST swap comparing with PRE swap.



3G Throughput DL (HSDPA)

It was calculated PRE and POST Swap:

Average throughput / bin = Sum of throughputs for all common bins / Nr. of common bins

PRE swap: Avg Throughput / bin: 4364 Kbps

POST swap: Avg Throughput / bin: 5012 Kbps



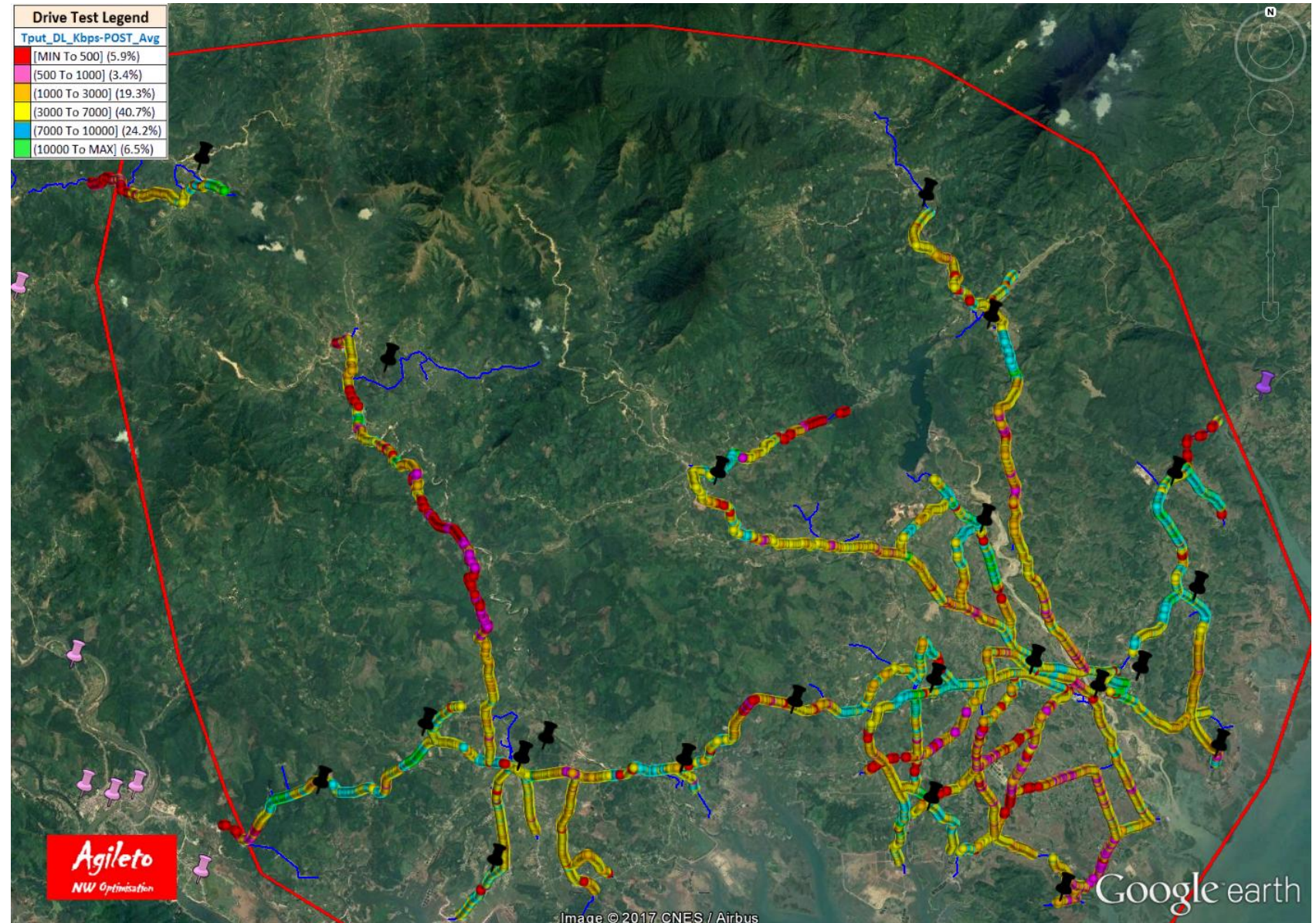
Avg Tput / bin POST > Avg Tput / bin PRE

3G Throughput DL POST Swap [Kbps] - Reference

On the right side it is presented the **3G Throughput DL** [Kbps] recorded by the datacard used to perform FTP DL protocol along the drive test route during the **POST Swap** moment.

Below it is the presented the legend containing for each range the associated percentage related to the entire drive test route.

Drive Test Legend	
Tput_DL_Kbps-POST_Avg	
[MIN To 500]	(5.9%)
(500 To 1000]	(3.4%)
(1000 To 3000]	(19.3%)
(3000 To 7000]	(40.7%)
(7000 To 10000]	(24.2%)
(10000 To MAX]	(6.5%)



3G Throughput DL Difference POST - PRE Swap

Grace to Agileto's (M4.1) special feature it is evaluated on the common detected drive test routes on each bin the difference between the metrics detected during POST swap respective PRE swap (Diff=POST-PRE).

On the right side there are presented the results in the table format (like it is provided by Agileto tool) which includes for each drive test point all cases (POST / PRE / POST-PRE) related to the measured metric (Tput DL [Kbps]).

Pt_Nr	Time_Stamp	Latitude_WGS84	Longitude_WGS84	Tput_DL POST [Kbps]	Tput_DL PRE [Kbps]	Tput_DL POST-PRE [Kbps]
6137	10:10:54.583	26.36957	101.5738	6791.29	2828.75	3962.54
6138	10:10:55.283	26.36948	101.5738	6618.5	2913.33	3705.17
6139	10:10:55.982	26.36939	101.5738	6986	3122.83	3863.17
6140	10:11:02.181	26.36867	101.5739	7114.25	1627	5487.25
6141	10:11:03.169	26.36858	101.5739	7618.71	1566.07	6052.64
6142	10:11:03.351	26.36849	101.5739	8272	5351.5	2920.5
6143	10:11:09.083	26.36768	101.574	7238	1117.06	6120.94
6144	10:11:10.520	26.36759	101.574	8231.67	3954	4277.67
6145	10:11:16.299	26.36741	101.5741	5740.17	897.82	4842.35
6146	10:11:24.695	26.36732	101.5742	4324.42	1864.14	2460.28
6147	10:11:25.736	26.36732	101.5743	3186.04	2359.77	826.27
6148	10:11:27.399	26.36732	101.5744	4257.65	3553.86	703.79
6149	10:11:29.685	26.36723	101.5745	3679.04	3340	339.04
6150	10:11:29.979	26.36723	101.5746	3689.45	4149.67	-460.22
6151	10:11:31.760	26.36714	101.5747	6820.15	3325.67	3494.49
6152	10:11:32.260	26.36714	101.5748	8320	3248	5072
6153	10:11:33.801	26.36705	101.5749	8010.43	3793.2	4217.23
6154	10:11:35.884	26.36696	101.5751	8128.78	4008	4120.78
6155	10:11:37.839	26.36687	101.5753	7778	4304.5	3473.5
6156	10:11:39.747	26.36679	101.5754	7398.3	3556.17	3842.13

3G Throughput DL Difference POST - PRE Swap

Grace to Agileto's (M4.1) special feature it is evaluated on the common drive test routes on each bin the difference between the metrics detected during POST swap respective PRE swap (Diff=**POST-PRE**) and the results are plot back on the map.

There are three main cases:

POST worst than PRE
POST-PRE \leq -500 Kbps

■ **36.8 %**

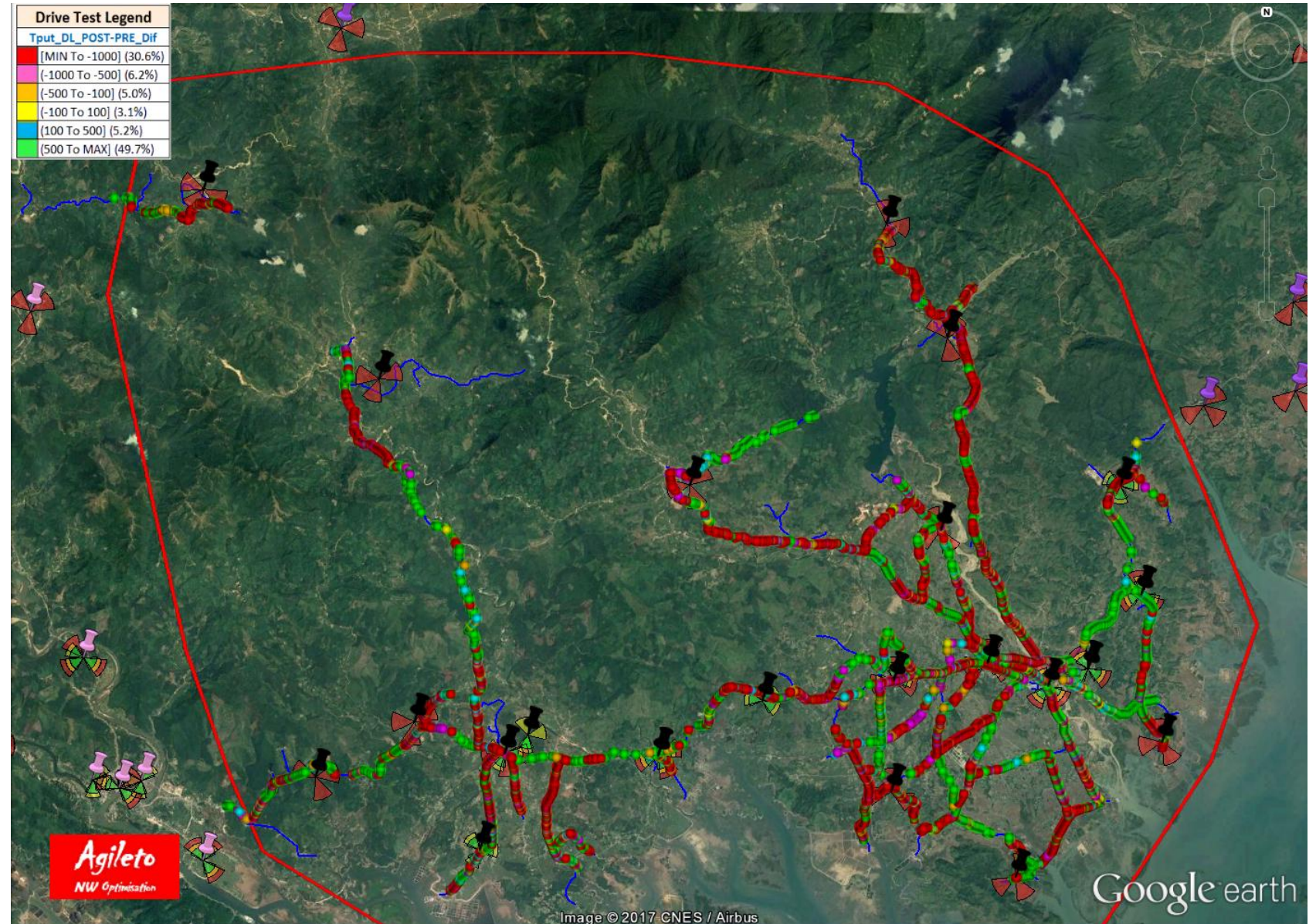
POST comparable PRE
-500Kbps \leq POST-PRE < 500Kbps

■ **13.5 %**

POST better than PRE
POST-PRE \geq 500Kbps

■ **49.7 %**

(Overall POST is **better** than PRE)

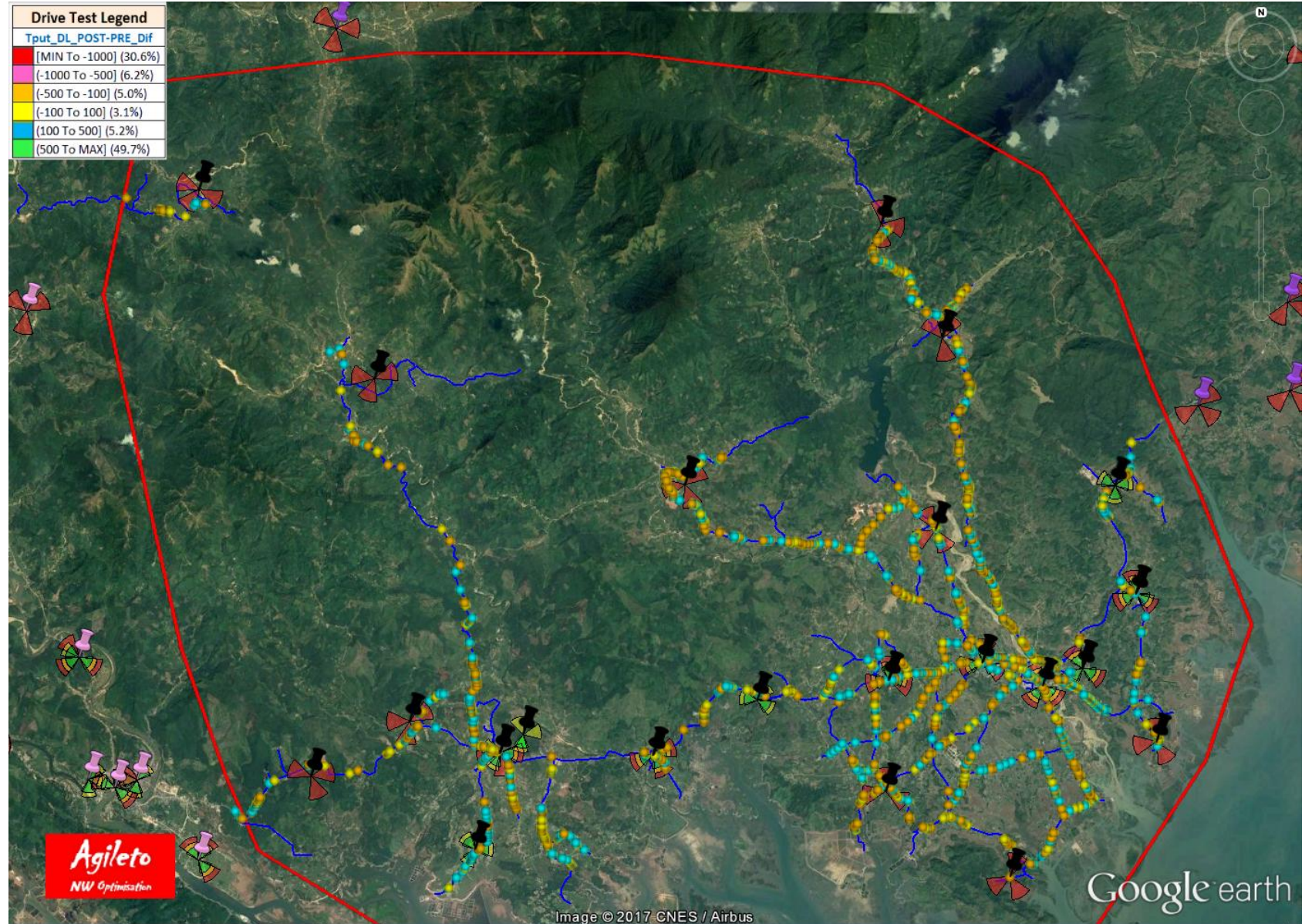


3G Throughput DL Difference POST - PRE Swap

POST-PRE swap
(comparable locations)

POST comparable PRE
-500Kbps ≤ POST-PRE < 500Kbps

■ **13.5 %**



3G Throughput DL Difference POST - PRE Swap

POST-PRE swap

(one is minimum 500Kbps better than the other)

POST worst than PRE

POST-PRE \leq -500 Kbps

■ **36.8 %**

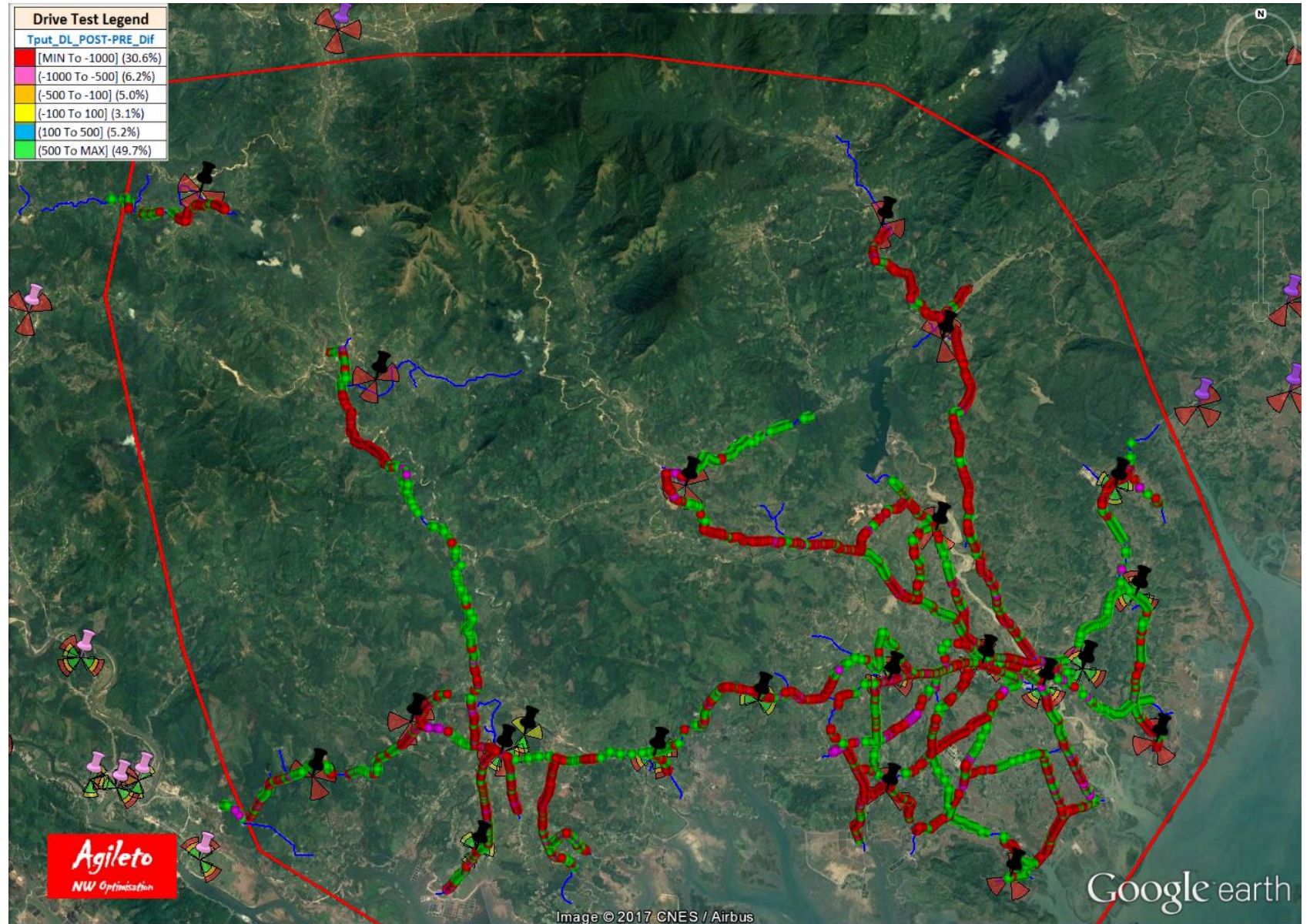
POST better then PRE

POST-PRE \geq 500 Kbps

■ **49.7 %**

Obs.

It is easy to locate places where we have **better** / **worst** performance POST swap comparing with PRE swap.



3G Throughput UL (HSUPA)

It was calculated PRE and POST Swap:

Average throughput / bin = Sum of throughputs for all common bins / Nr. of common bins

PRE swap: Avg Throughput / bin: 1968 Kbps

POST swap: Avg Throughput / bin: 1734 Kbps



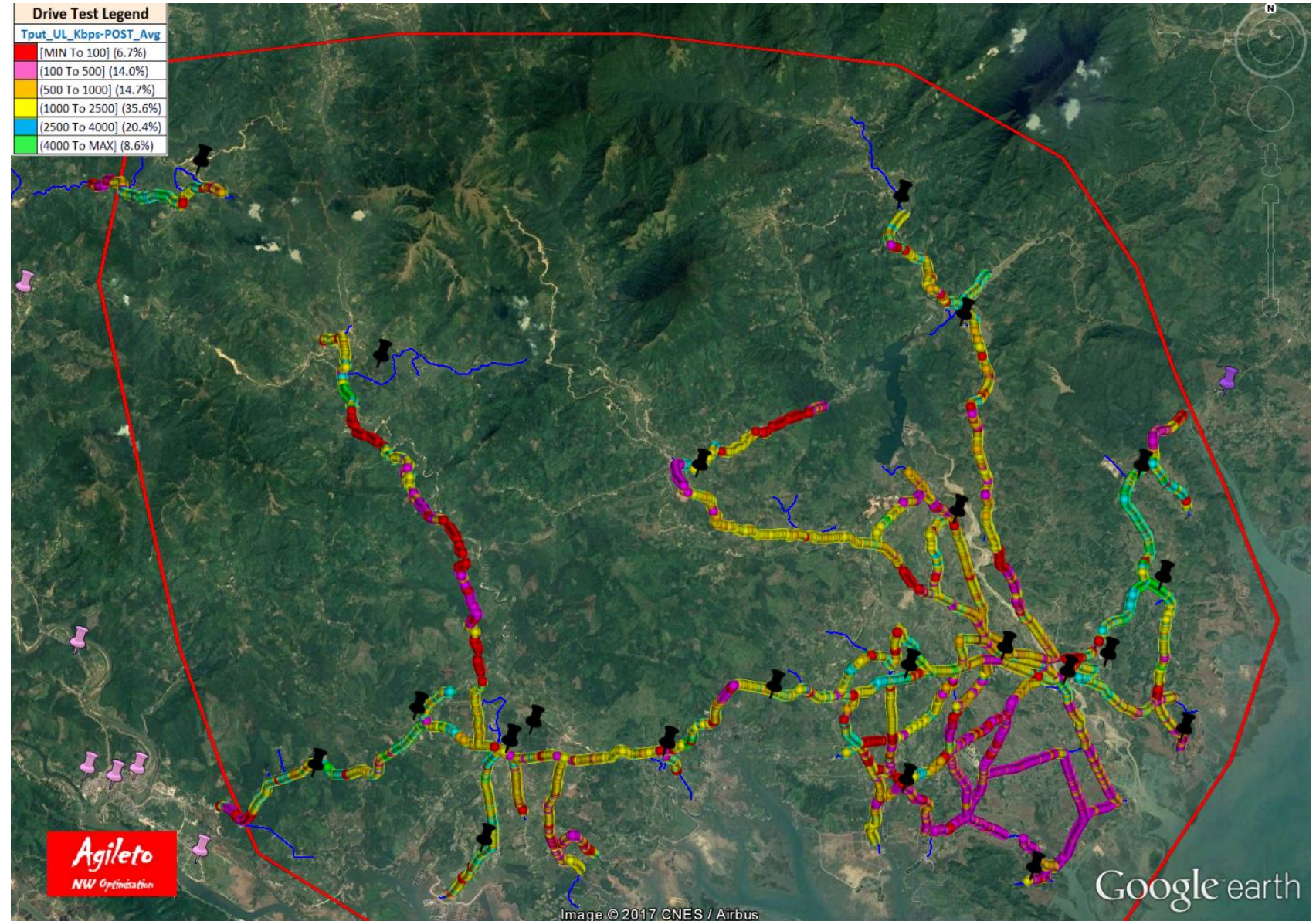
Avg Tput / bin POST < Avg Tput / bin PRE

3G Throughput UL POST Swap [Kbps] - Reference

On the right side it is presented the **3G Throughput UL** [Kbps] recorded by the datacard used to perform FTP UL protocol along the drive test route during the **POST** Swap moment.

Below it is the presented the legend containing for each range the associated percentage related to the entire drive test route.

Drive Test Legend	
Tput_UL_Kbps-POST_Avg	
[MIN To 100]	(6.7%)
(100 To 500]	(14.0%)
(500 To 1000]	(14.7%)
(1000 To 2500]	(35.6%)
(2500 To 4000]	(20.4%)
(4000 To MAX]	(8.6%)



3G Throughput UL Difference POST - PRE Swap

Grace to Agileto's (M4.1) special feature it is evaluated on the common drive test routes on each bin the difference between the metrics detected during POST swap respective PRE swap (Diff=**POST-PRE**) and the results are plot back on the map.

There are three main cases:

POST worst than PRE
POST-PRE \leq -250 Kbps

■ **47.2 %**

POST comparable PRE

-250 Kbps \leq POST-PRE < 250 Kbps

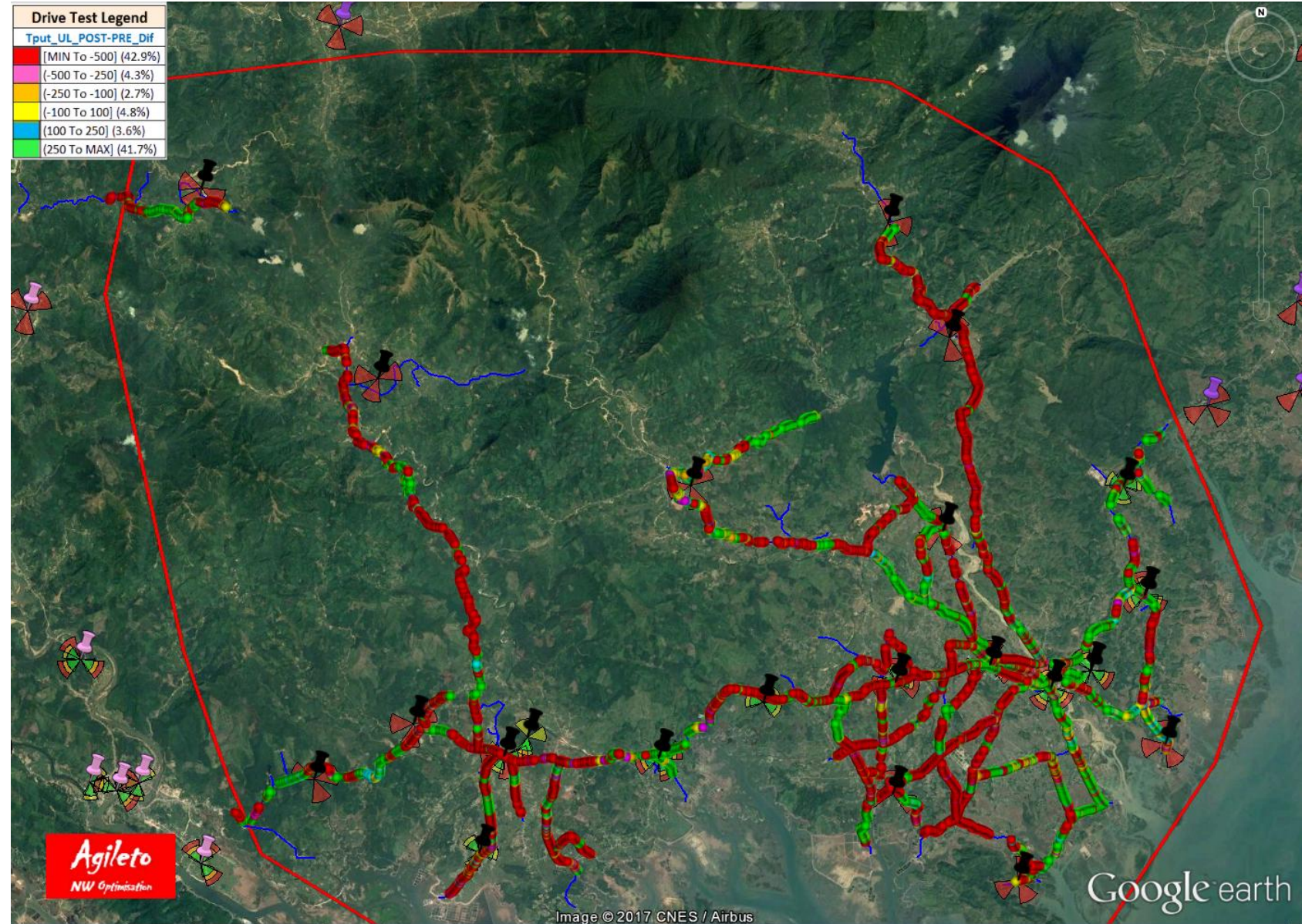
■ **11.1 %**

POST better than PRE

POST-PRE \geq 250 Kbps

■ **41.7 %**

(Overall POST is **worst** than PRE)



3G Throughput UL Difference POST - PRE Swap

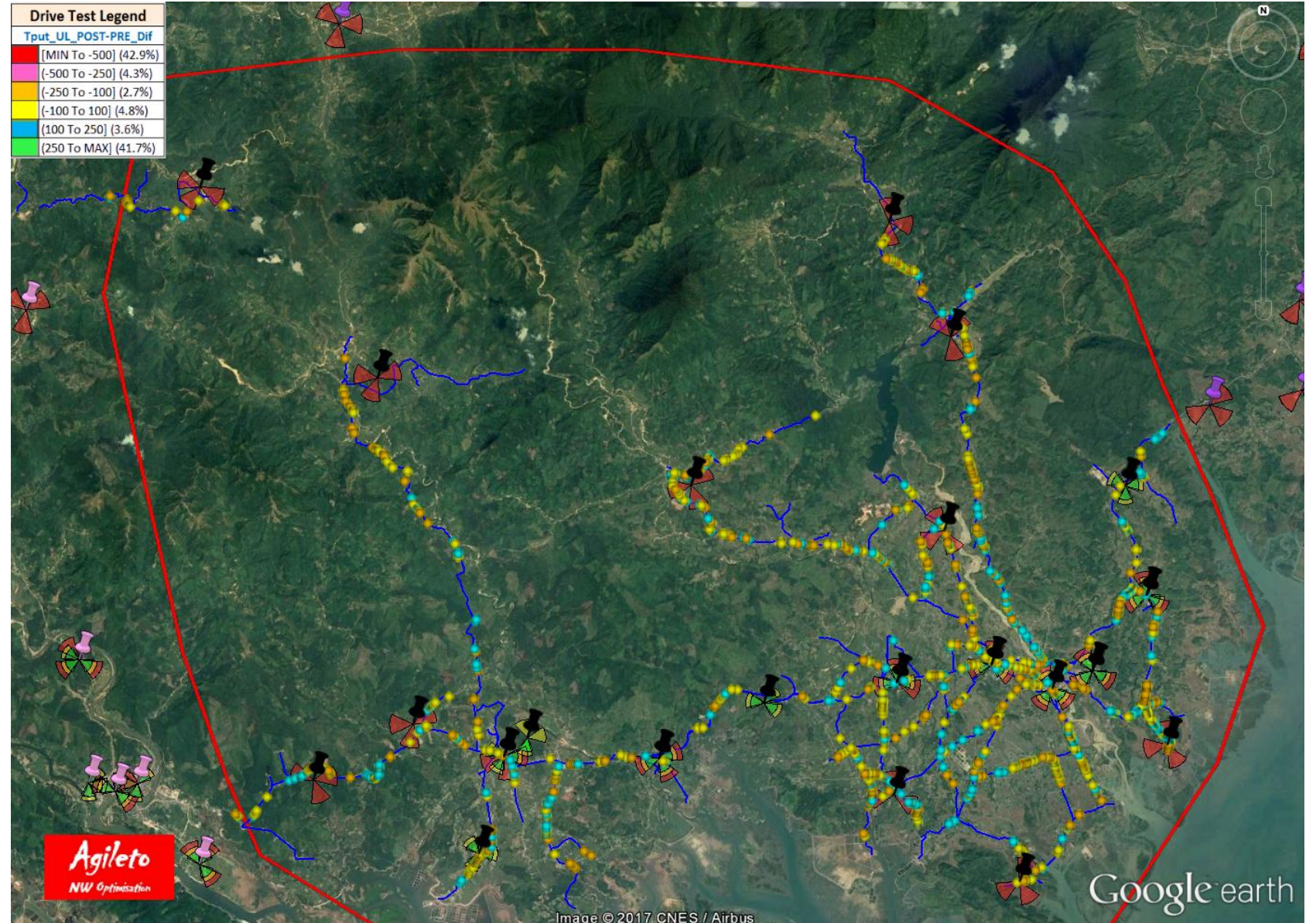
POST-PRE swap

(comparable locations)

POST comparable PRE

$-250 \text{ Kbps} \leq \text{POST-PRE} < 250 \text{ Kbps}$

■ **11.1 %**



3G Throughput UL Difference POST - PRE Swap

POST-PRE swap

(one is minimum 250 Kbps better than other)

POST worst than PRE

POST-PRE \leq -250 Kbps

■ **47.2 %**

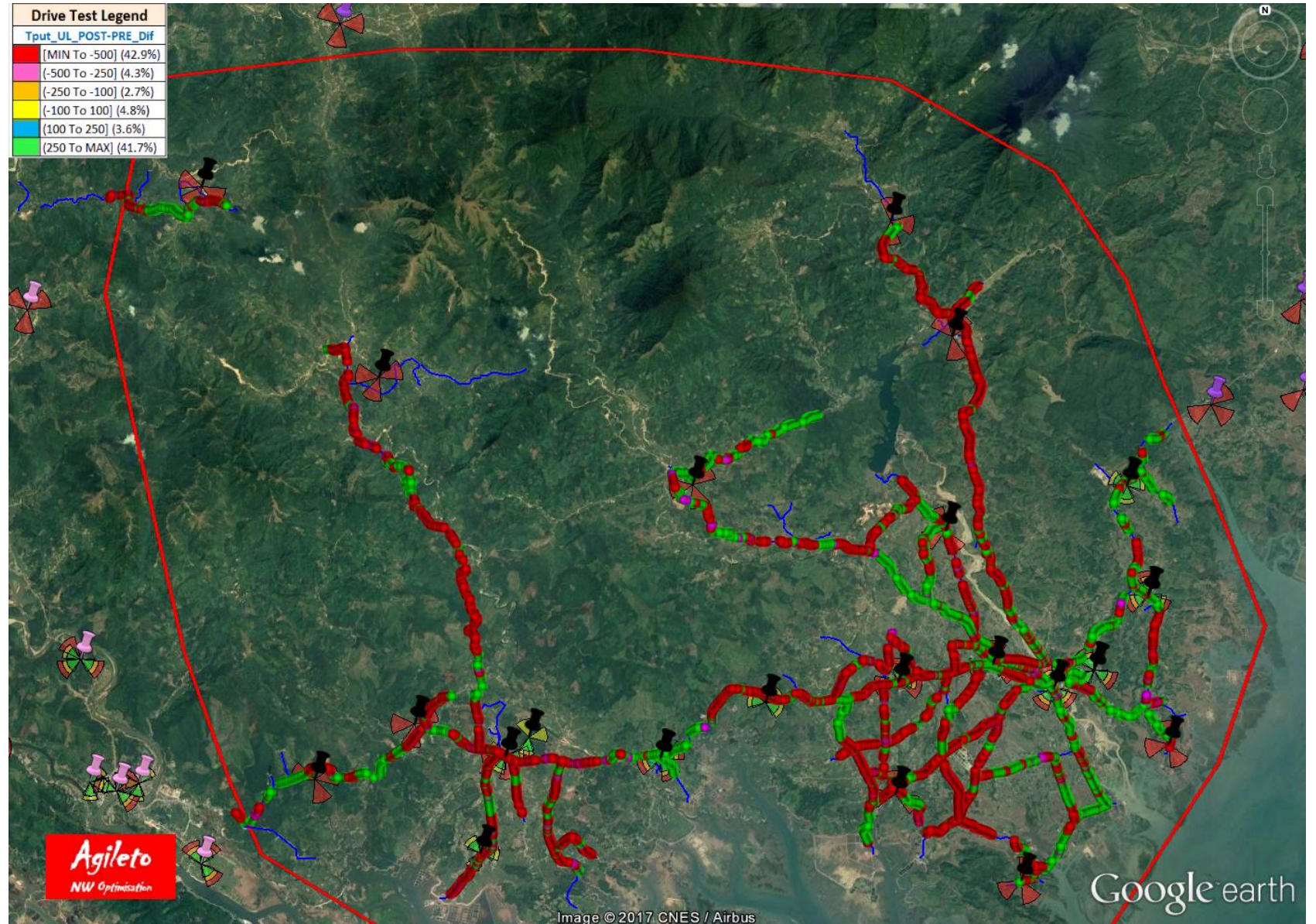
POST better then PRE

POST-PRE \geq 250 Kbps

■ **41.7 %**

Obs.

It is easy to locate places where we have **better** / **worst** performance POST swap comparing with PRE swap.



Thank you



Agileto
www.agileto.com





What kind of services are we providing currently ?

- **Network Optimization services** (including roll-out or/and swap) for any mobile networks (2G/3G/4G/5G) from small clusters to large (BSCs/RNCs/TACs) areas;
- **Benchmark** (between different Mobile Operators, too) on requested drive test metrics;
- **Enhanced Agileto PRO Edition license(s)** for your own usage;

We are providing for **FREE** our services as POC (Proof Of Concept) for all our new clients so do not hesitate to contact us Today !

Agileto Contact details:



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WhatsApp: [+40 773 991 443](https://wa.me/40773991443) (Mon-Fri, 8:00-15:00 GMT)

Telegram: <https://t.me/agileto> and https://t.me/agileto_news

