Coverage Dominance in IMNOS

T··Mobile·

Dominance: Count when 3 neighbors stronger than server

Downtilt Offender … Uptilt Victim

Innovation: This prioritizes tilt opportunities by aggregating poor dominance from each record.
Patent Pending, IDF1642

Highlighted record shows all 3 neighbors RSRP greater than the Server RSRP

Start Time	End Time	RSRP [dBm]	N1 RSRP [dBm]	N2 RSRP [dBm]	N3 RSRP [dBm]
10/04/17 10:55:25 pm	10/04/17 10:55:52 pm	-106	-109	-110	-110
10/04/17 10:55:50 pm	10/04/17 10:56:01 pm	-106	-114	-116	-117
10/04/17 10:56:09 pm	10/04/17 10:56:28 pm	-106	-110	-110	-111
10/04/17 10:56:30 pm	10/04/17 10:56:37 pm	-106	-109	-109	-110
10/04/17 10:57:09 pm	10/04/17 10:57:20 pm	-106	-103	-104	-104
10/04/17 10:57:01 pm	10/04/17 10:57:37 pm	-106	-109	-111	-112
10/04/17 10:57:33 pm	10/04/17 10:57:38 pm	-106	-106	-108	-111
10/04/17 10:57:37 pm	10/04/17 10:57:43 pm	-106	-109	-109	-111
10/04/17 10:58:01 pm	10/04/17 10:58:10 pm	-106	-120	-121	-122

Offender
High count N3 > Server RSRP
Offender > Victim distance
Victim RSRP >= -114 dBm

DOWNTILT

Victim
High count N3 > Server RSRP
Offender > Victim distance
Victim RSRP < -114 dBm

UPTILT

Where the data comes from

- Source is TrueCall call records
- TrueCall only has PCI for N1/N2/N3
  - Correlate PCI to closest cell name with that PCI
- Dominance table
  - Count the number of times N3 RSRP is greater than Server RSRP
  - Aggregate into 504m hexagon per server/neighbor combo
  - Server = Victim
  - Neighbor = Offender
- Offender cells
  - Aggregate Dominance table by offender
  - Filter for Victim (i.e. Server) with RSRP >= -114 dBm
  - Per 504m ensure the offenders (i.e. Neighbors) are further away than the victims
- Victims cells
  - Aggregate Dominance table by victim
  - Filter for Victim (i.e. Server) with RSRP < -114 dBm
  - Per 504m ensure the offenders (i.e. Neighbors) are further away than the victims

Dominance Prioritization

- If prioritize by raw count, then highest traffic will always be on top
- Need method to also prioritize cells with high percentage of dominance issues

Definitions

$$N3 = 3rd\ Strongest\ Neigbhor$$

$$[Samples\ where\ N3 > Server\ RSRP\ and\ Server\ RSRP \geq -114\ dBm] = Samples\ where:$$

$$N3\ RSRP > Server\ RSRP$$

$$Server\ RSRP \geq -114\ dBm$$

$$Aggregate\ by\ offender\ (aka\ neighbor\ cell)$$

$$N3\ Offender\ Market\ Avg = \frac{[Samples\ where\ N3 > Server\ RSRP\ and\ Server\ RSRP \geq -114\ dBm]_{market}}{[All\ Samples]_{market}}$$

$$N3\ Offender\ Cell\ Avg = \frac{[Samples\ where\ N3 > Server\ RSRPand\ Server\ RSRP \geq -114\ dBm]_{cell}}{[All\ Samples]_{cell}}$$

Dominance Prioritization (2)

- Prioritize by the number of samples above the market average

Prioritization

$$N3\ Cell\ Avg >?\ N3\ Market\ Avg \Rightarrow How\ much\ higher\ percentage\ for\ cell\ compared\ to\ the\ market?$$

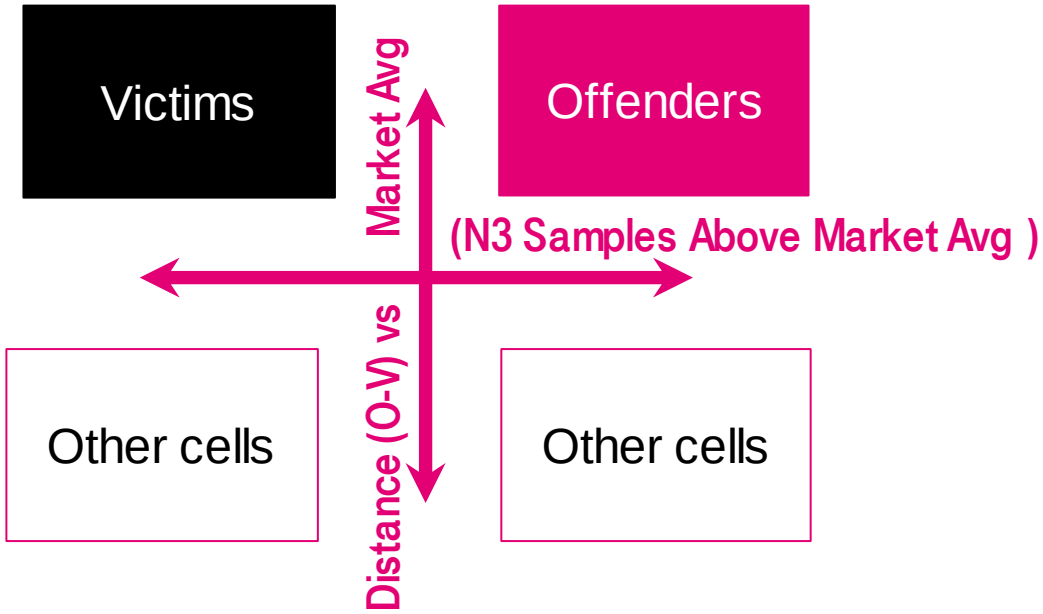
$$\frac{[Samples\ where\ N3 > Server\ RSRP]_{cell} - [N3\ Samples\ Above\ Market\ Avg]}{[All\ Samples]_{cell}} = [N3\ Market\ Avg]$$

$$([Samples\ where\ N3 > Server\ RSRP]_{cell} - [N3\ Samples\ Above\ Market\ Avg]) = [N3\ Market\ Avg] * [All\ Samples]_{cell}$$

$$[N3\ Samples\ Above\ Market\ Avg] = ([Samples\ where\ N3 > Server\ RSRP]_{cell} - [N3\ Market\ Avg] * [All\ Samples]_{cell})$$

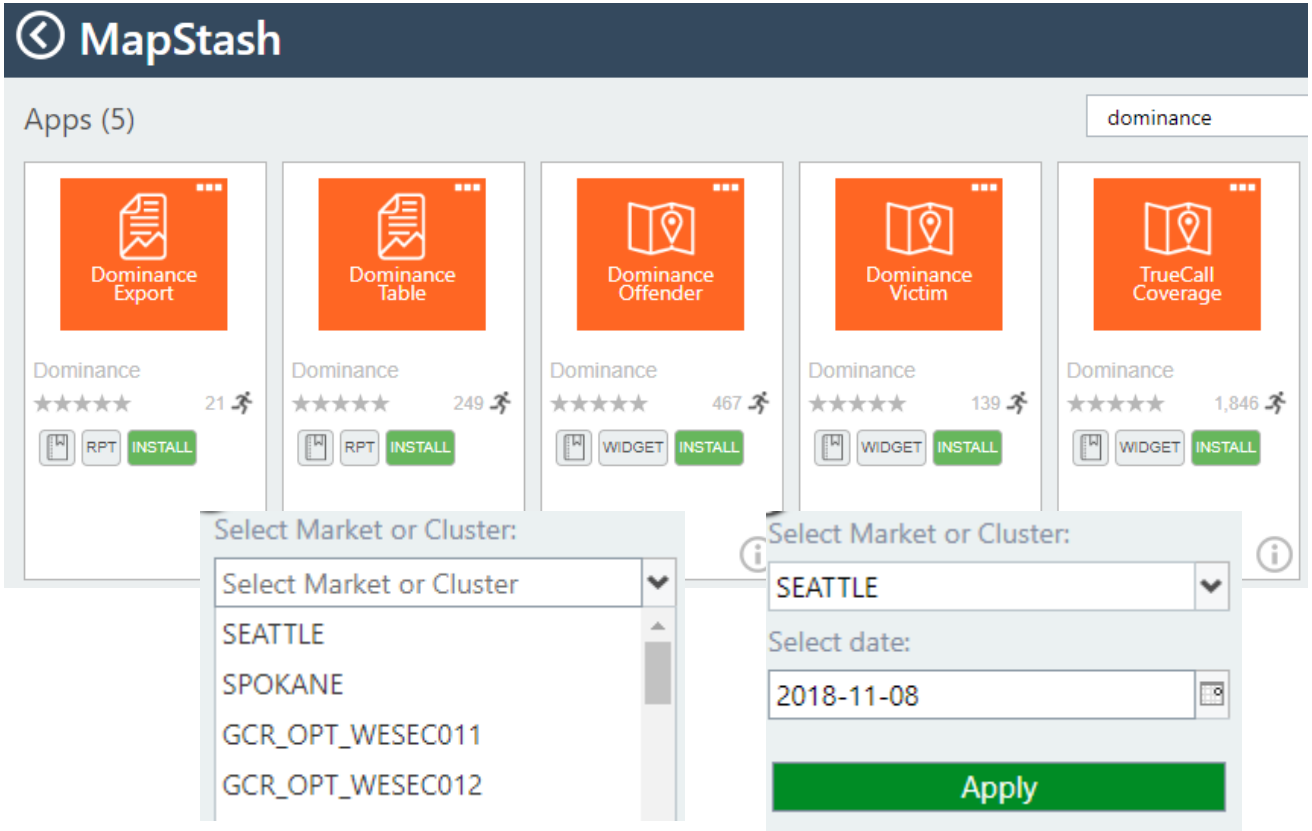
Dominance Prioritization (3)

- Eliminate half of cells: only choose when offenders are further away than market average
- Distance (Offender – Victim):
  - ([Offender Cell] – [504m Hex of Ue Location]) - ([Victim Cell] – [504m Hex of Ue Location])



Dominance Table

- MapStash
- Search for "Dominance" to see all reports related to Dominance
- Click on "Dominance Table" and select a Market/Cluster and Date
- Table will show list of Offenders and Victims
- Click on "Dominance Export" to see a list that can be exported



Dominance Table (2)

- N3 Samples Above Market Avg
  - Positive: offenders (aka neighbors) that need downtilt
  - Negative: victims (aka servers) that need uptilt
- Score: Normalized similar to SON CCO module
  - Offenders: Downtilt cells with scores greater than 1
  - Victims: Uptilt cells with scores less than -0.75

Dominance Table Offenders — Positive Number — Export

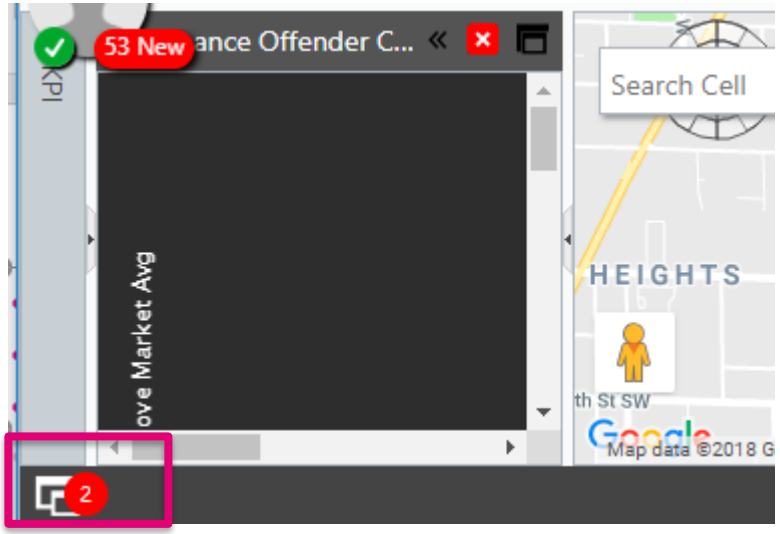
CELL NAME	BAND	COVERAGE TYPE	N3 Samples Above Market Avg	Score
LSE04655A31	AWS	Macro	512.265	2.5
LSE04649C11	AWS	Macro	450.68	2.5
BSE04655A31	PCS	Macro	285.61	2.5
LSE03480A61	AWS	Macro	230.48	2.5
LSE05079B31	AWS	Macro	226.475	2.5

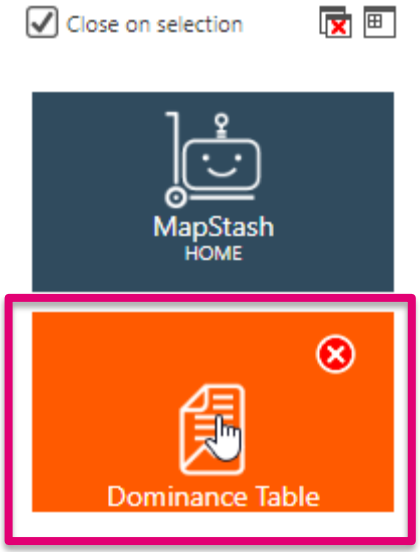
Dominance Table Victims — Negative Number — Export

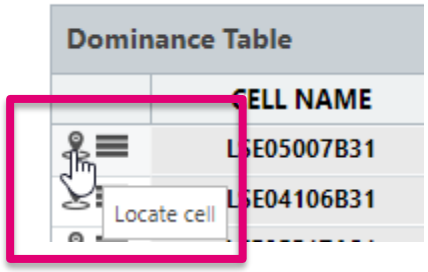
CELL NAME	BAND	COVERAGE TYPE	N3 Samples Above Market Avg	Score
LSE05007B31	AWS	Macro	-254.73	-2.5
LSE04106B31	AWS	Macro	-219.13	-2.5
LSE05517A21	AWS	Macro	-217.603	-2.5
LSE04653A31	AWS	Macro	-207.491	-2.5
LSE01518Q31	AWS	Macro	-206.699	-2.5

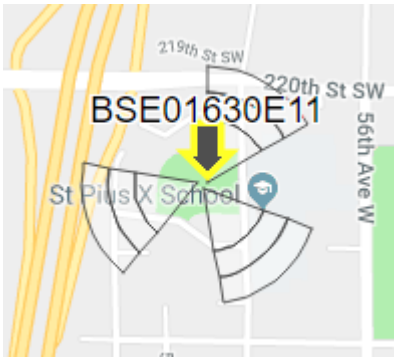
Dominance Offender

- Click on “Back Arrow” in the top-left corner of the screen
- In MapStash, click on “Dominance Offender”
- It will go back to the map, and open a blank black chart on the left
- Click on the multi-window icon in the bottom-left to show the open windows
- Click on the Dominance Table icon
- Click on the “Locate cell” icon next to a cell, and it will find that site for that cell on the map



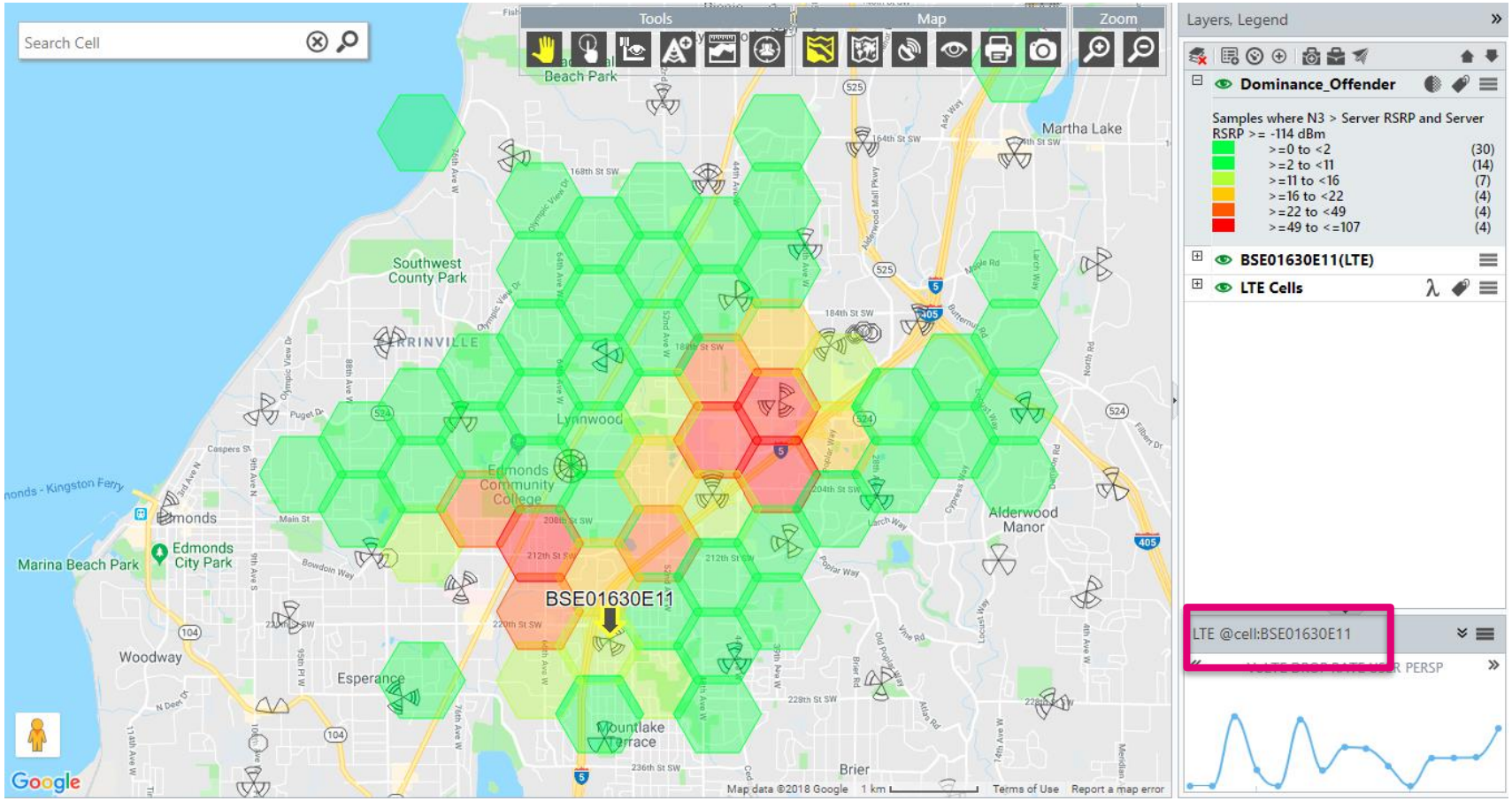




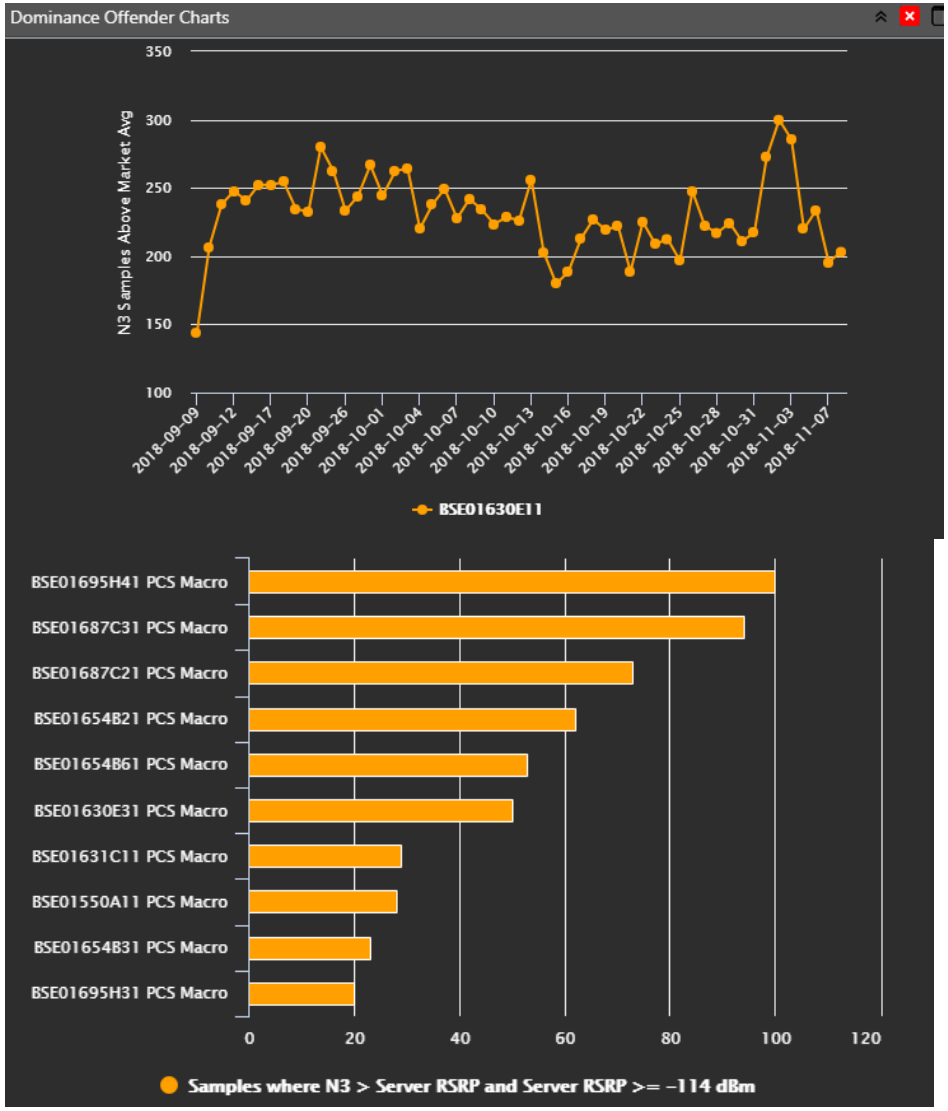


Dominance Offender (2)

- On the map, click on the cell and the plot will appear after 10 seconds
- The bottom-right corner shows the cell being mapped
- To remove the cell name from the map, click on the “eye” to hide the layer, or bars to delete it
- Move “LTE Cells” to top layer to click on other cells



Dominance Offender (3)

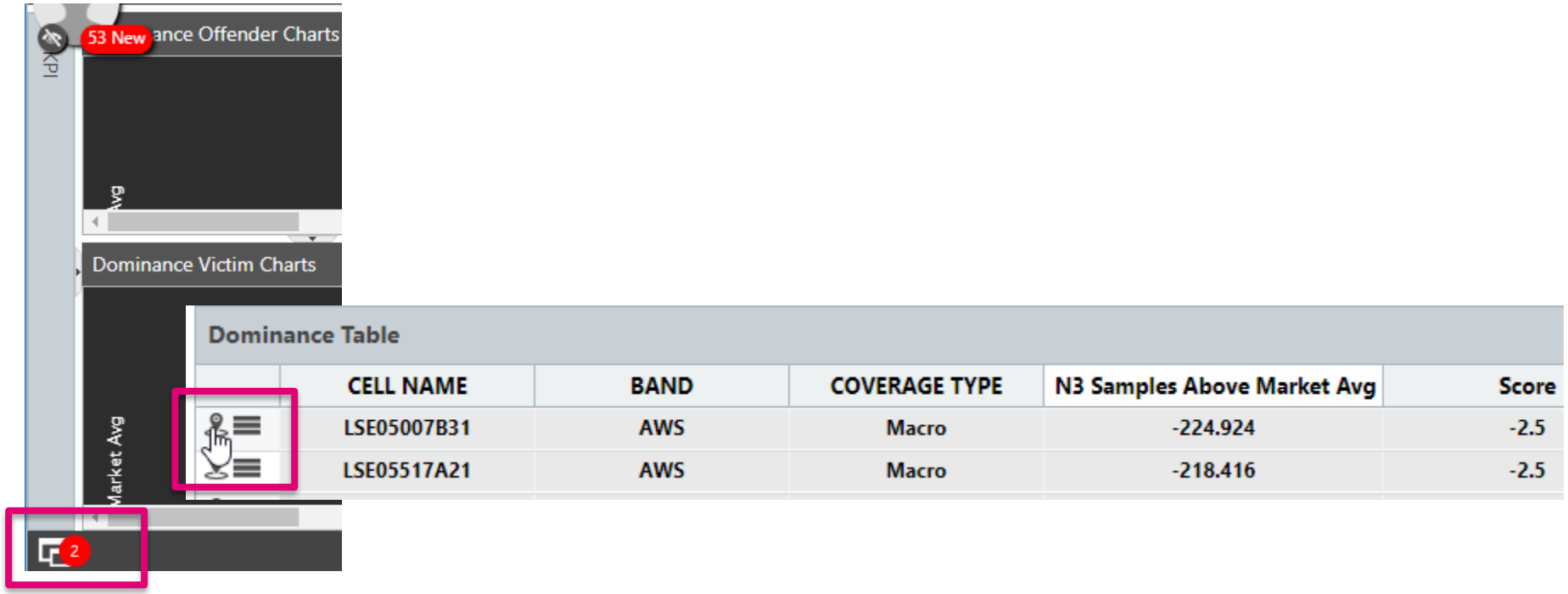


- Trend of the dominance for this offender cell

- Victims (aka servers) most affected by this offender

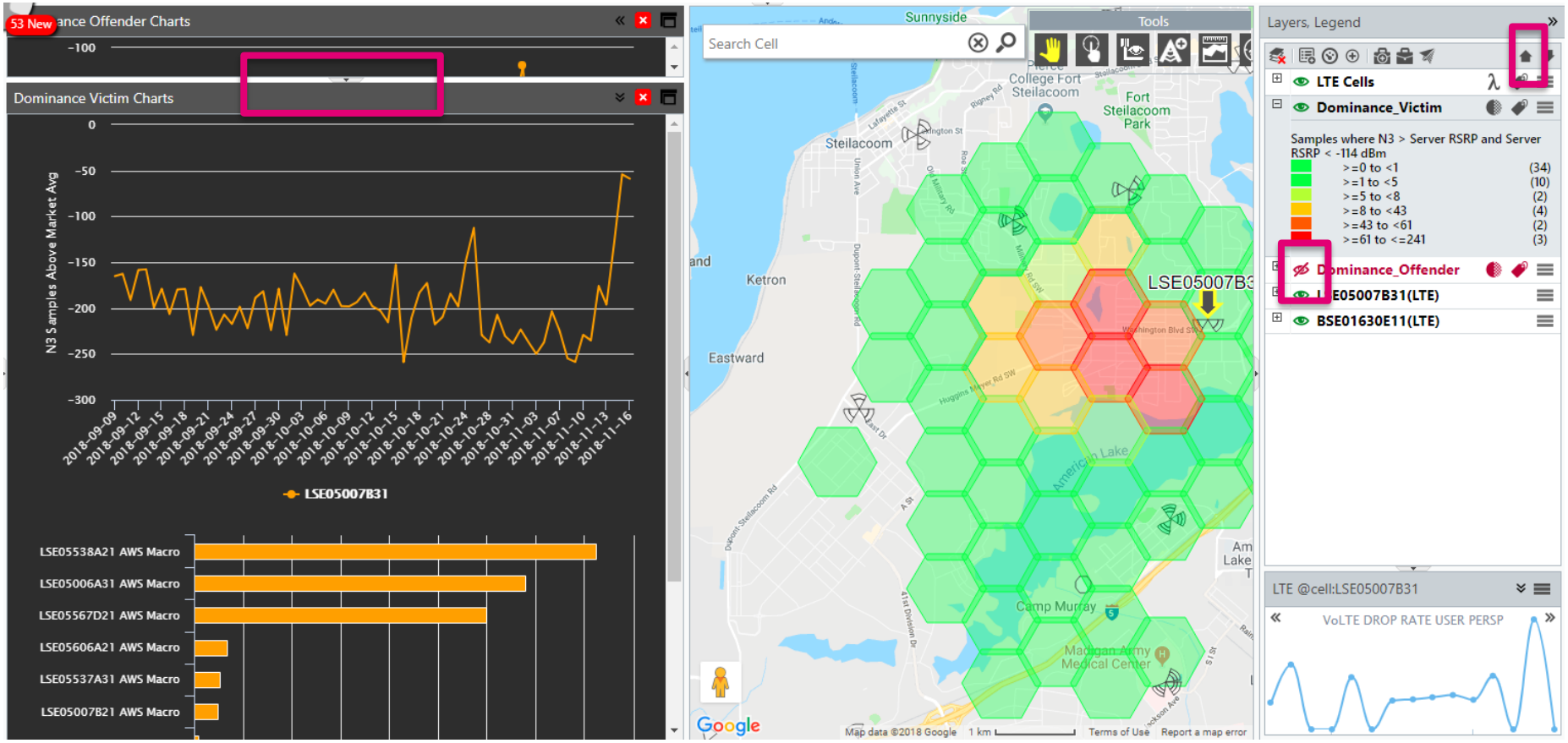
Dominance Victim

- In the bottom-left, click on the multi-window, and click on MapStash
- In MapStash, click on “Dominance Victim”, select a date and market
- It will go back to the map, and open a blank black chart on the left below the Offender chart
- Click on the multi-window icon in the bottom-left to show the open windows
- Click on the Dominance Table icon
- Click on “N3 Samples Above Market Avg” to sort from negative to positive
- Click on the “Locate cell” icon next to a cell, and it will find that site for that cell on the map



Dominance Victim (2)

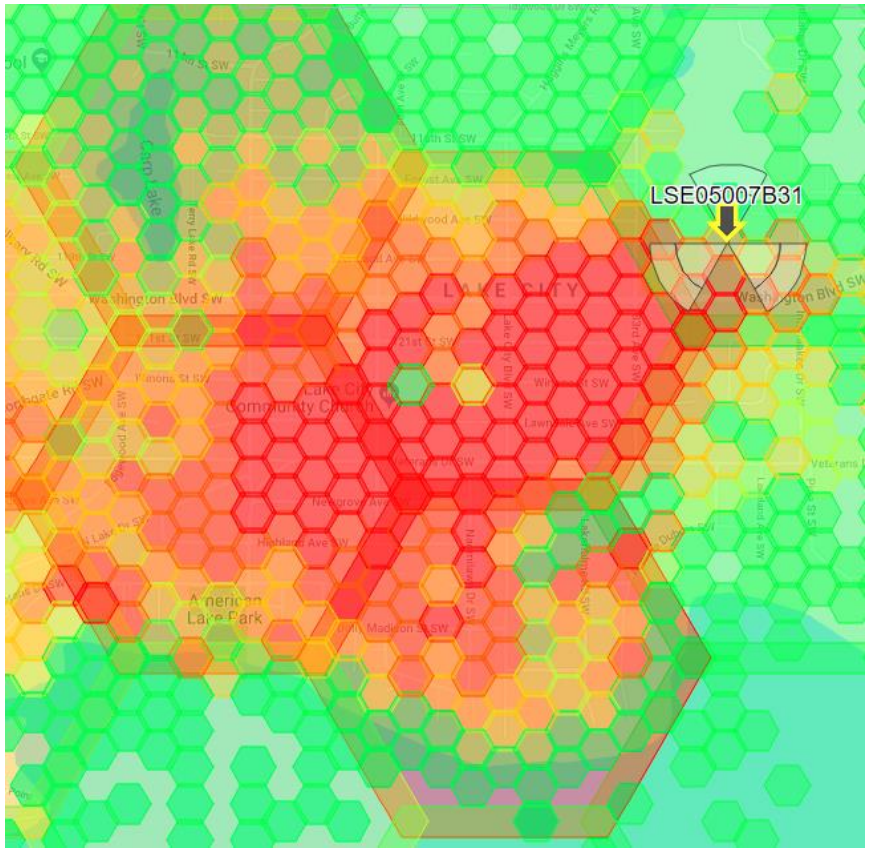
- On the map, click on the cell and the plot will appear after 10 seconds
- For charts on left, click on the divider to make the “Victim” charts taller
- In the layers on right, move LTE Cells to top to make selectable, hide Dominance Offender
- Chart shows offenders (aka neighbors) that have highest impact on this victim (aka server)



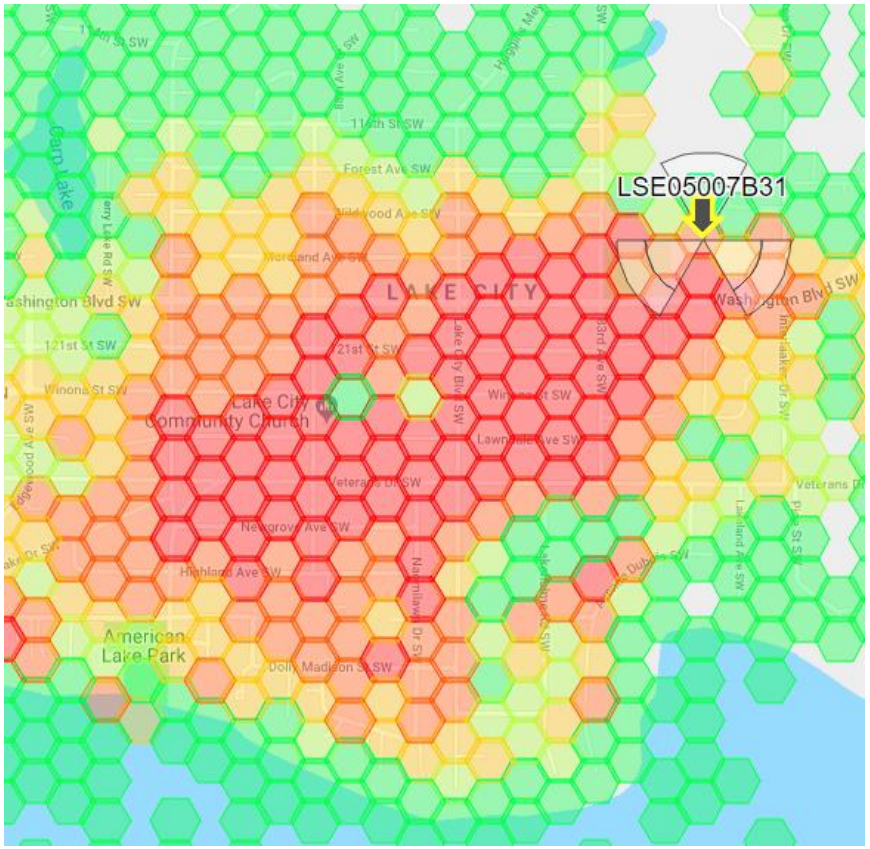
TrueCall Coverage with Dominance Maps

- In the bottom-left, click on the multi-window, and click on MapStash
- In MapStash, click on "TrueCall Coverage", select a date and market, it will go back to the map
- Click on the cell again, and it will show the 56m Hexagon coverage in addition
- Remove the dominance layers to see only coverage; Move cell layer to top to click other cells

Dominance Victim with TrueCall Coverage

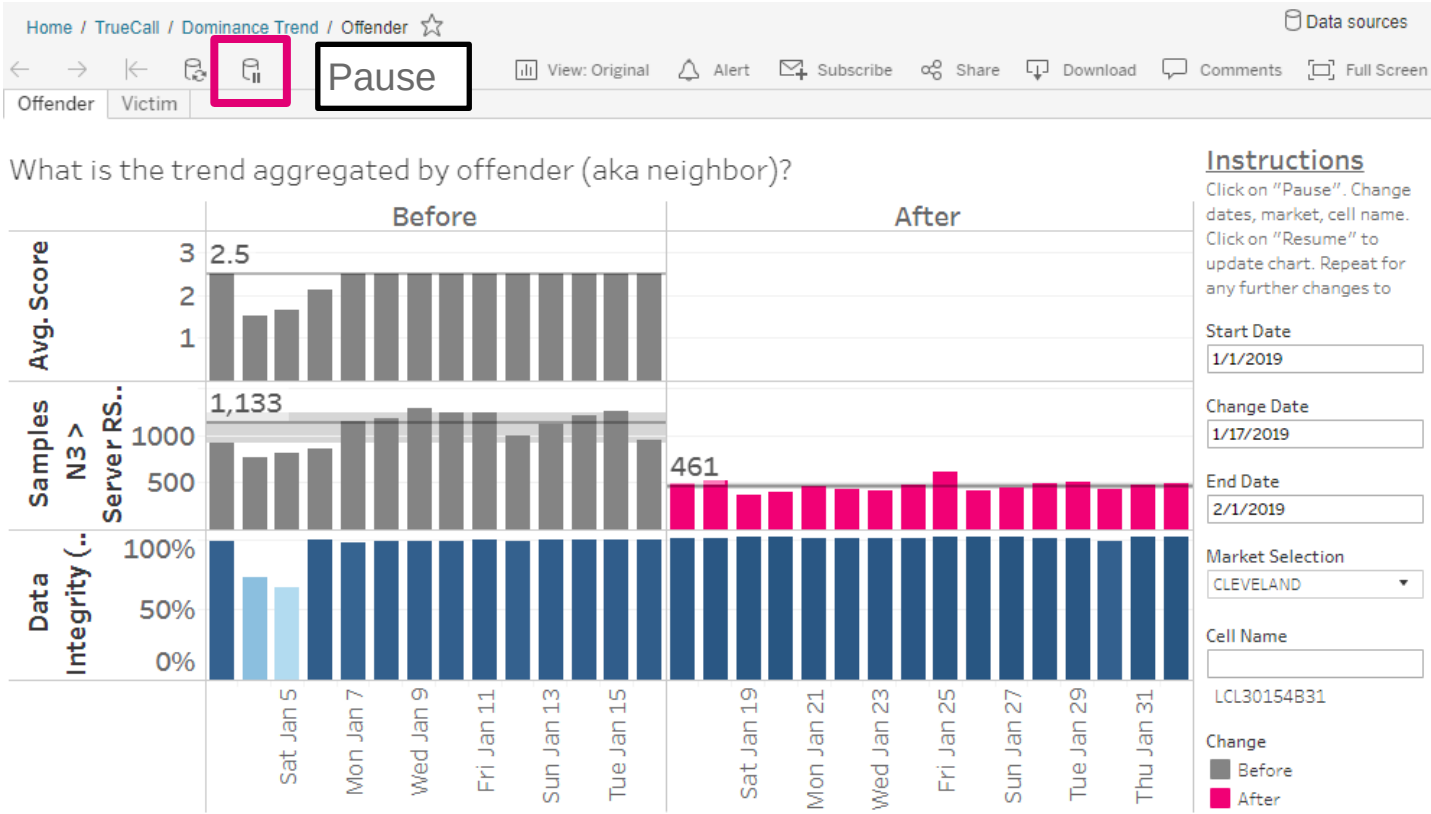


TrueCall Coverage



Dominance Trend in Tableau

- Open the report https://analytics.eng.t-mobile.com/#/site/RANPerformance/views/DominanceTrend/Offender?:iid=1
- Click on "Pause". Change dates, market, cell name. Click on "Resume" to update chart. Repeat for any further changes to parameters.



Trial 1 KPI Improvements

Only 1 deg of tilt: even more improvements possible if allowed to iterate to best tilt

		Cluster Evaluation		Single cell tilt evaluations
		Dominance	ABA	Dominance
Orlando				76% Success Rate (29 out of 38)
Philadelphia	Cells	81	104	87% Success Rate (7 out of 8)
	CQI	Inconclusive	Inconclusive	
	SINR	Inconclusive	Inconclusive	
	DL Thpt	19% impr	Inconclusive	
	Dominance	83 impr	0 impr	
Kansas City	Cells	123	96	100% Success Rate (18 out of 18)
	CQI	No change	No change	
	SINR	No change	No change	
	DL Thpt	No change	No change	
	Dominance	126 impr	95 impr	
Phoenix	Cells	22	50	75% Success Rate (6 out of 8)
	CQI	8% impr	No change	
	SINR	3% impr	No change	
	DL Thpt	No change	No change	
	Dominance	62 impr	14 degr	
Houston	Cells	84	21	67% Success Rate (6 out of 9)
	CQI	3% impr	11% impr	
	SINR	2% impr	1% impr	
	DL Thpt	No change	No change	
	Dominance	129 impr	104 impr	

Trial 2 KPI Improvements

Only 1 deg of tilt: even more improvements possible if allowed to iterate to best tilt

	Cells	Type	DL Thpt	UL Thpt	CQI	SINR	SIP DCR
Austin	42	Offenders	7% impr	No change	No change	70 bps impr	No change
	70	Offenders	No change	No change	No change	No change	No change
	9	Victims	No change	No change	38 bps degr	No change	No change
	20	Victims	No change	No change	23 bps impr	No change	No change
Dallas	17	Offenders	No change	11% impr	14 bps impr	83 bps	3 bps