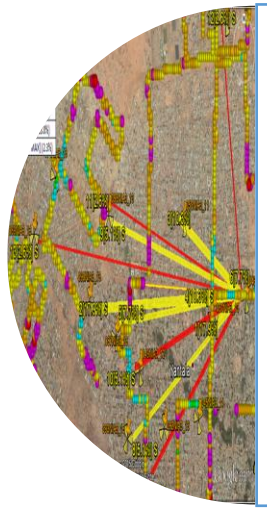
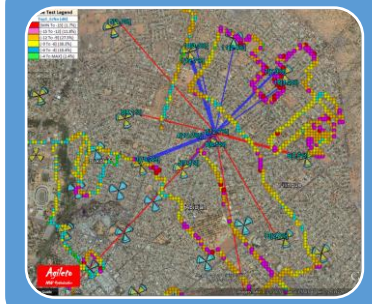


MOBILE RADIO NETWORK OPTIMIZATION



PoC (Proof of Concept) Benchmark

Agileto Mobile NW Optimization PRO EDITION

Agileto NW Optimisation

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 of different times.

- It may be used to compare the performance between **different mobile operators** of 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

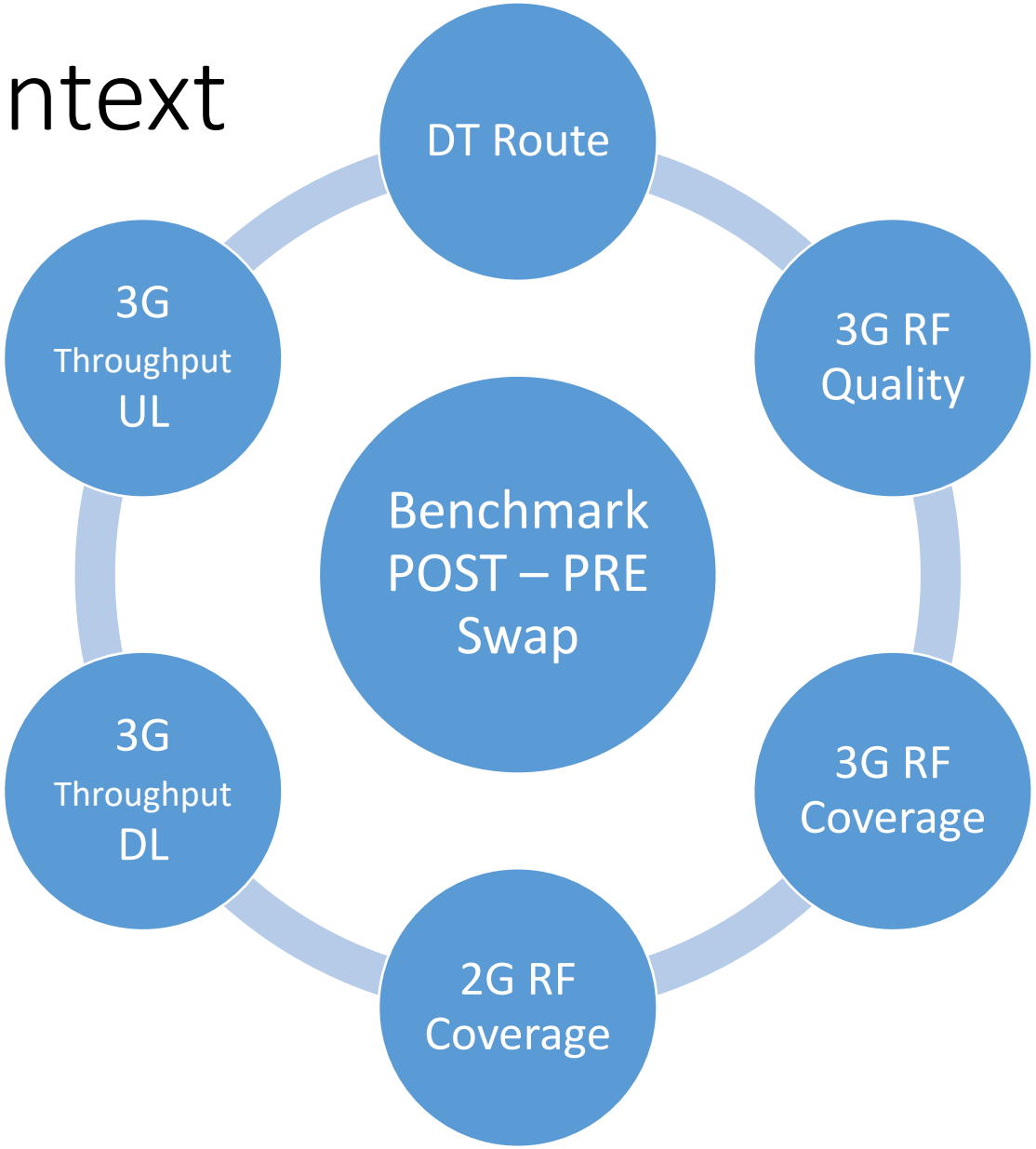
Inputs:

- 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



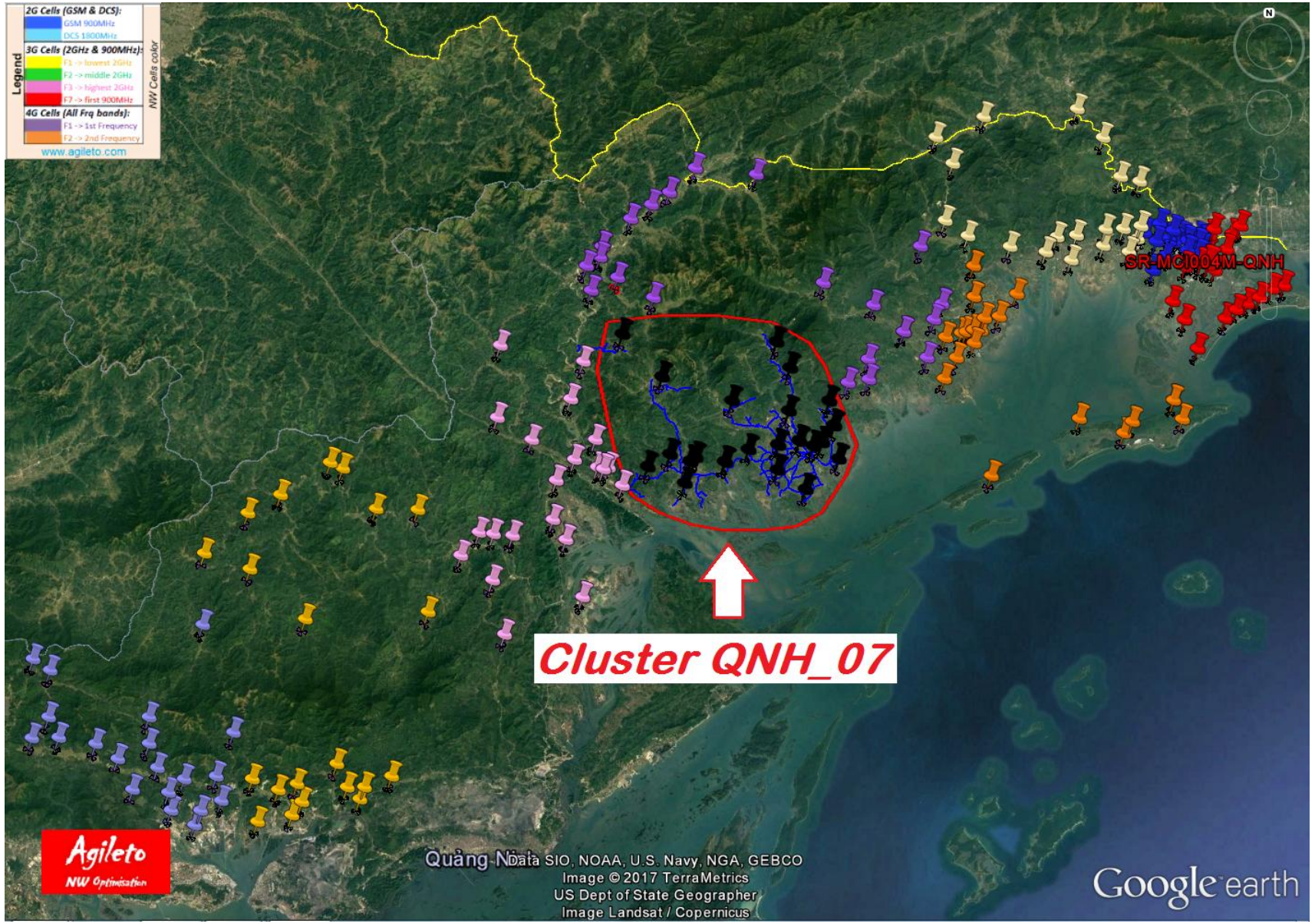
Agenda

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

Geographical cluster distribution

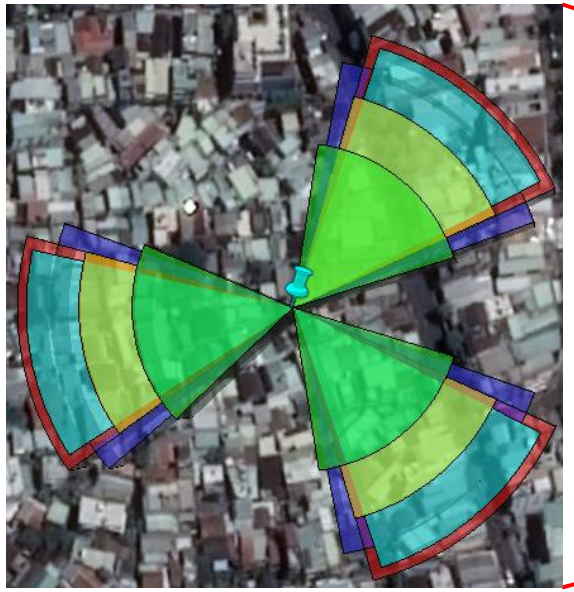
Cluster QNH_07

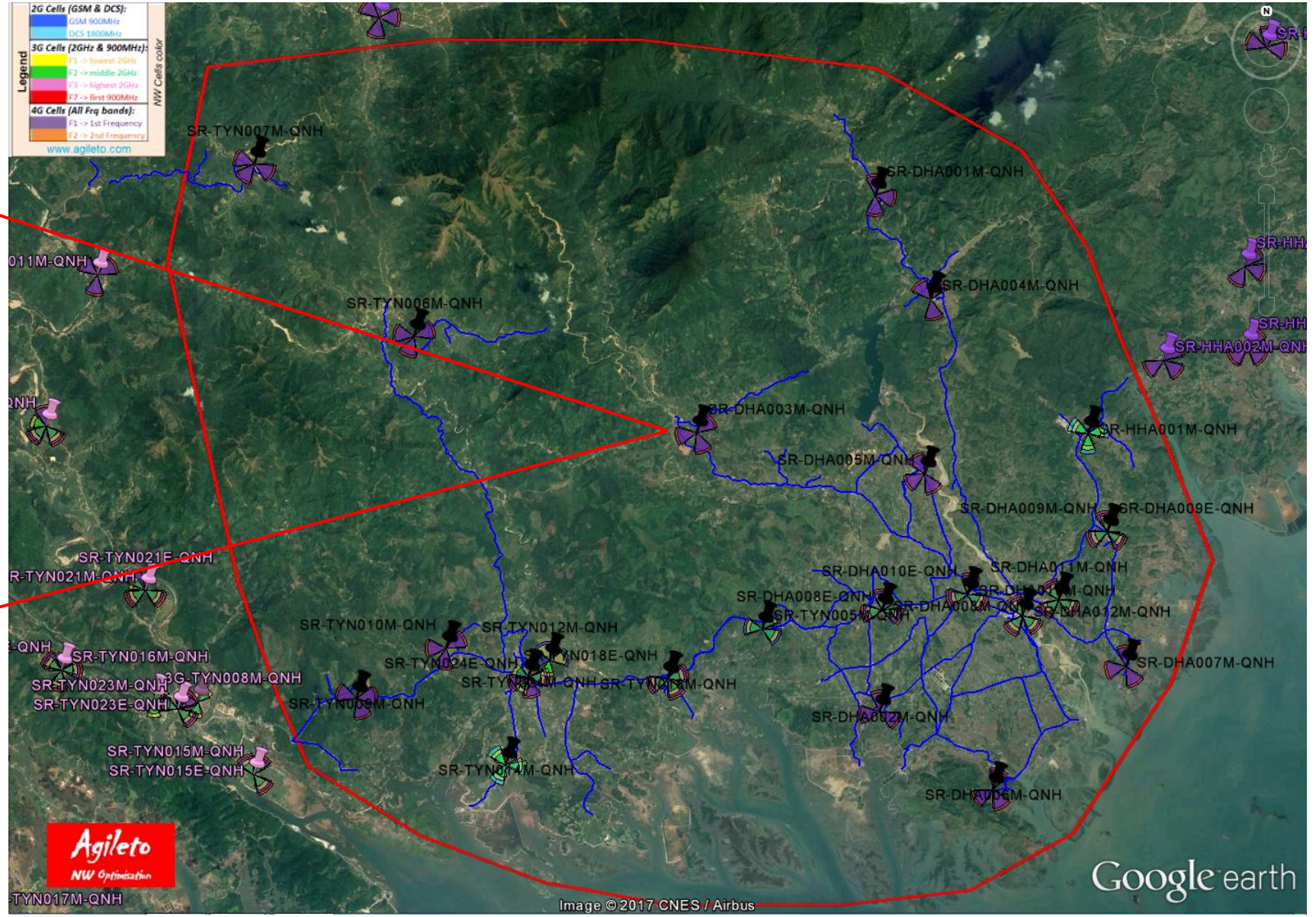
General Overview



Geographical cluster distribution

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





Layers color Legend:

3G: F1, F2 (2100MHz)

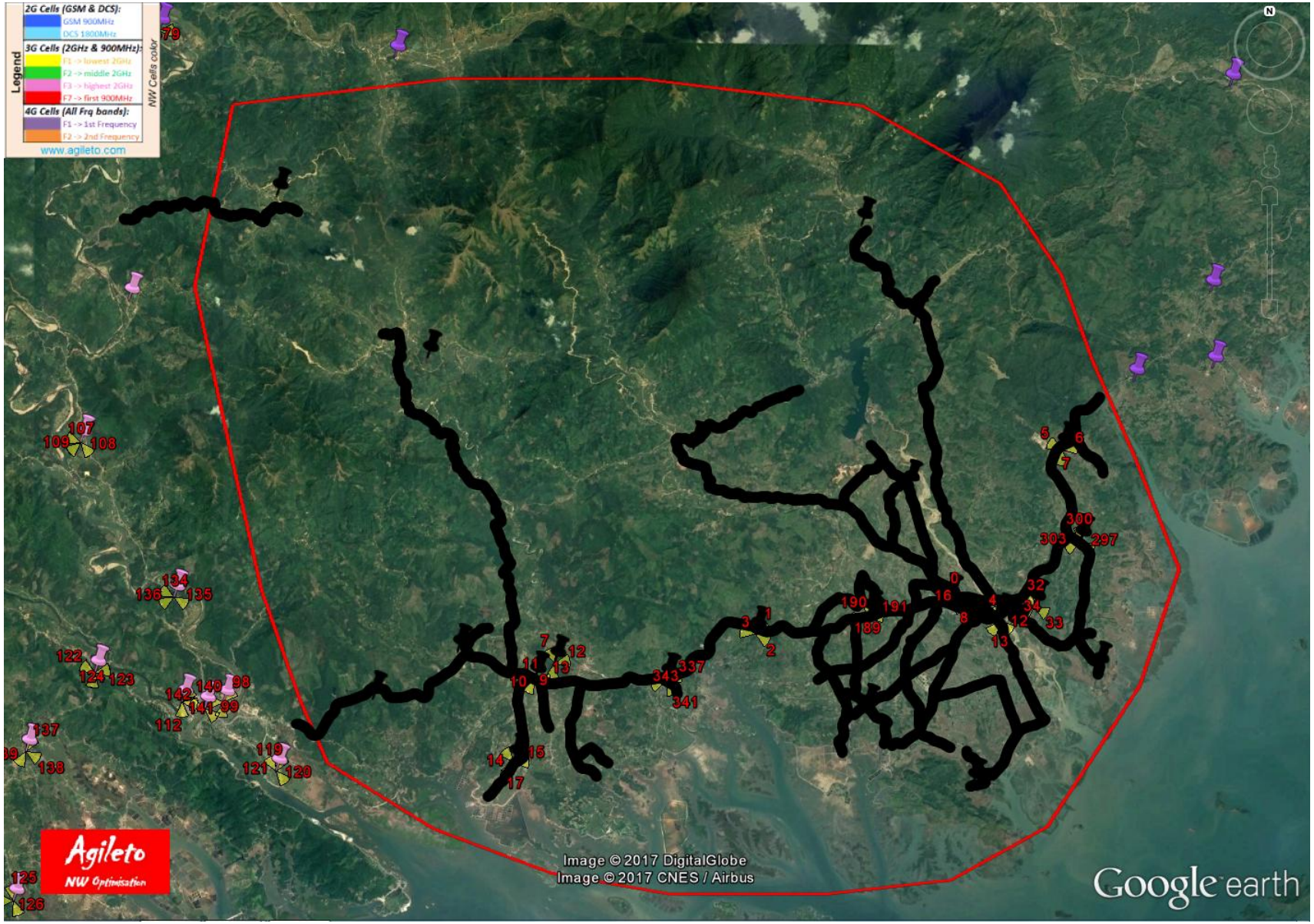
3G: F7 (900MHz)

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.

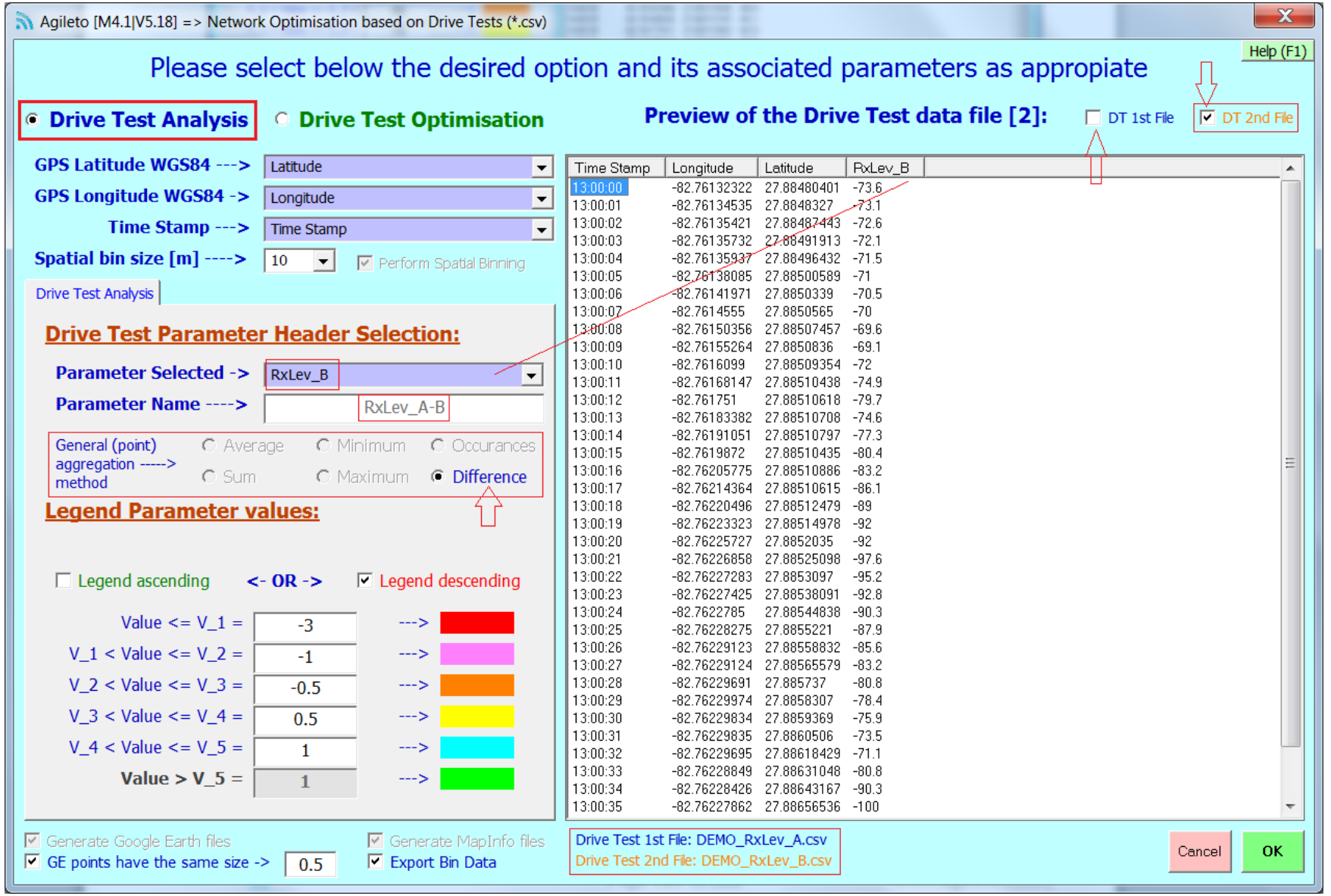
- The DT covers ~ 182 Km (without counting repetitive routes)



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)



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 ≤ -3dB

- **19.5 %**

POST comparable PRE

-3dB ≤ POST-PRE < 3dB

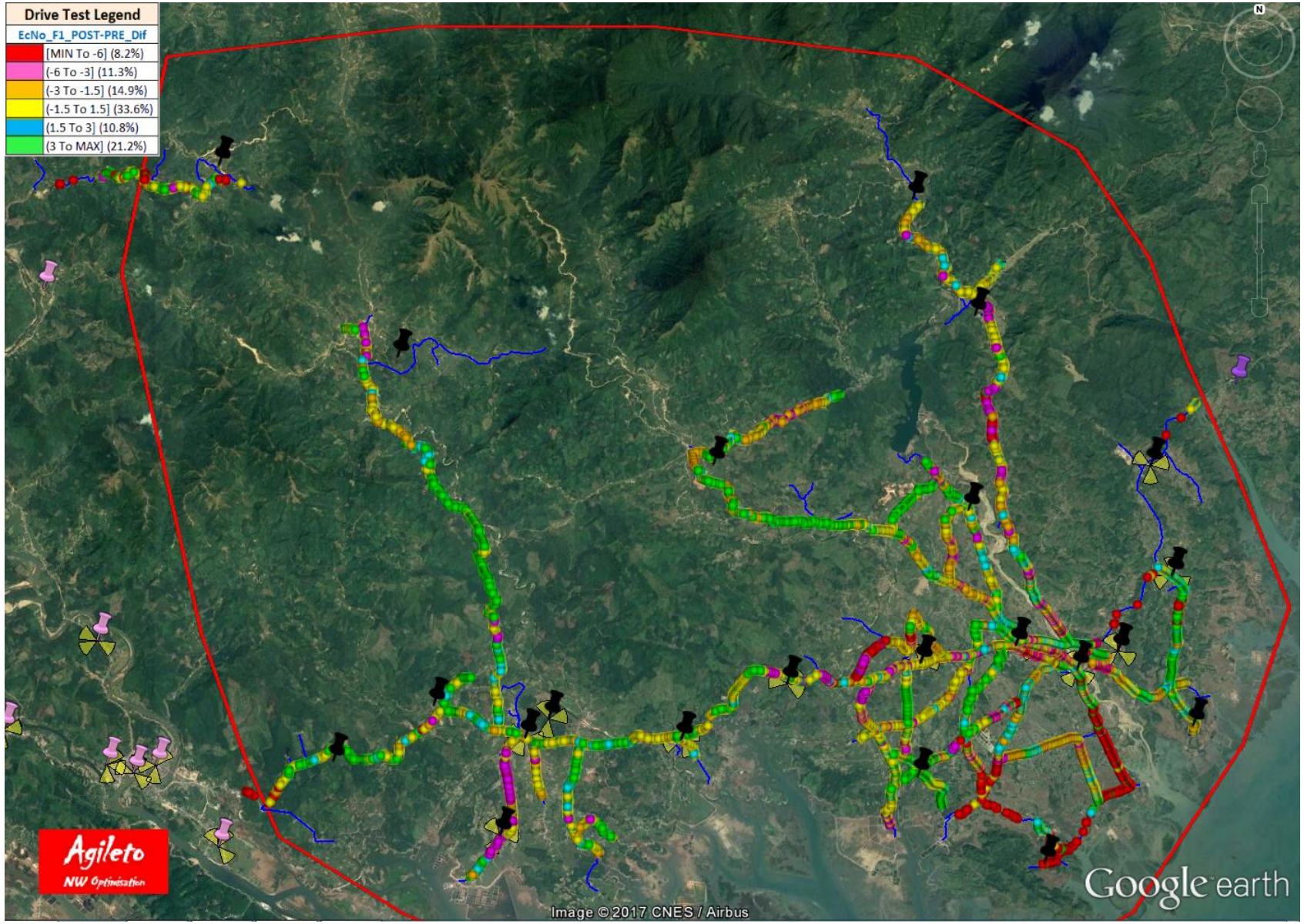
- **59.3 %**

POST better then PRE (double)

POST-PRE ≥ 3dB

- **21.2 %**

(Overall POST is better than PRE)

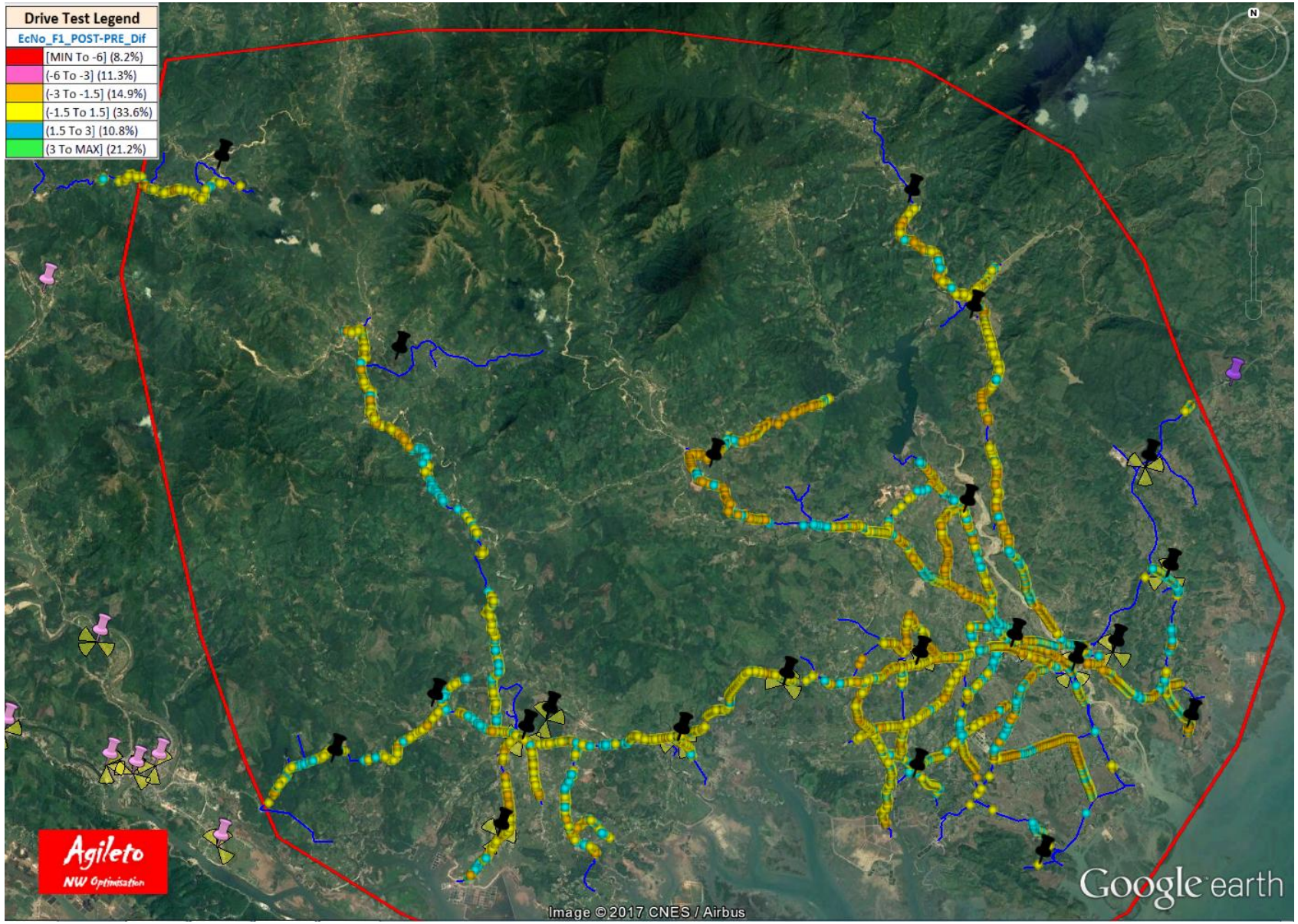


Quality: EcNo Difference POST - PRE Swap (3G_F1 -> 2100MHz)

POST-PRE swap
(comparable locations)

POST comparable PRE
-3dB ≤ POST-PRE < 3dB

- **59.3 %**



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

POST-PRE swap
(one is 3dB better than other)

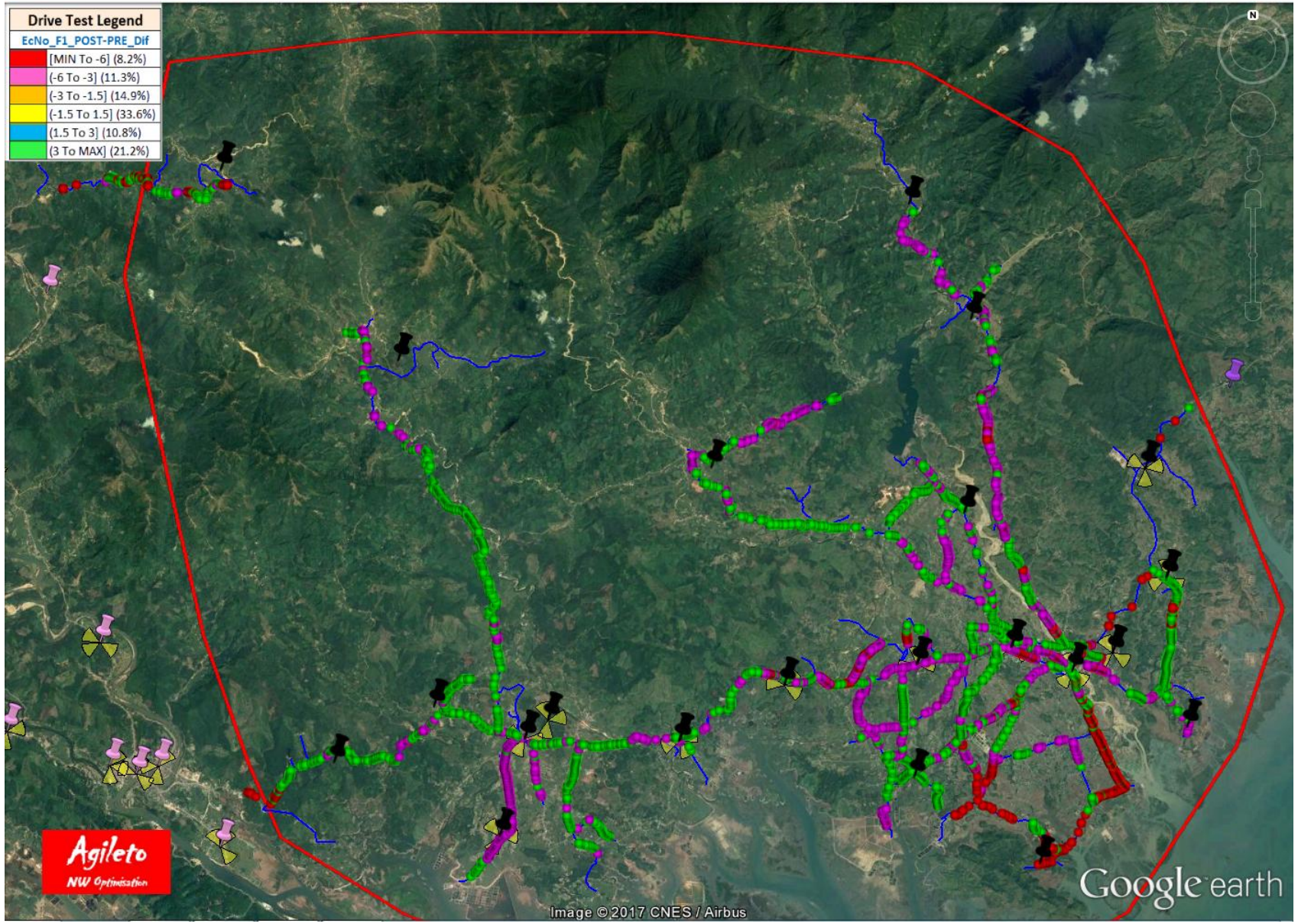
POST worst than PRE (double)
POST-PRE ≤ -3dB

- **19.5 %**

POST better then PRE (double)
POST-PRE ≥ 3dB

- **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 ≤ -3dB

- **16.4 %**

POST comparable PRE

-3dB ≤ POST-PRE < 3dB

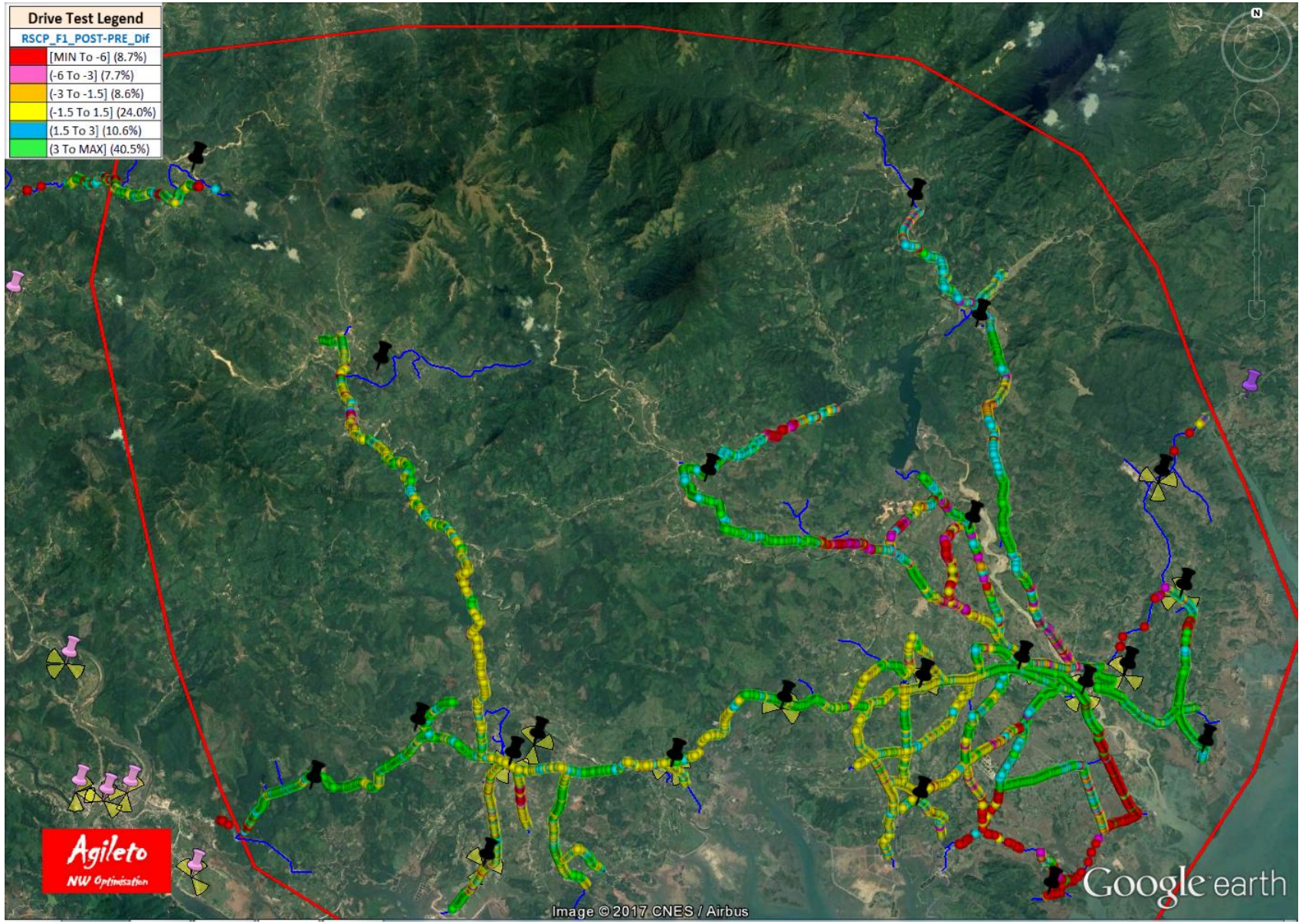
- **43.1 %**

POST better then PRE (double)

POST-PRE ≥ 3dB

- **40.5 %**

(Overall POST is better than PRE)

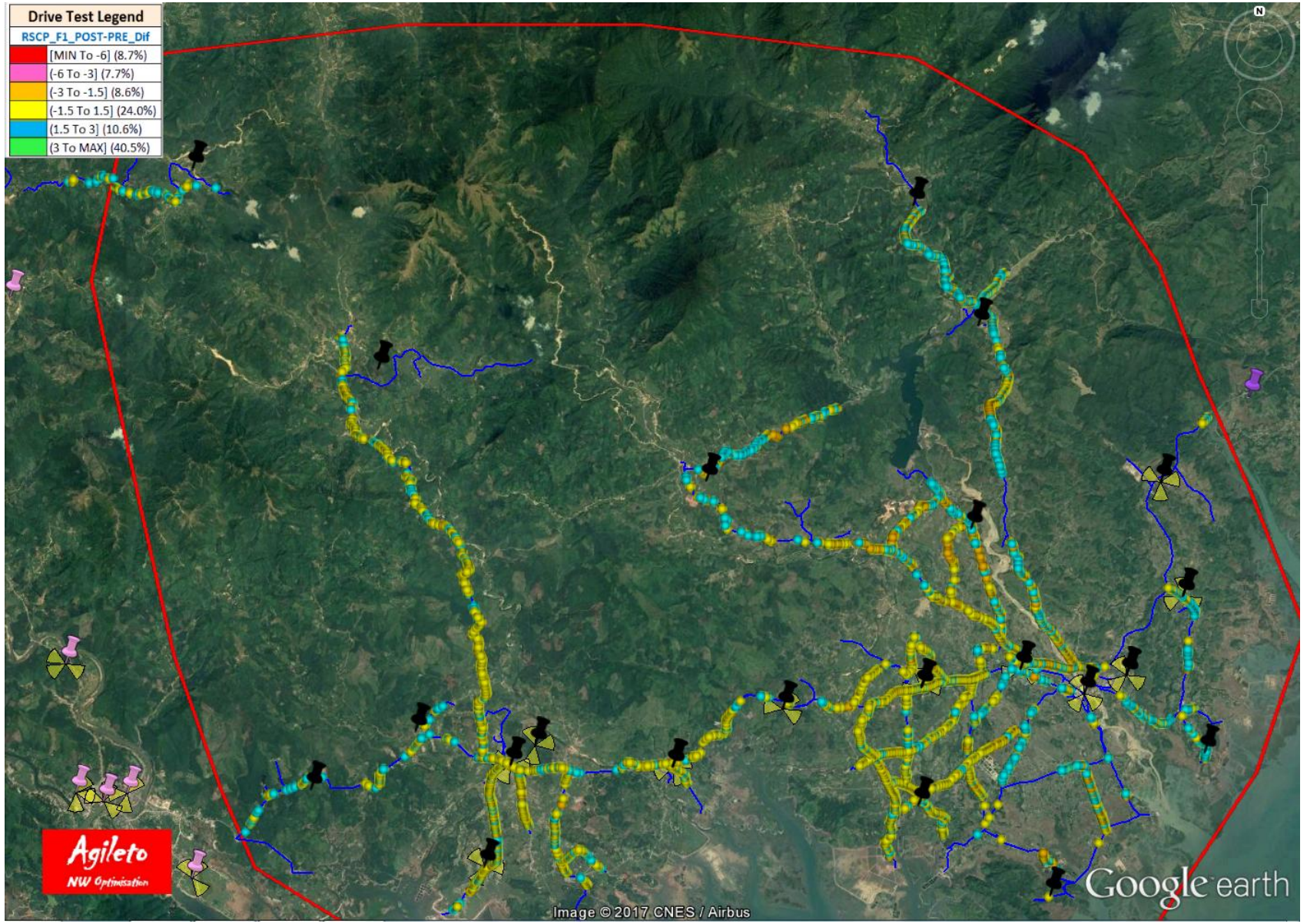


Coverage: RSCP Difference POST - PRE Swap (3G_F1 -> 2100MHz)

POST-PRE swap
(comparable locations)

POST comparable PRE
-3dB ≤ POST-PRE < 3dB

- **43.1 %**



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

POST-PRE swap
(one is 3dB better than other)

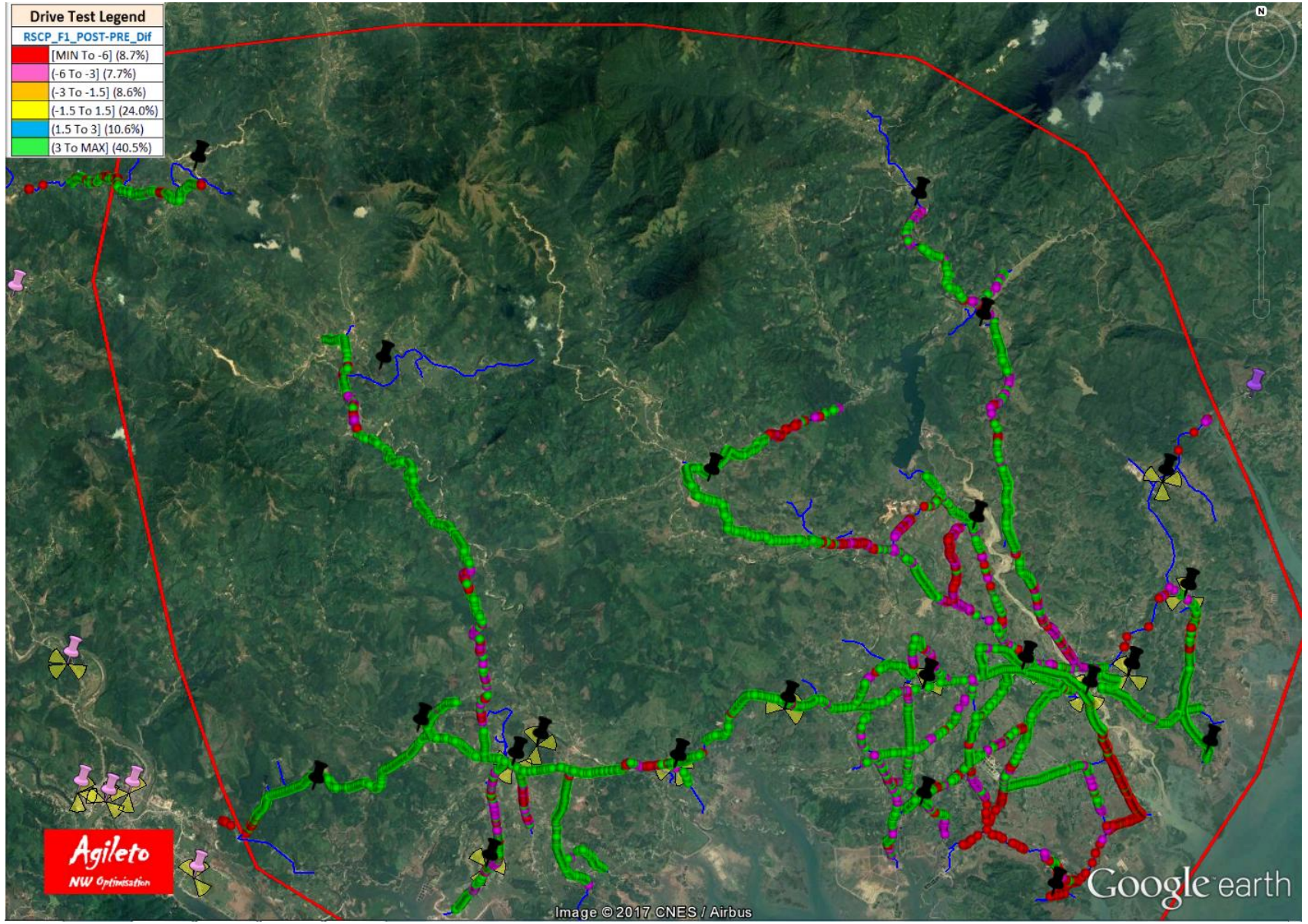
POST worst than PRE (double)
POST-PRE ≤ -3dB

- **16.4 %**

POST better then PRE (double)
POST-PRE ≥ 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 ≤ -3dB

- **23.0 %**

POST comparable PRE

-3dB ≤ POST-PRE < 3dB

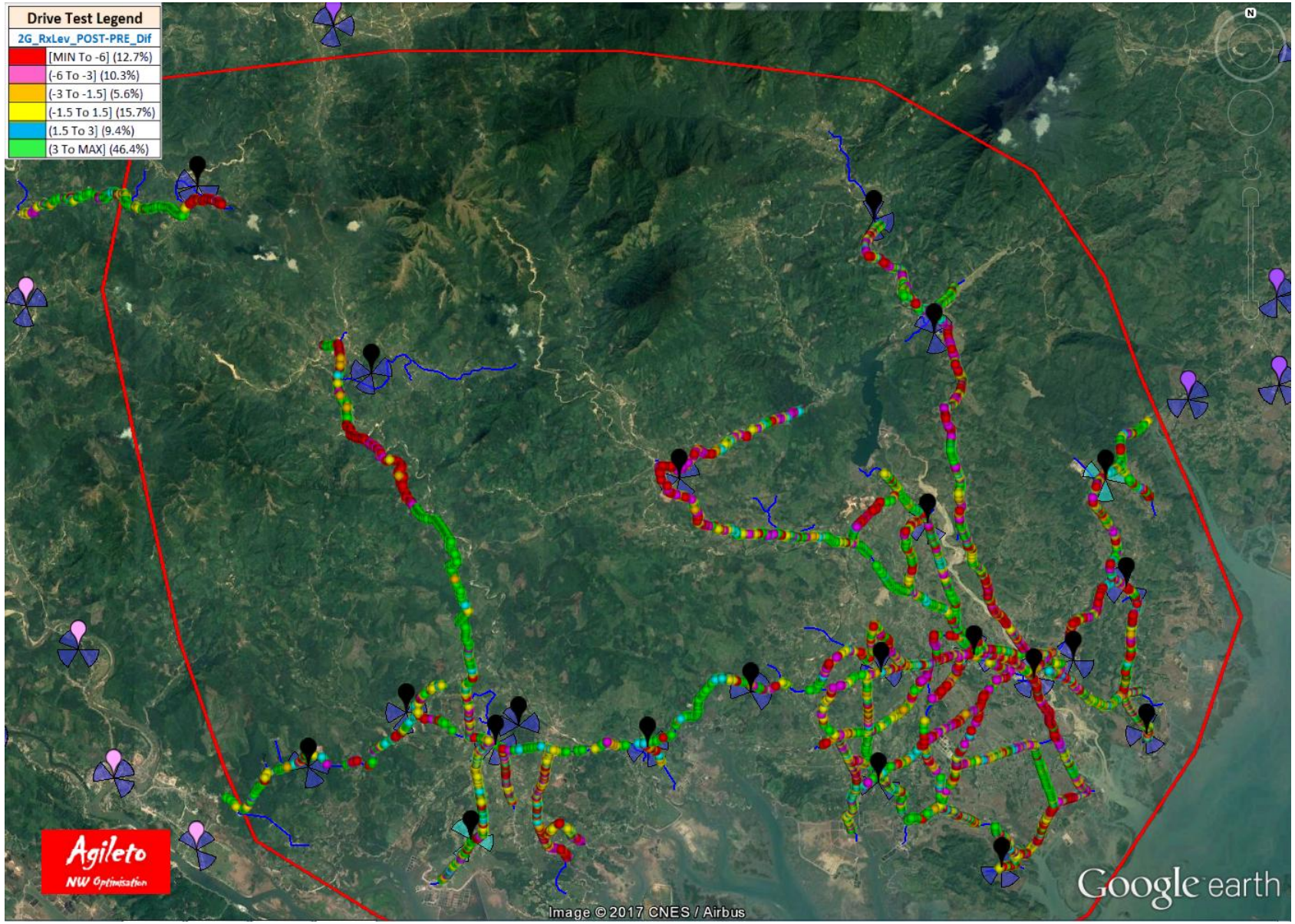
- **30.6 %**

POST better then PRE (double)

POST-PRE ≥ 3dB

- **46.4 %**

(Overall POST is better than PRE)

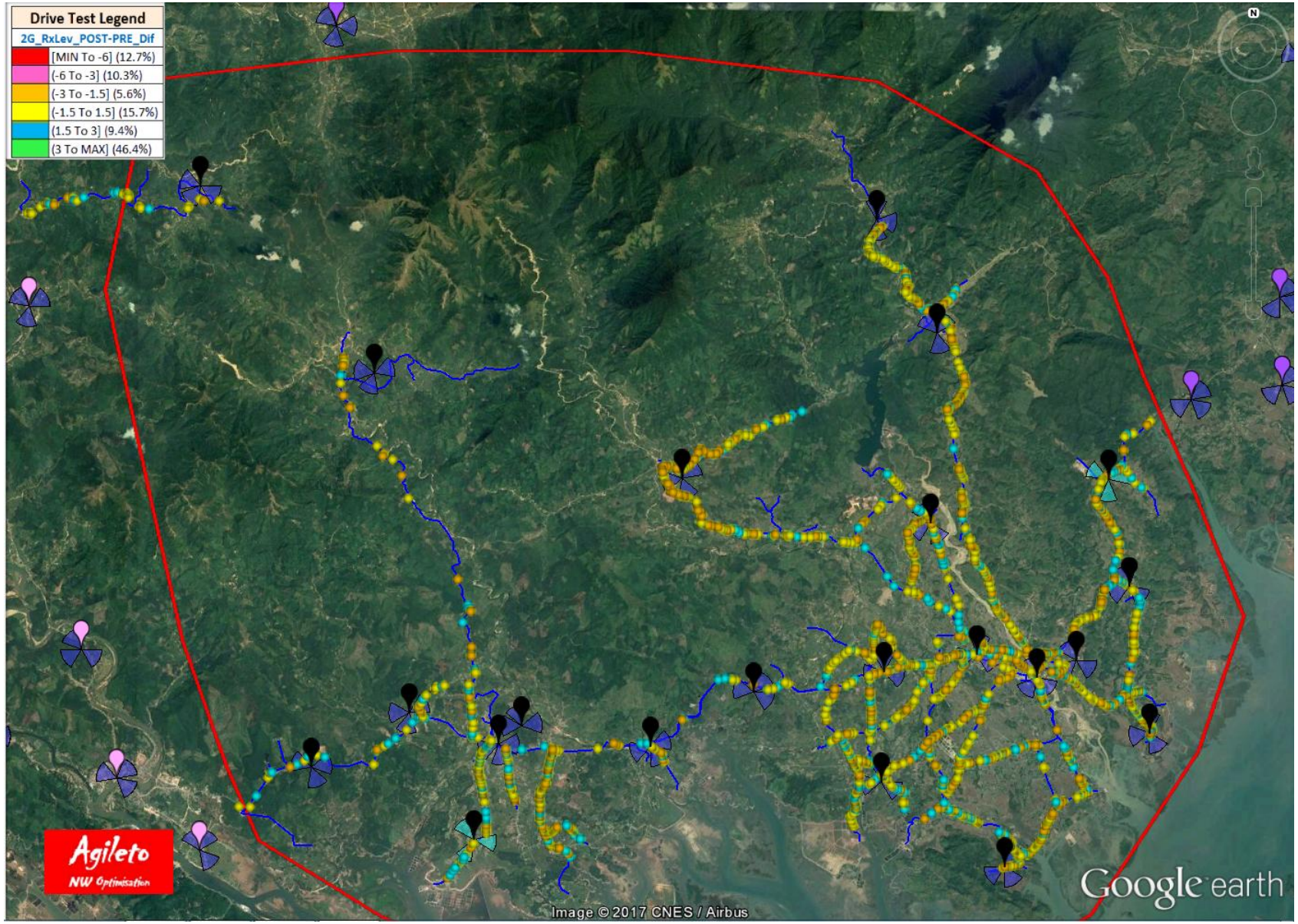


Coverage: 2G RxLev Difference POST - PRE Swap

POST-PRE swap
(comparable locations)

POST comparable PRE
-3dB ≤ POST-PRE < 3dB

- **30.6 %**



Coverage: 2G RxLev Difference POST - PRE Swap

POST-PRE swap
(one is 3dB better than other)

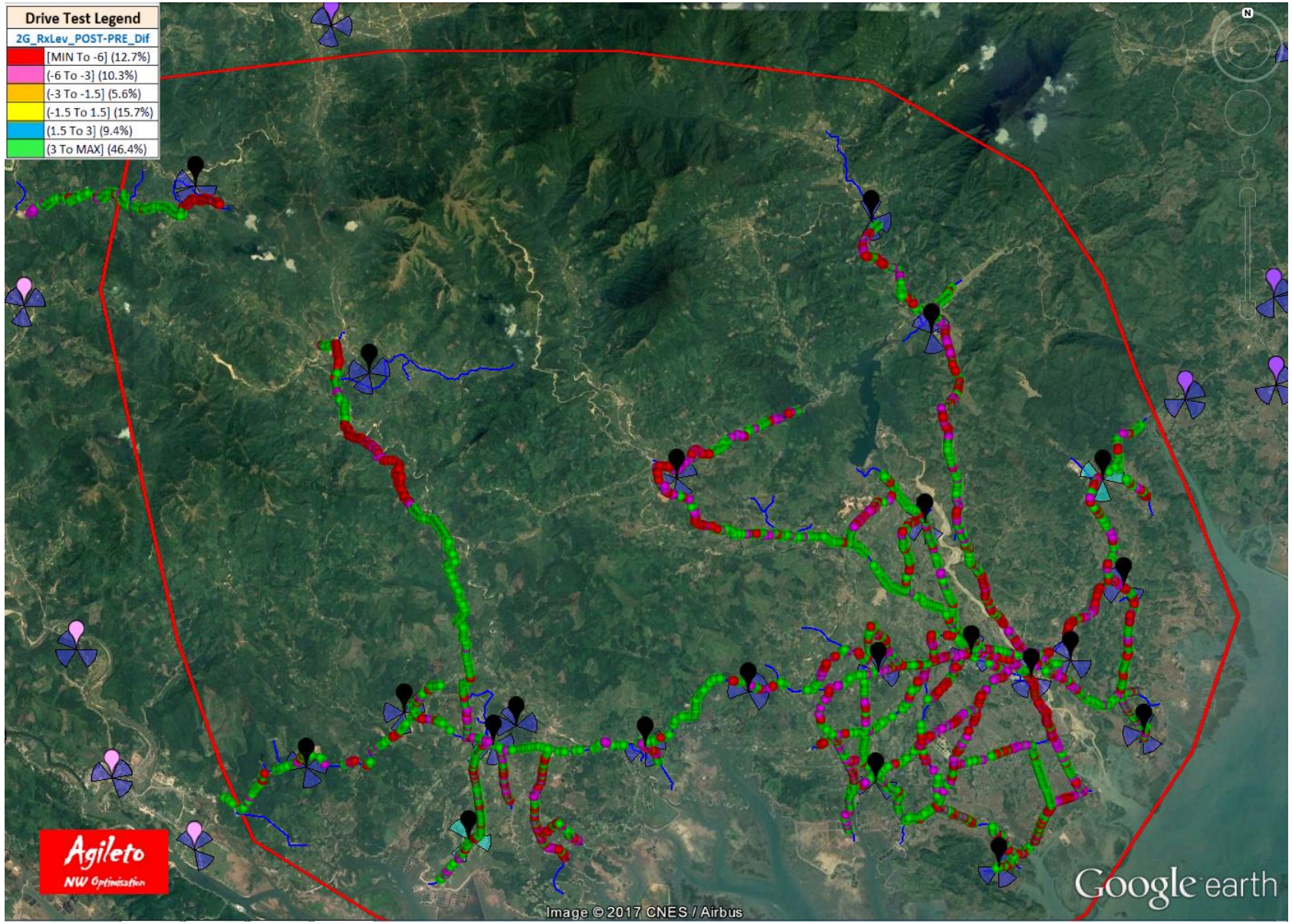
POST worst than PRE (double)
POST-PRE ≤ -3dB

- **23.0 %**

POST better then PRE (double)
POST-PRE ≥ 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 Troughput / bin: 4364 Kbps

POST swap: Avg Troughput / bin: 5012 Kbps

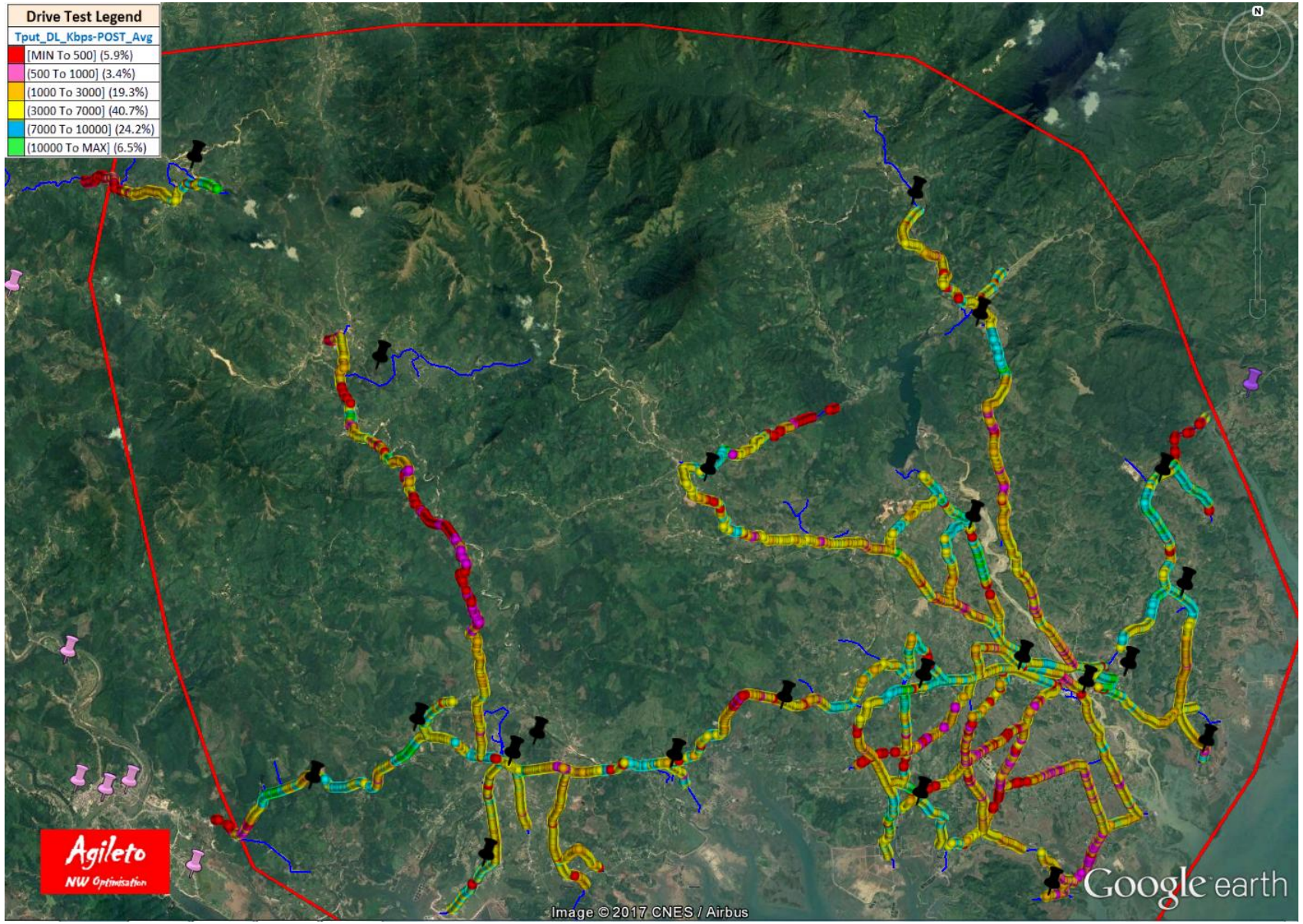
Avg Tput / bin POST > Avg Tput / bin PRE

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 ≤ -500 Kbps

- **36.8 %**

POST comparable PRE

-500Kbps ≤ POST-PRE < 500Kbps

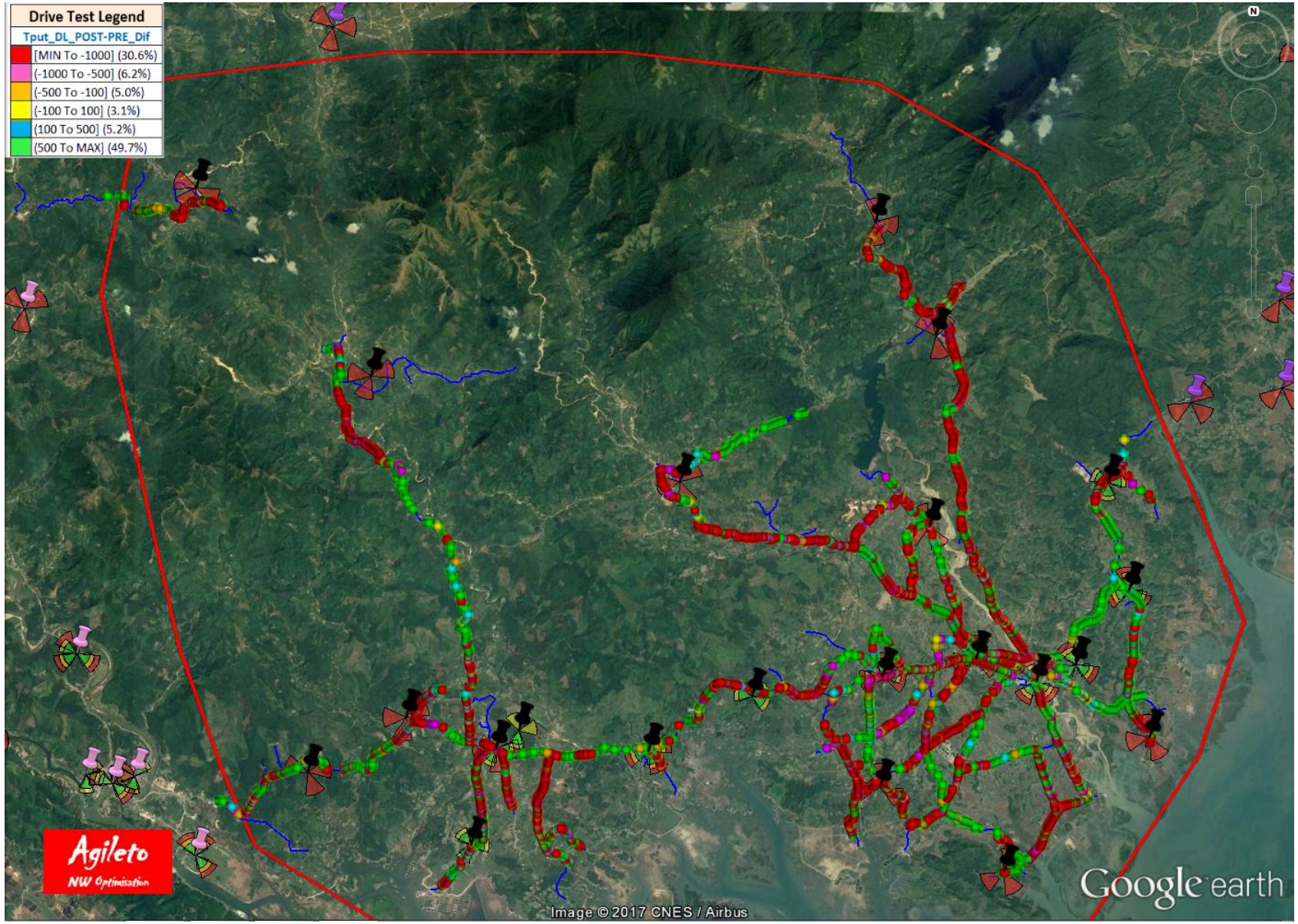
- **13.5 %**

POST better then PRE

POST-PRE ≥ 500Kbps

- **49.7 %**

(Overall POST is better than PRE)

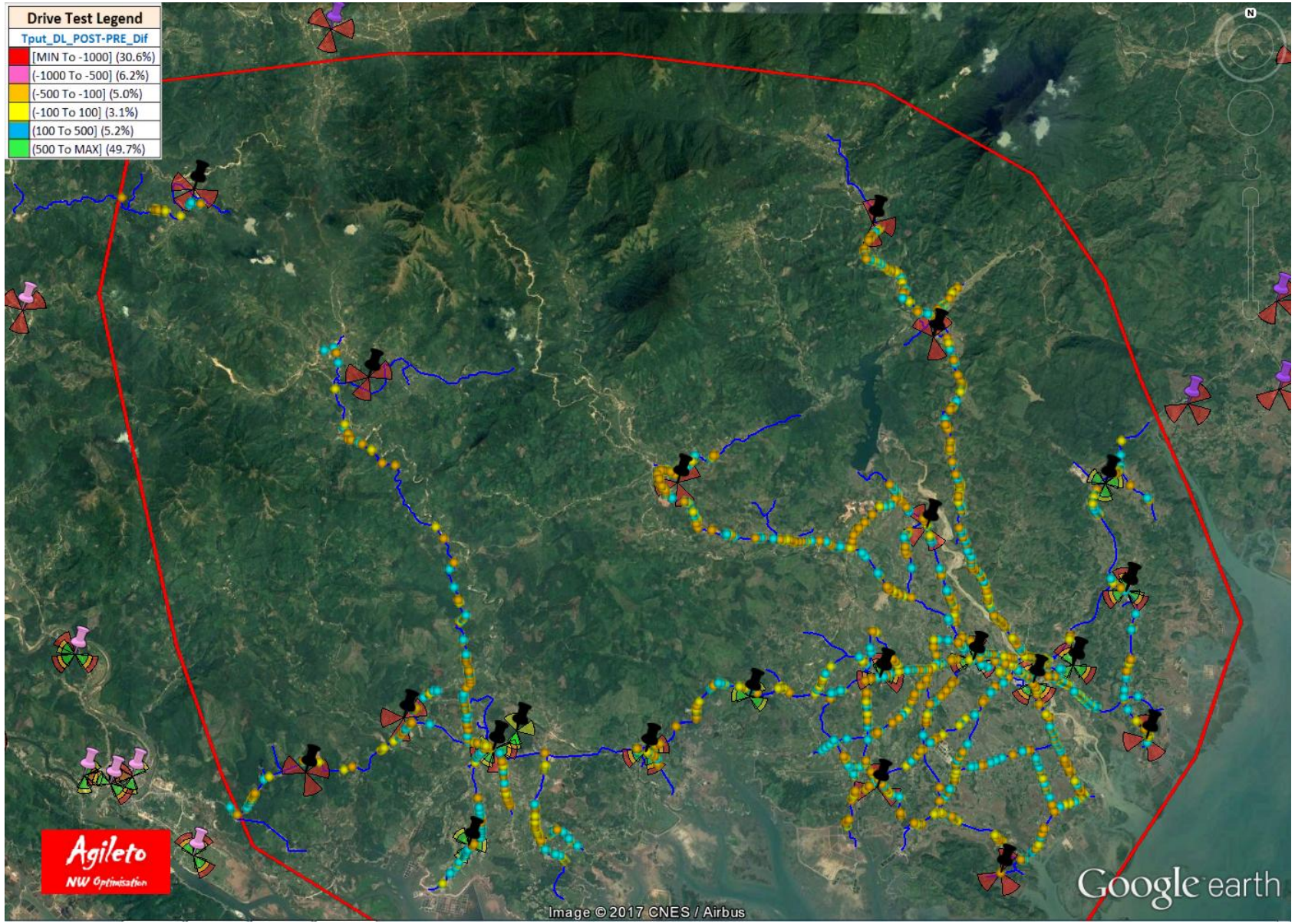


3G Throughput DL Difference POST - PRE Swap

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)

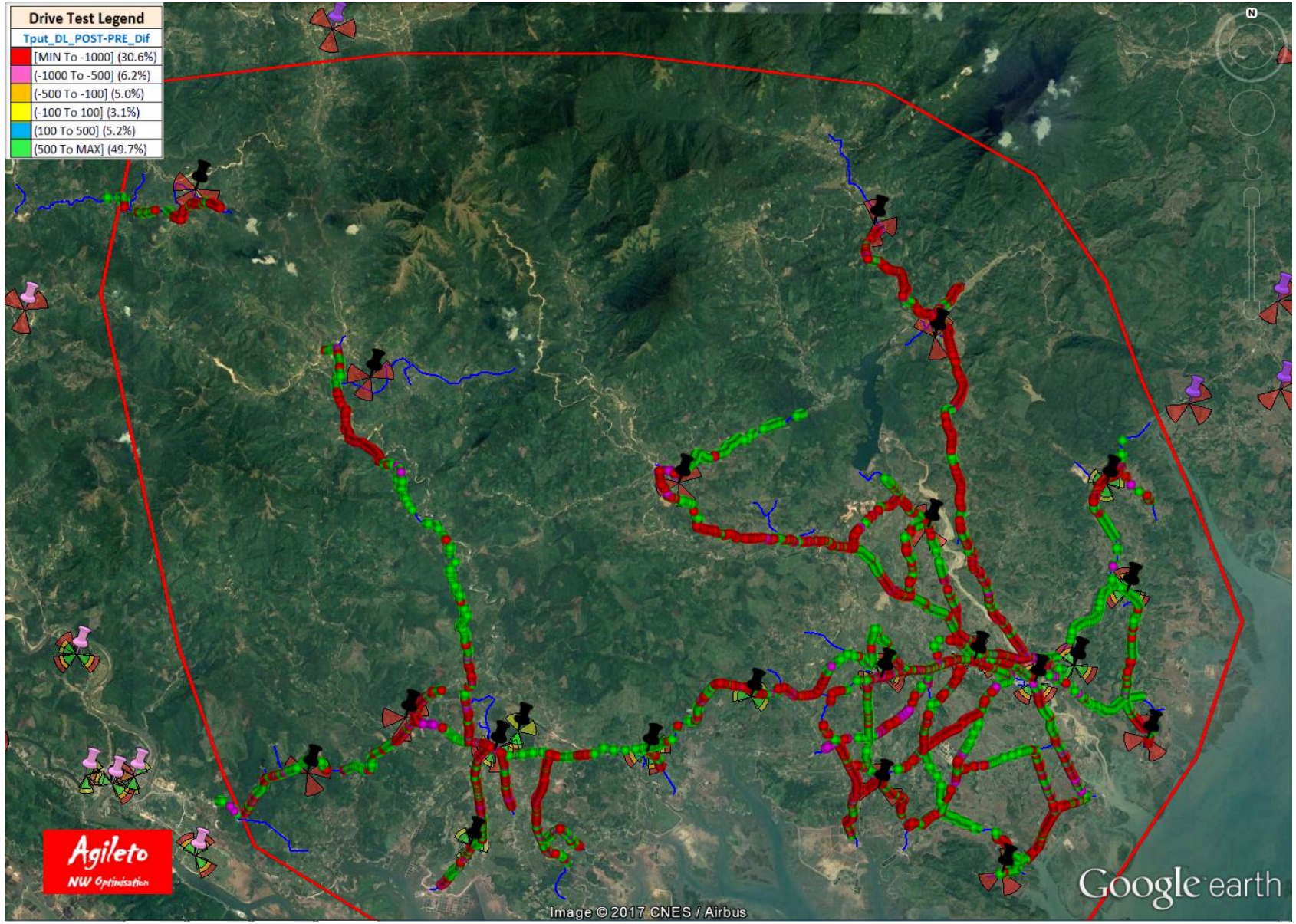
POST worst than PRE
POST-PRE ≤ -500 Kbps

- **36.8 %**

POST better then PRE
POST-PRE ≥ 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 Troughput / bin: 1968 Kbps

POST swap: Avg Troughput / bin: 1734 Kbps

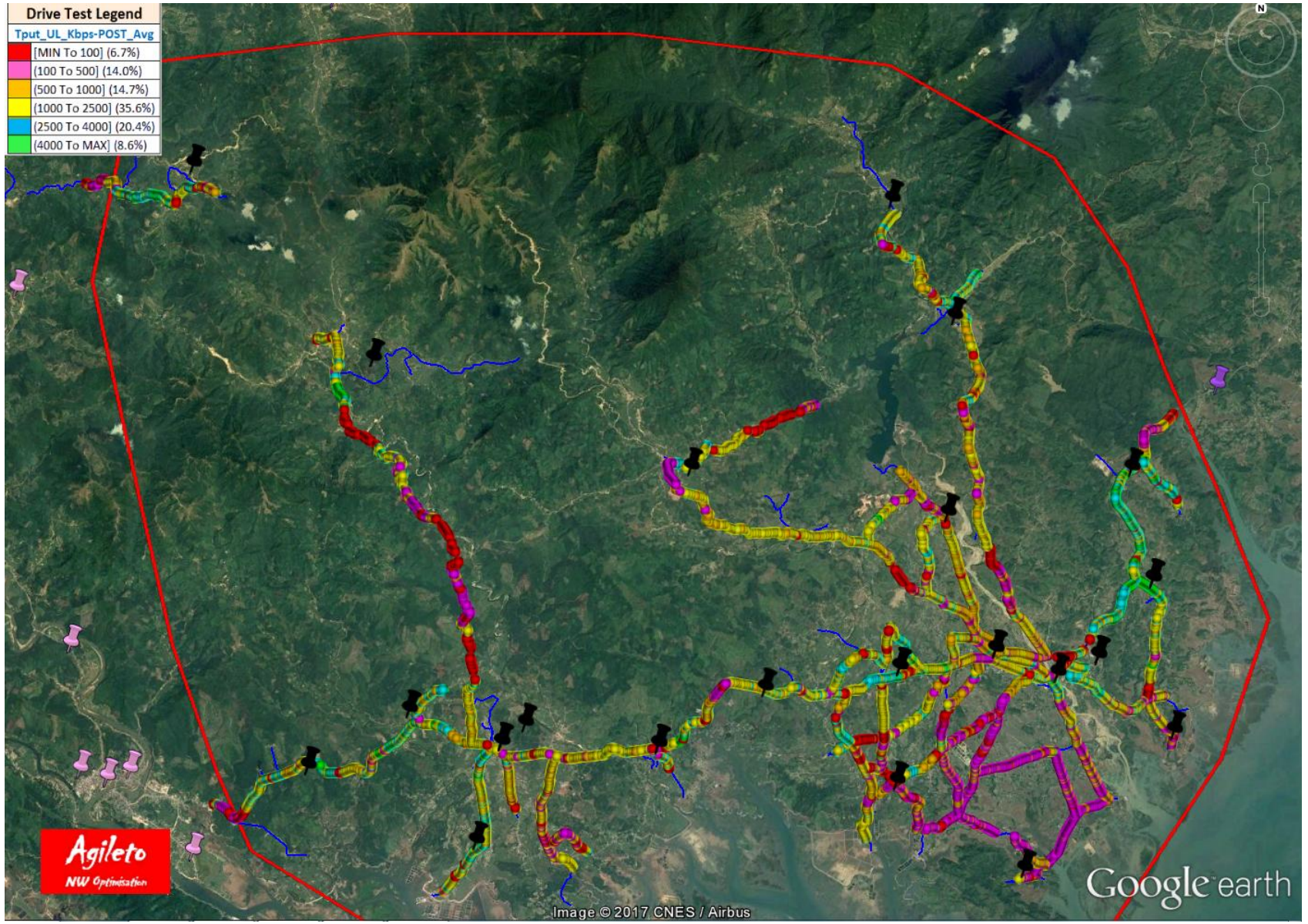
Avg Tput / bin POST < Avg Tput / bin PRE

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.

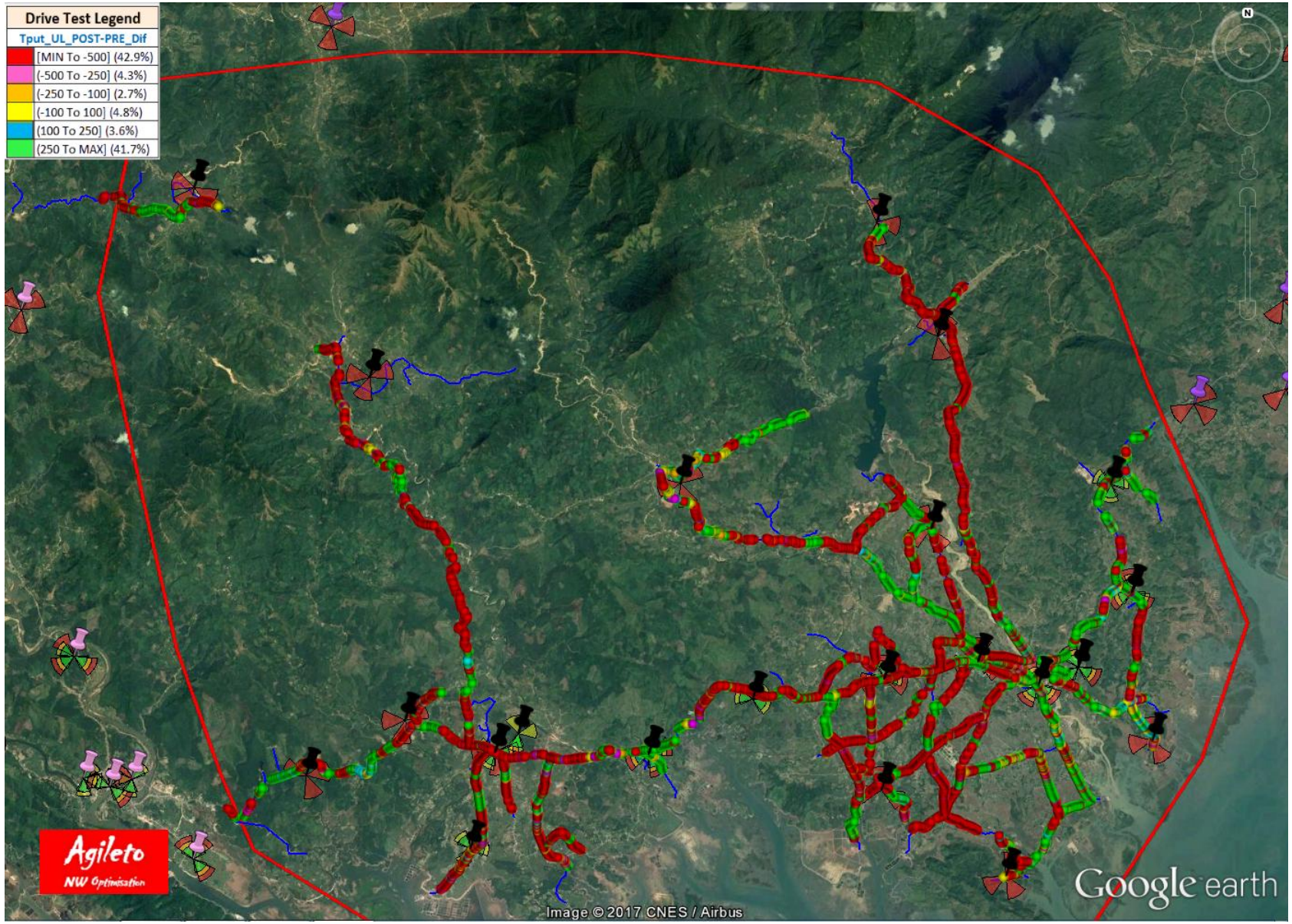
Below it is the presented the legend containing for each range the associated percentage related to the entire drive test route.

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 ≤ -250 Kbps

- **47.2 %**

POST comparable PRE

-250 Kbps ≤ POST-PRE < 250 Kbps

- **11.1 %**

POST better then PRE

POST-PRE ≥ 250 Kbps

- **41.7 %**

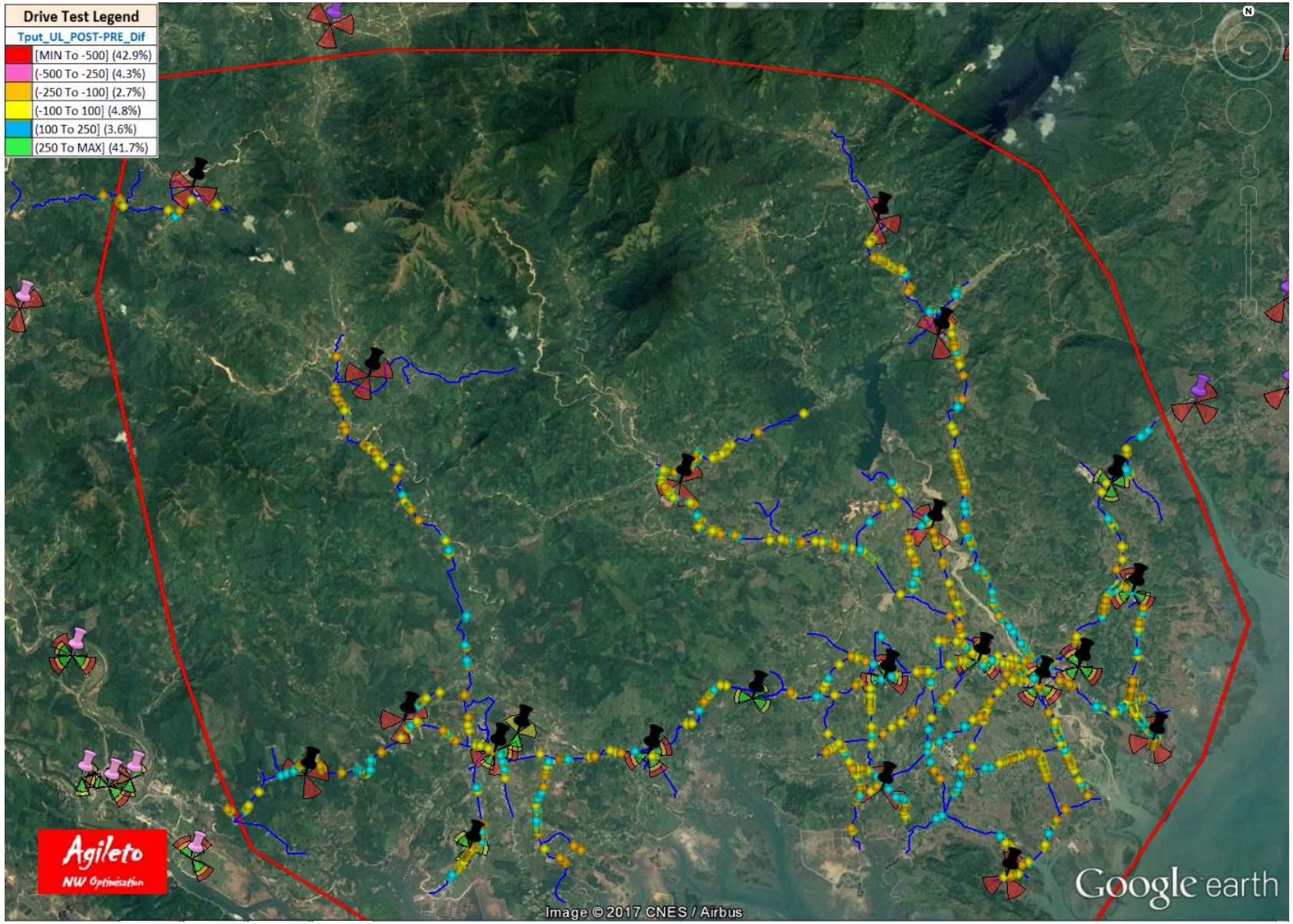
(Overall POST is **worst** than PRE)

3G Throughput UL Difference POST - PRE Swap

POST-PRE swap
(comparable locations)

POST comparable PRE
-250 Kbps ≤ POST-PRE < 250 Kbps

- **11.1 %**



3G Throughput UL Difference POST - PRE Swap

POST-PRE swap
(one is minimum 250 Kbps better than other)

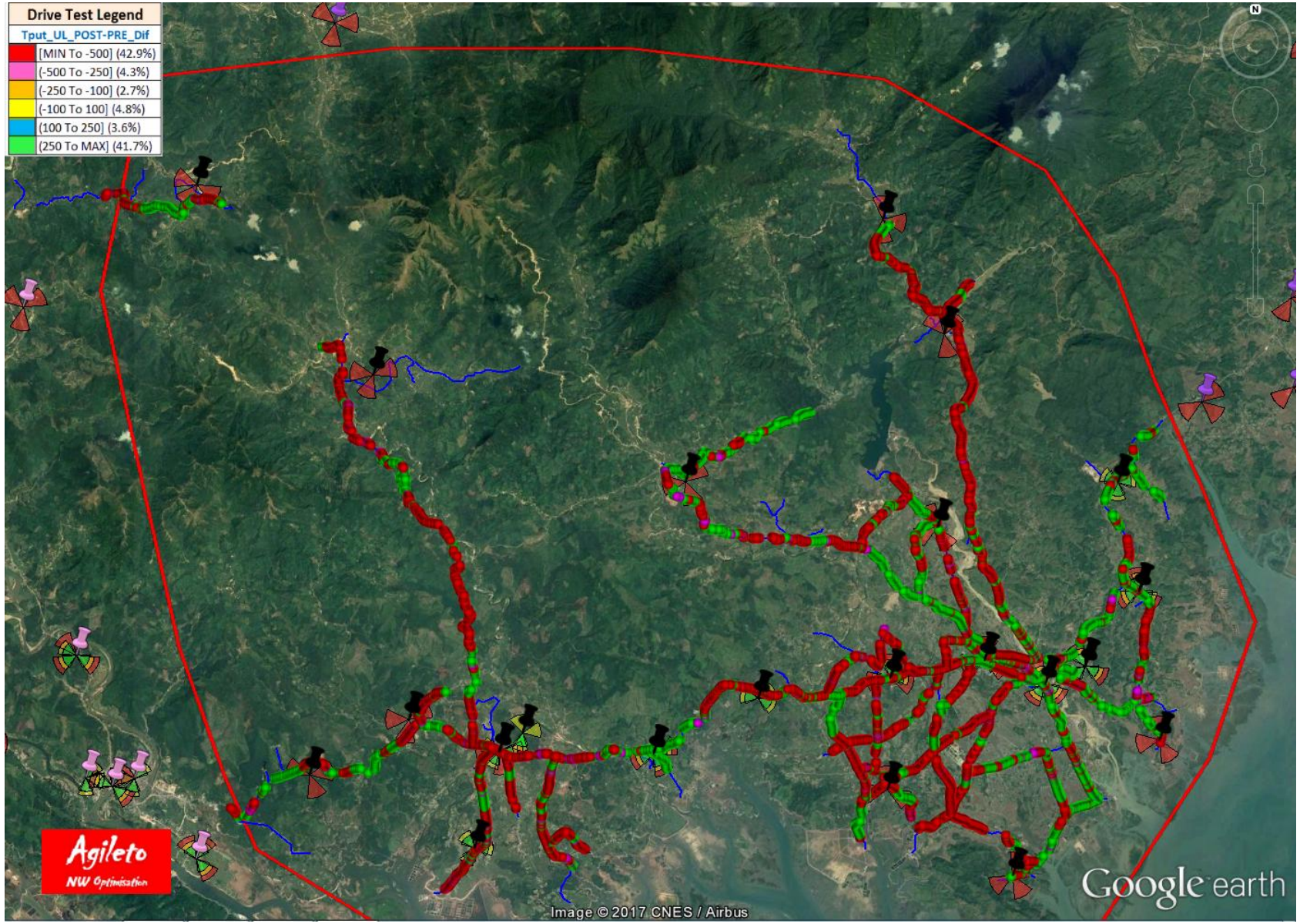
POST worst than PRE
POST-PRE ≤ -250 Kbps

- **47.2 %**

POST better then PRE
POST-PRE ≥ 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

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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:

Web site: www.agileto.com

Sales: sales@agileto.com

Support: support@agileto.com

Facebook: https://www.facebook.com/agileto

WhatsApp: +40 773 991 443 (Mon-Fri, 8:00-15:00 GMT)

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