

Mobitel's Initiatives for Evaluating Customer QoE and Ensuring Network QoS



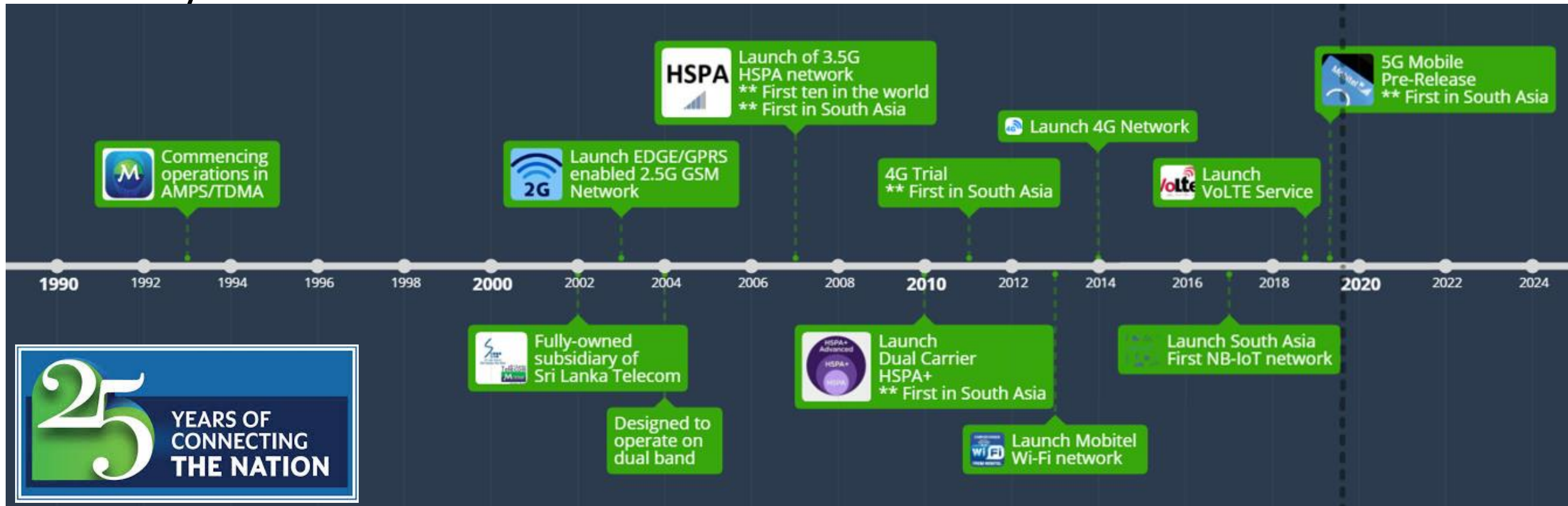
- Ishantha Pandigamage
- Ruwan Liyanage

Our Telecommunication Industry

- Sri Lanka – Small Island in South East Asia
- Four Mobile Operators & Two Fixed Operators
- Competitive Market for Mobile Industry
- Quality of Experience and Quality of Service decides the retention of a customer
- Sri Lanka has among the lowest prices in the world, ITU
 - Lowest entry level charges for fixed broadband
 - Ranked at no.21 for mobile broadband out of 181
- Removal of floor based price rate in 2018
- Reduction of Telecommunications Levy
- Mobile Broadband : Price vs. Affordability
- Compare to early years a significant improvement in Mobile data speed
- Fixed FTTH & Mobile 4.5G deployment
- First 5G device Pre-Release testing , Ookla

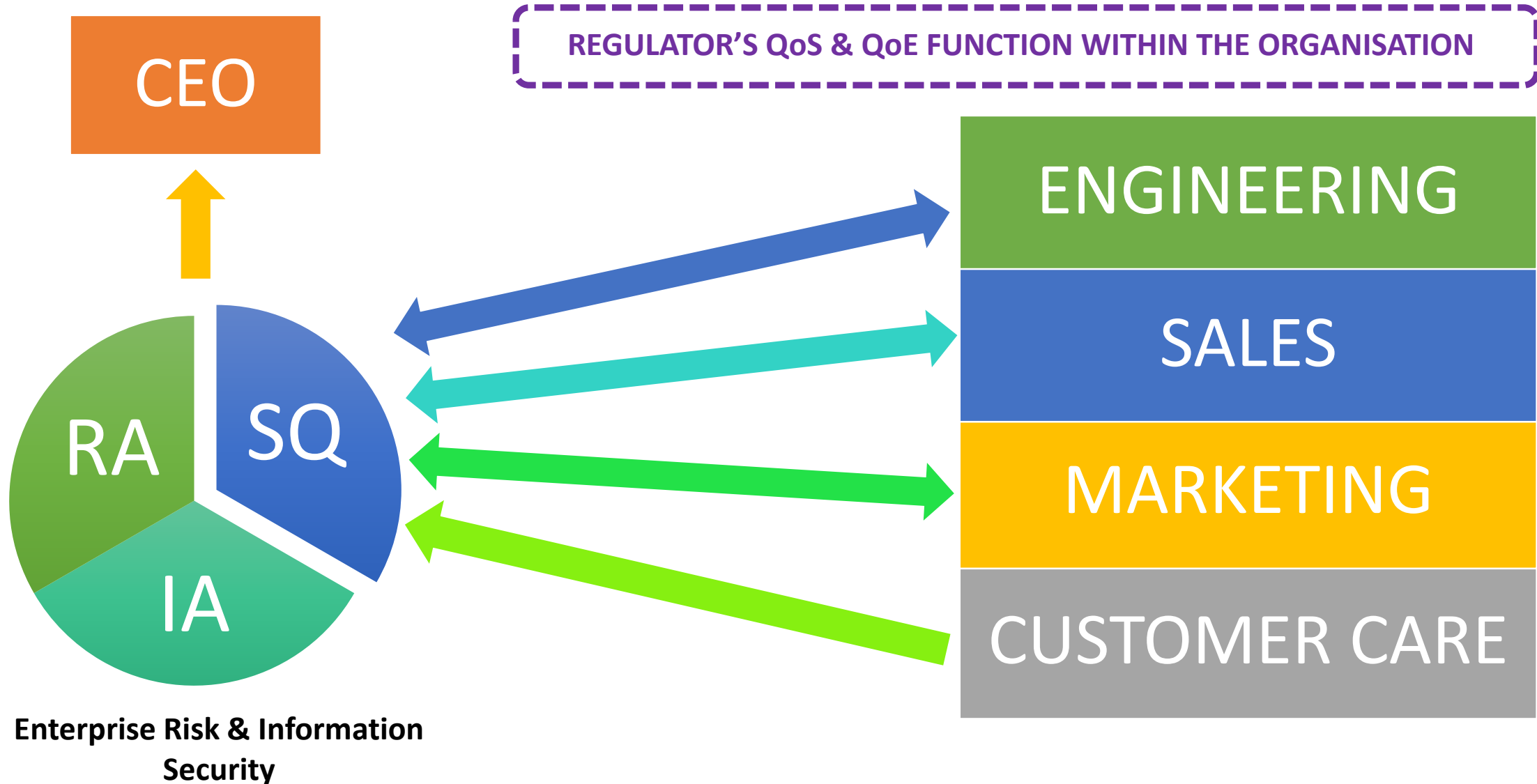


Journey of Mobitel



- Customer base of over 10 million
- Engineering Excellence Award - Stage VII Expansion project
- Awarded prestigious ISO 27001:2005 certification for the company's solid and reliable Information Security Management System

Service Quality Functions at Mobitel



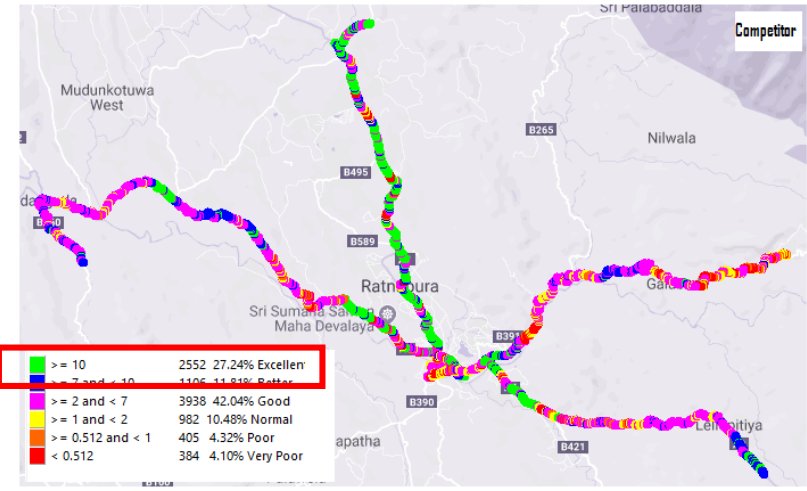
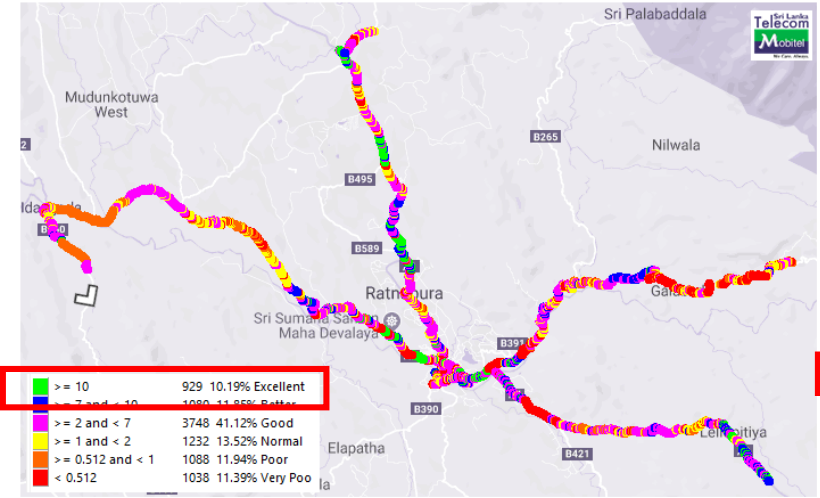
KEY AREAS OF SQ

- Network Performance Monitoring & Troubleshooting
- Network Service Quality Auditing
- Network Data Analytics
- Benchmarking & Drive Testing

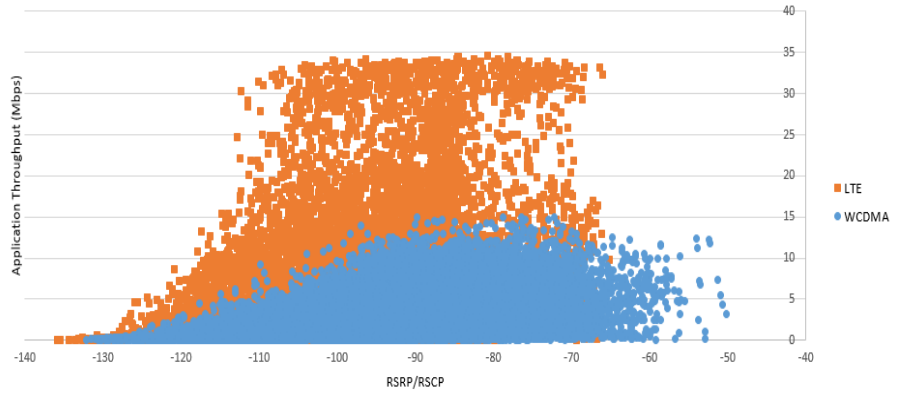
NETWORK PERFORMANCE MONITORING & TROUBLESHOOTING

Internet Data Speed Clipping

- Reduction of monthly data traffic
- Compared to competitor less number of samples > 10Mbps in 3G throughput DT
- RSCP/RSRP vs. Application Throughput
- 34Mbps data clipping on application throughput while in LTE
- Further testing was carried stationary
 - FTP/HTTP Download – Finland
 - FTP/HTTP Download – Netherland
 - FTP/HTTP Download – Singapore
 - FTP/HTTP Download – USA
 - Local FTP/HTTP Download – Mobitel SL



1 2 3 4 Auto Mode: RSRP/RSCP Vs Application Throughput 7 28 29 30 31



Internet Data Speed Clipping...

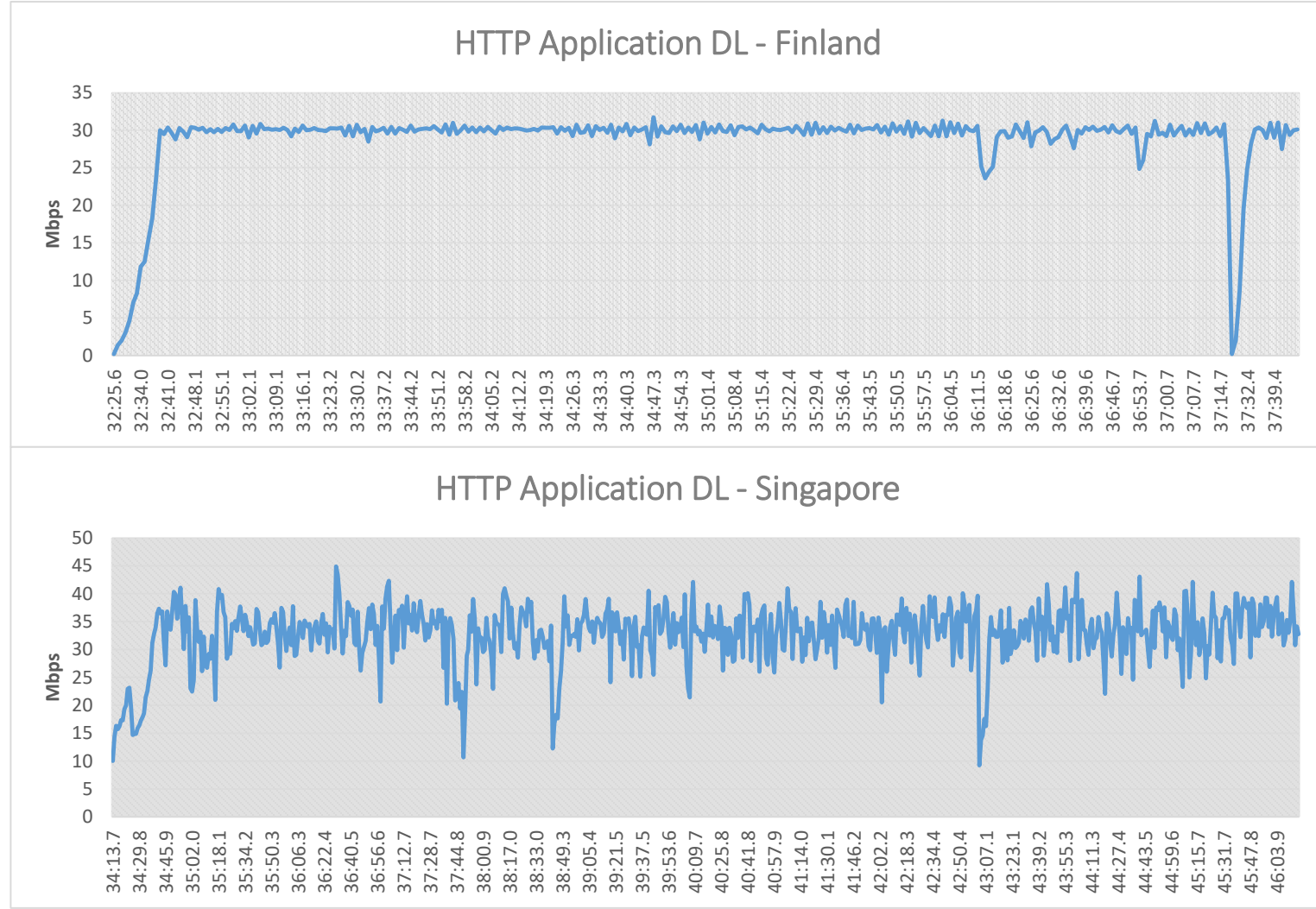
- The maximum data speed for Netherland recorded as 34.95 Mbps
- Finland was 31.74 Mbps
- All Europe links had data clipping
- No data limitation on US, Singapore & Local links

Cause:

- ISP traffic routing issue
- Routing most Europe traffic via Singapore ISP link

Impact:

- Data revenue loss
- Affected the customer experience of high speed data downloading



High RTWP - External Interference

- Sudden RTWP increase
- Omni directional and very high RTWP (> -80 dBm)

Impact:

- Poor user experience in data speed

Cause:

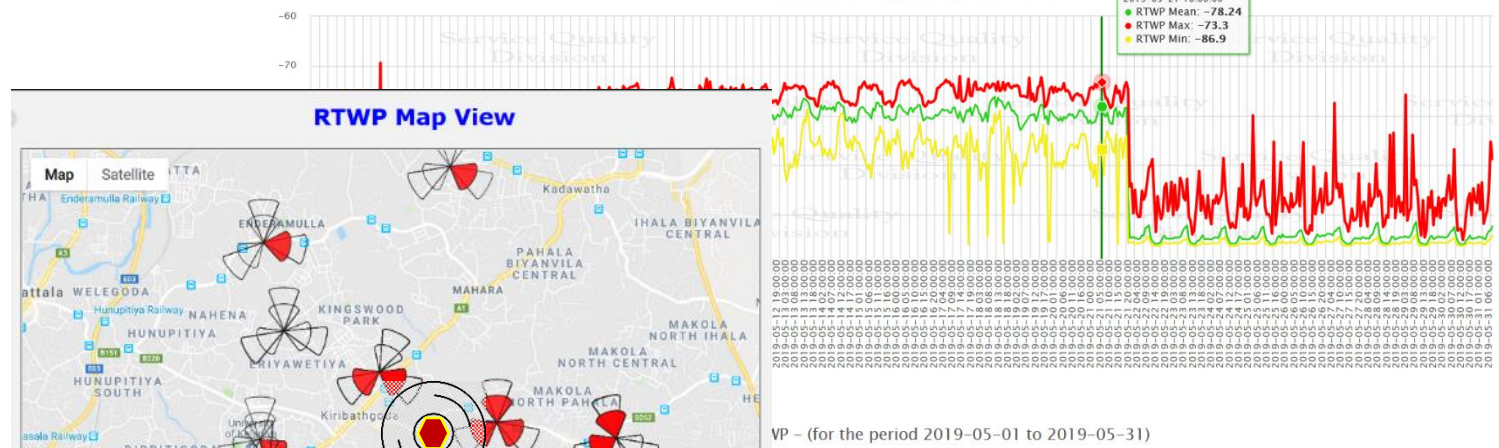
- Faulty 3G Repeater

KPI Viewer : RTWP - (for the period 2019-05-01 to 2019-05-31)

Cell Name : ZKEL03M

RTWP Mean RTWP Max RTWP Min

2019-05-21 16:00:00
 RTWP Mean: -78.24
 RTWP Max: -73.3
 RTWP Min: -86.9

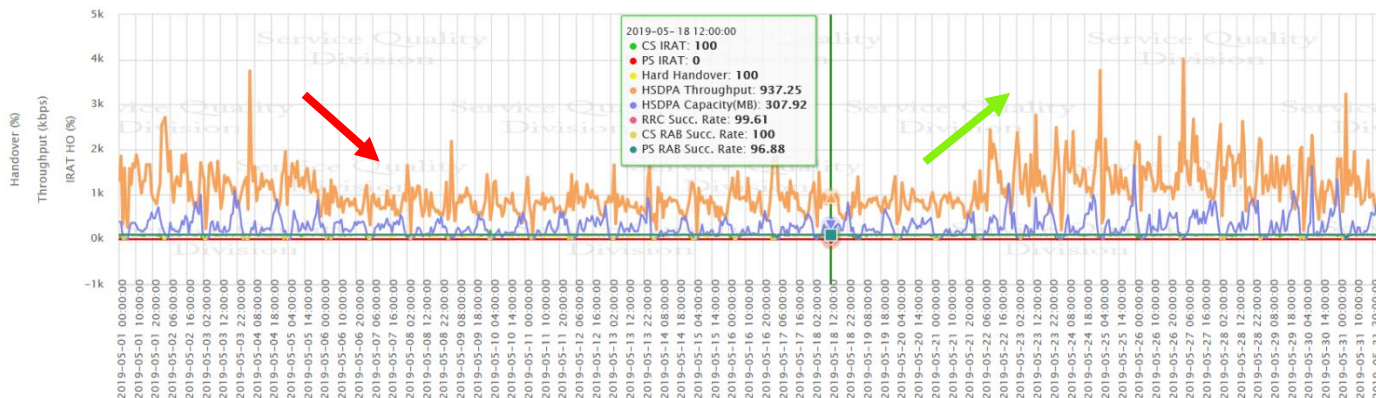


3G : Throughput + IRAT - (for the period 2019-05-01 to 2019-05-31)

Cell Name : ZKEL03M

CS IRAT PS IRAT Hard Handover HSDPA Throughput HSDPA Capacity(MB) RRC Succ. Rate CS RAB Succ. Rate PS RAB Succ. Rate

2019-05-18 12:00:00
 CS IRAT: 100
 PS IRAT: 0
 Hard Handover: 100
 HSDPA Throughput: 937.25
 HSDPA Capacity(MB): 307.92
 RRC Succ. Rate: 99.61
 CS RAB Succ. Rate: 100
 PS RAB Succ. Rate: 96.88

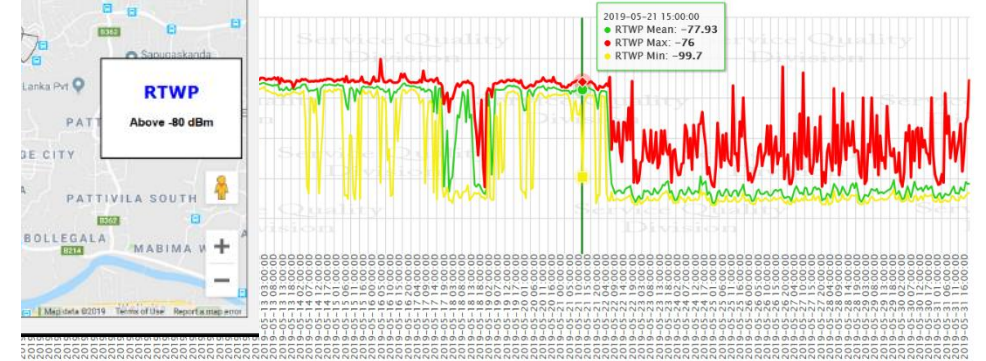


VP - (for the period 2019-05-01 to 2019-05-31)

Cell Name : ZKEL06K

RTWP Mean RTWP Max RTWP Min

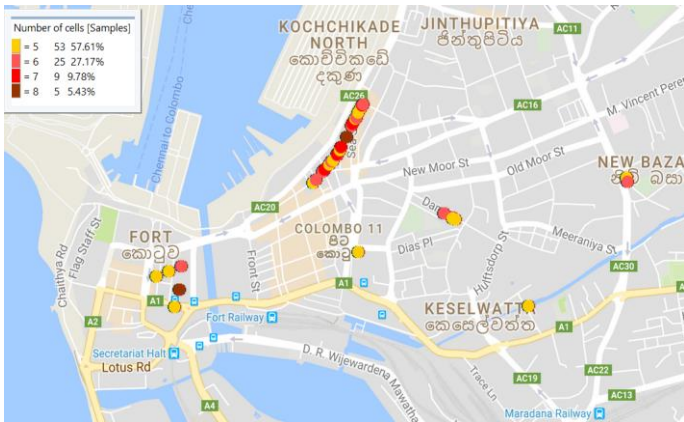
2019-05-21 15:00:00
 RTWP Mean: -77.93
 RTWP Max: -76
 RTWP Min: -99.7



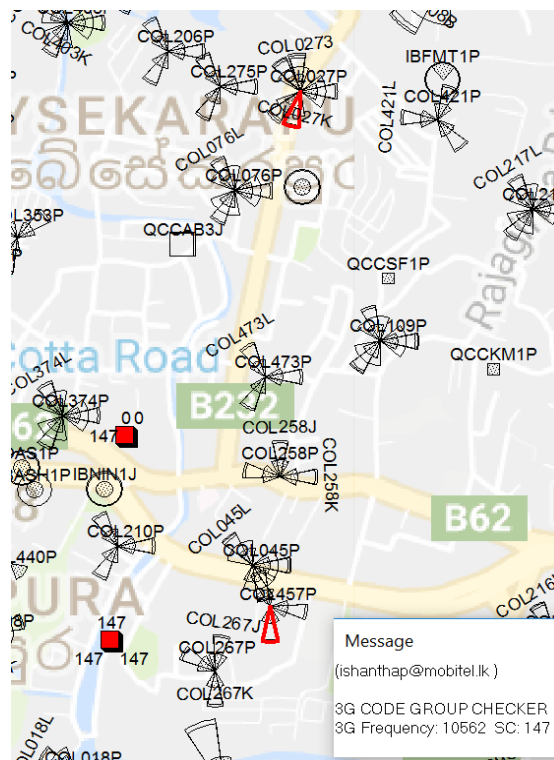
NETWORK SERVICE QUALITY AUDITING

Internal Network Interference

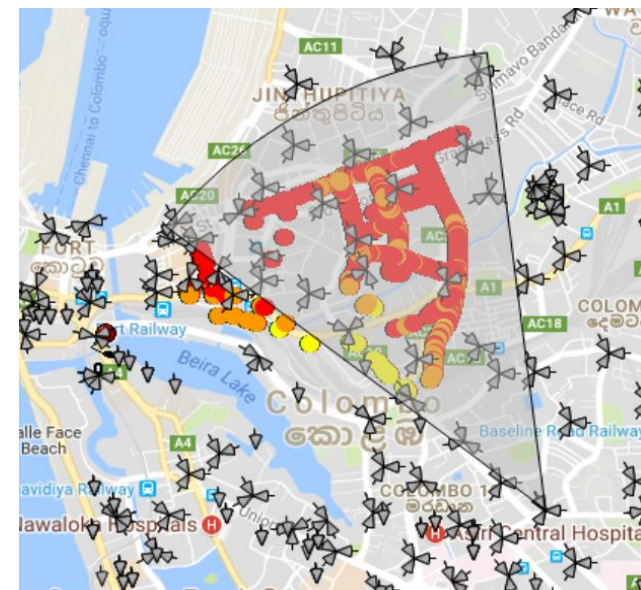
- Identification of internal interference sources
- Pollution was analyzed for pilot count of greater than 3 with a pilot level difference of -6 to -12dB of EcNo below and -95dBm of RSCP above the threshold
- Scrambling code analysis
- Cross feeder analysis



UARFCN 10587 is heavily affected with cells >5



COL027K and COL267K are configured in same scrambling code and clashing each other



Ch	Cell name	Cell ID	SC	In beam samples	Out of beam samples
10762	COL4240	9249	438	0	1325
10762	COL030N	5308	13	822	939
10762	COL002N	5028	61	205	241
10762	COL003O	5039	270	68	231
10762	COL104M	6047	68	364	220

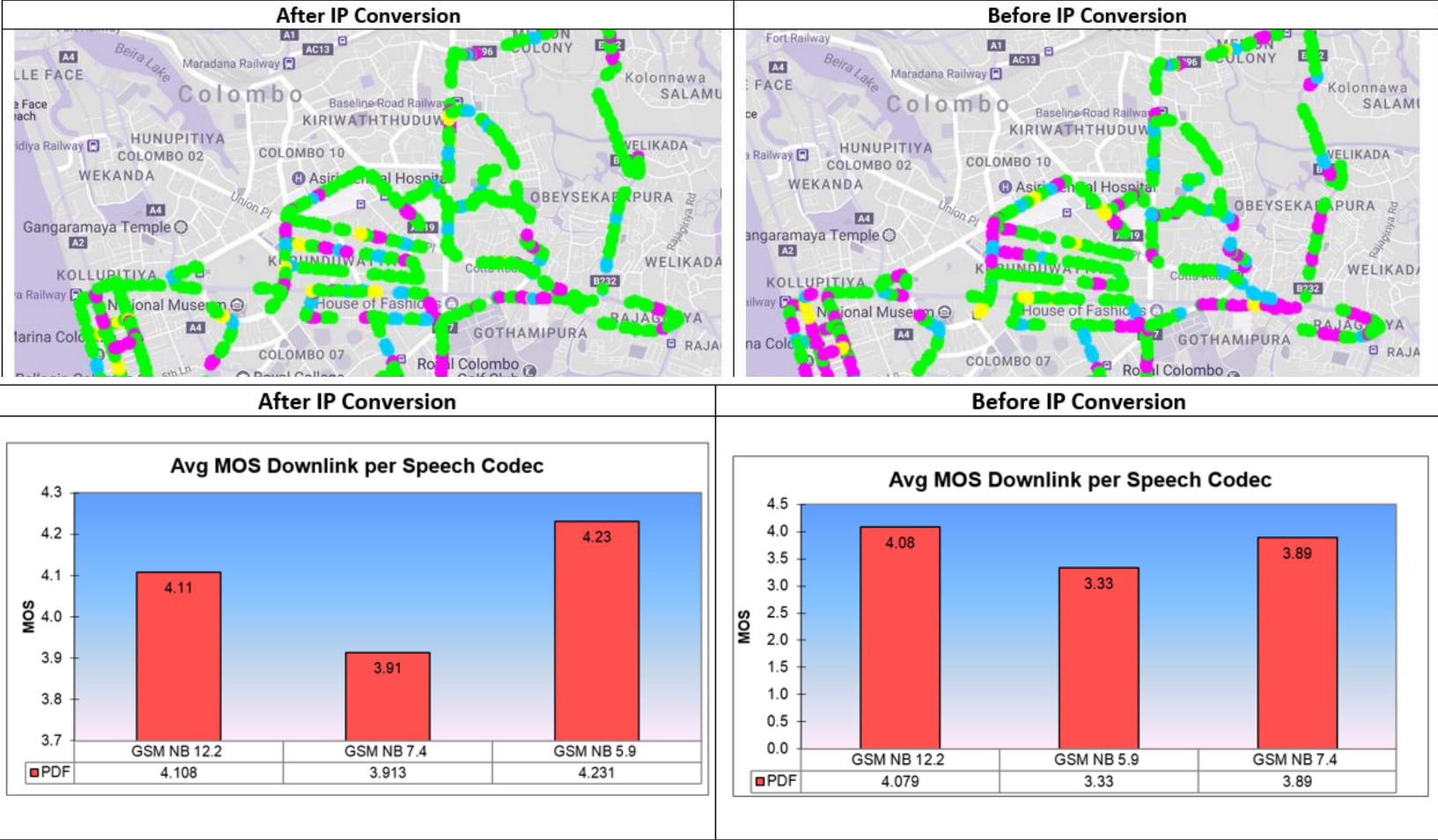
PSC 438 of COL4240 is overshooting to Colombo 11

IP BSC Conversion

- A-interface over IP
- Conversion of AoTDM to AoIP
- Voice Codec selection
- QoS Control
- Tested Scenarios:
 - M2M (2G-2G, 2G-3G)
 - M2F (2G-PSTN)

Findings:

- 2G – 2G Voice MOS improvement
 - Nearly 70% of voice samples were experiencing excellent voice quality with MOS > 4.0
 - Average MOS for NB 5.9 codec improved significantly



IP BSC Conversion...

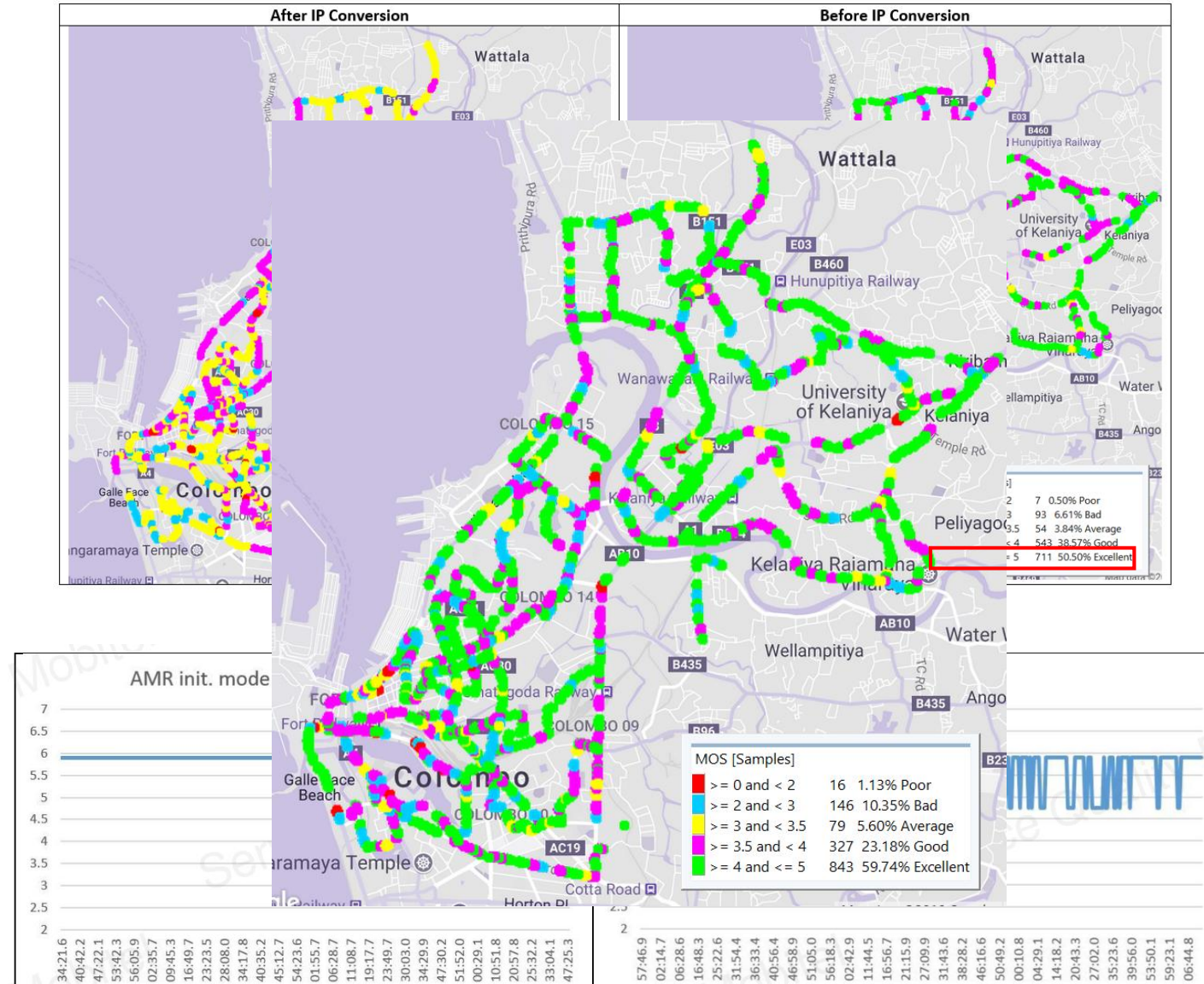
2G – 3G Voice MOS degradation

- Issue:
 - No excellent values of MOS > 4
- Initial Codec Negotiation
 - Previously all the initial voice samples started with NB 5.9
 - After the conversion majority of samples started from NB 4.75 codec.

• Solution :

- The rate-0 is not carried in the Assignment request
- Adding of AMR Codec in all RNC

2G – PSTN acceptable Voice MOS maintained



Long Distance Neighbor Cell Audit

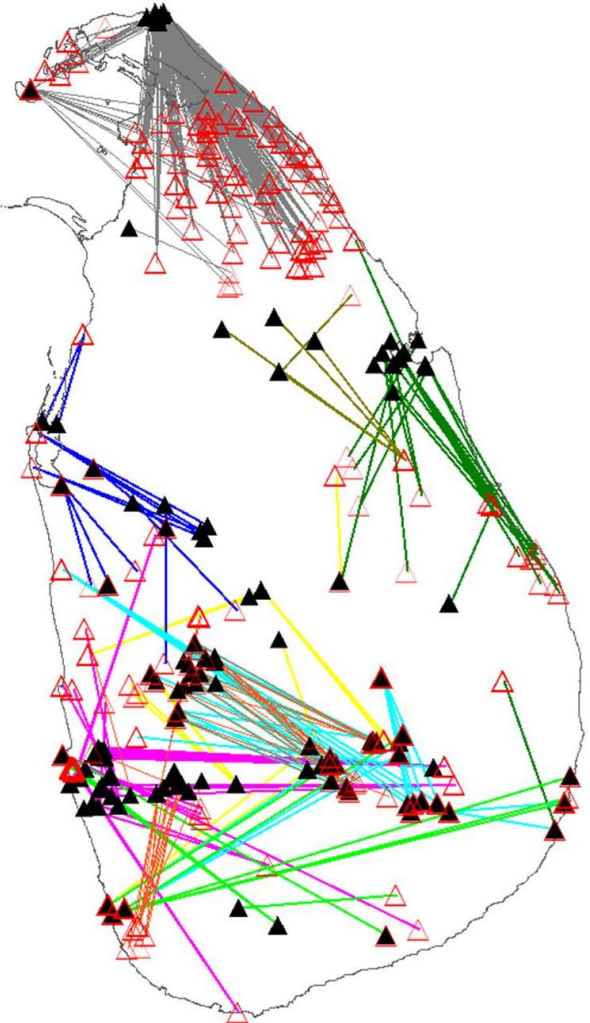
- Filtering neighbor relation cells > 20 km
- longest neighbor distance - 207 Km
- 1214 long distance neighbors removed from each NE

Cause:

- Due to Cell ID duplication
- Not using the CGI in creating the Handover Table

Impact:

- Customer impact minimum but nearest neighbors were missed



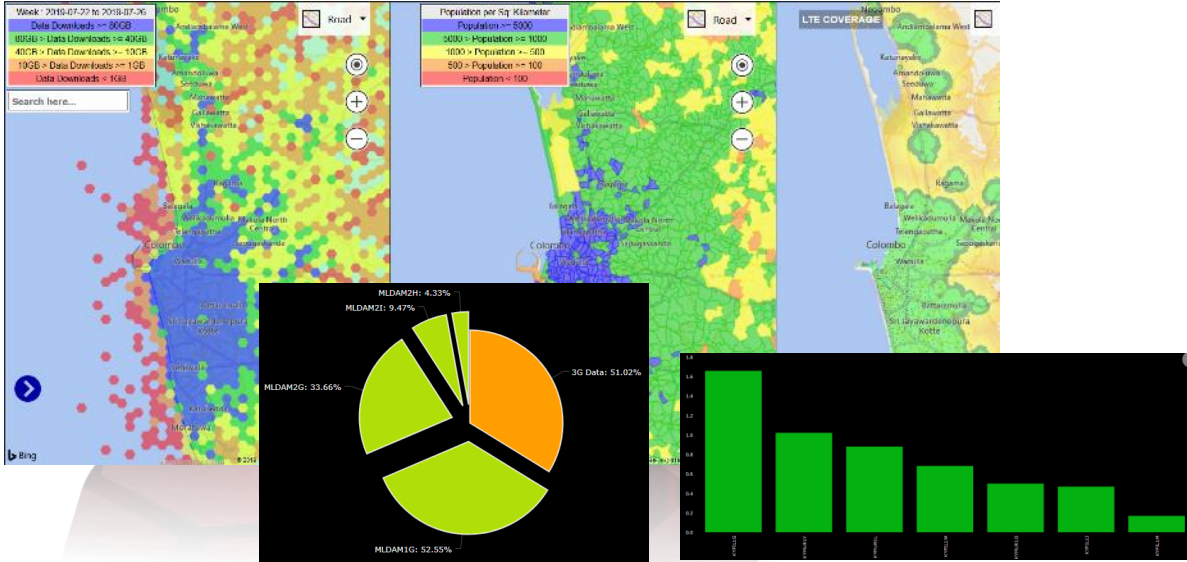
#	Source Cell	Target Cell	Distance (Km)
1	AMPOT1J	GLAHU2Q	207.17
2	AMPOT1P	GLAHU2Y	207.17
3	MOOKK1J	PTRAJ1P	191.62
4	MOOKK1Y	PTRAJ1Q	191.62
5	MOBUT11	PTRAJ1R	185.31
6	MOBUT3J	PTRAJ1P	183.1
7	MOPEL1J	PTRAJ1R	180.79
8	BDMAD1J	GLURA2A	141.14
9	BDGER1J	GLURA2A	138.05
10	BDPAS2J	GLURA2B	135.76
11	BDPAS2W	GLURA2B	135.76
12	MONAK1J	ZDOM08B	129.35
13	KGAMI2A	ZDOM04X	122.55
14	KGAMI2C	ZDOM08B	121.13
15	KGAMI2C	GMBGK1A	120.12
16	KGAMI2A	GMAMI1A	118.09
17	KGGON1F	KGAMI1A	117.36

NETWORK DATA ANALYTICS

Network Data Analytic Tools

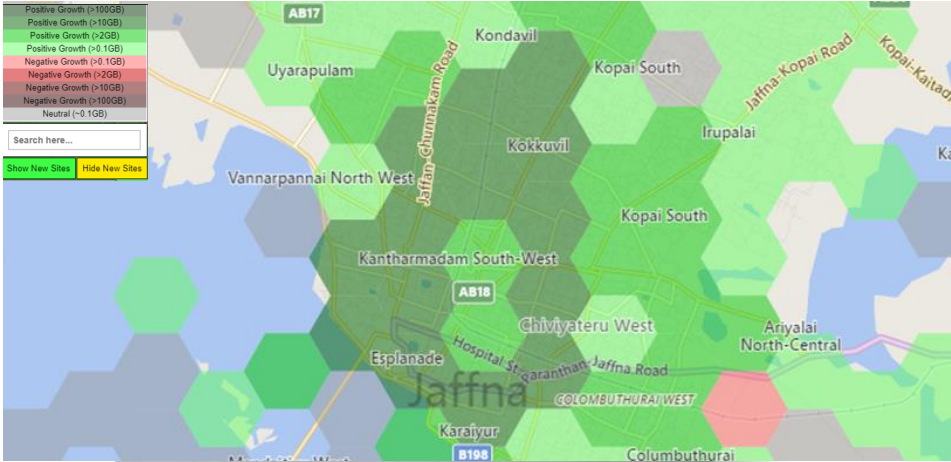
MTD – Mobitel Traffic Distribution viewer

- Distribution of Voice & Data traffic into 1Km² BINs
- Correlation with population density
- Identification of best/worst performing GNDs
- Bin-wise serving technology and cell details



MTG – Mobitel Traffic Growth viewer

- Distribution of Voice & Data traffic growth into BINs
- Analysis of traffic growth with reference to a selected week
- Serving cell patterns and cell wise traffic growth



Data Traffic Growth in 3D

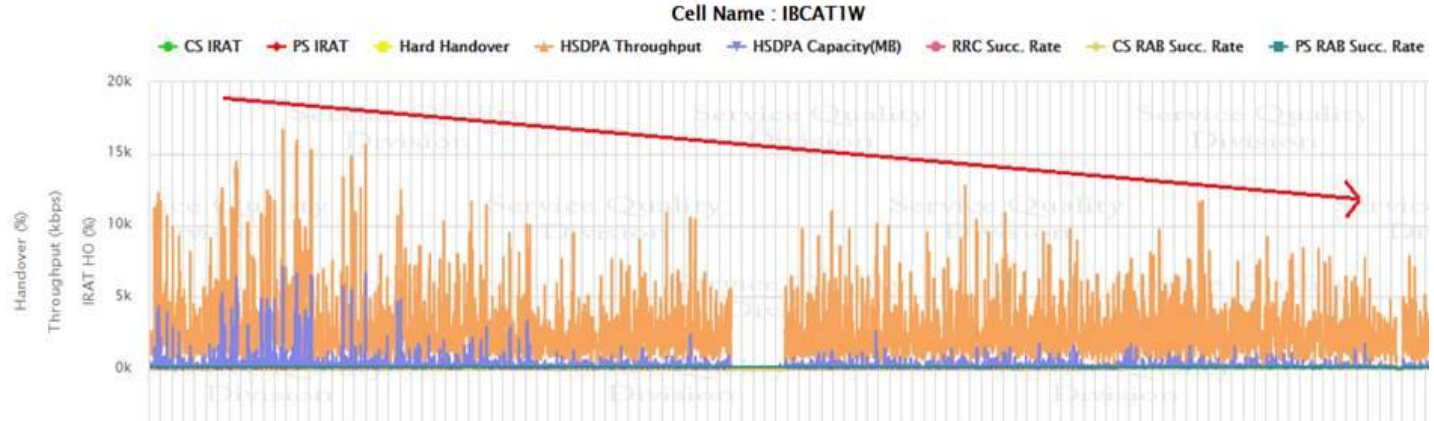
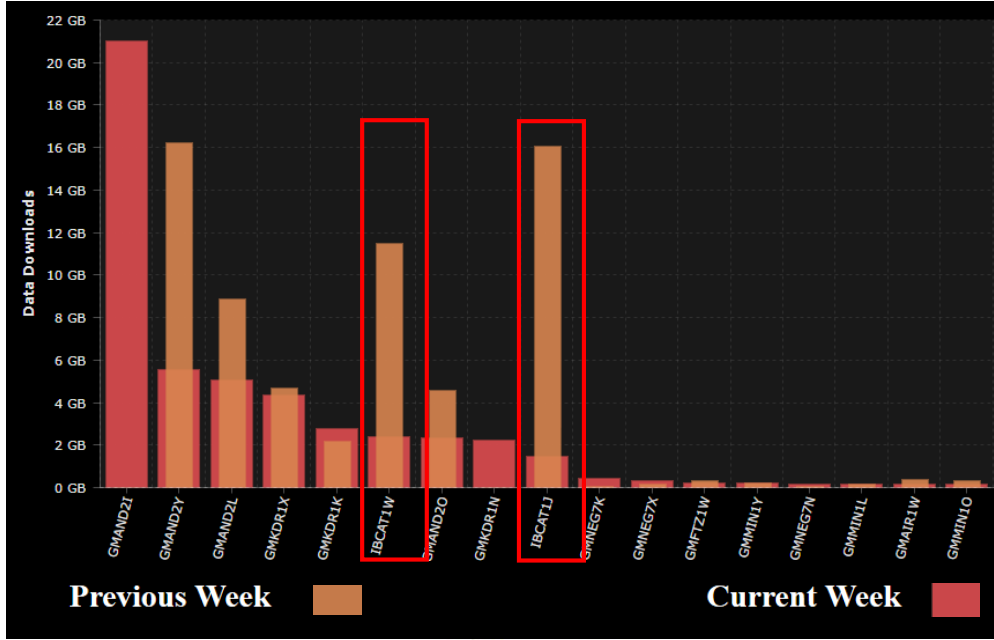
- Network data traffic extracted from Mobitel Traffic Distribution(MTD) viewer
- Real time 3D map with high traffic growth regions
- Drilled down to ZIP levels and District Secretariat Division (DSD) levels
- Colombo District : The highest data growth
- Kaduwela DSD : The highest growth among all island DSD's
- Sales and marketing insights
- Improve customer data penetration
- Engineering assist in capacity and coverage planning



Data Reduction in Customer In-Building

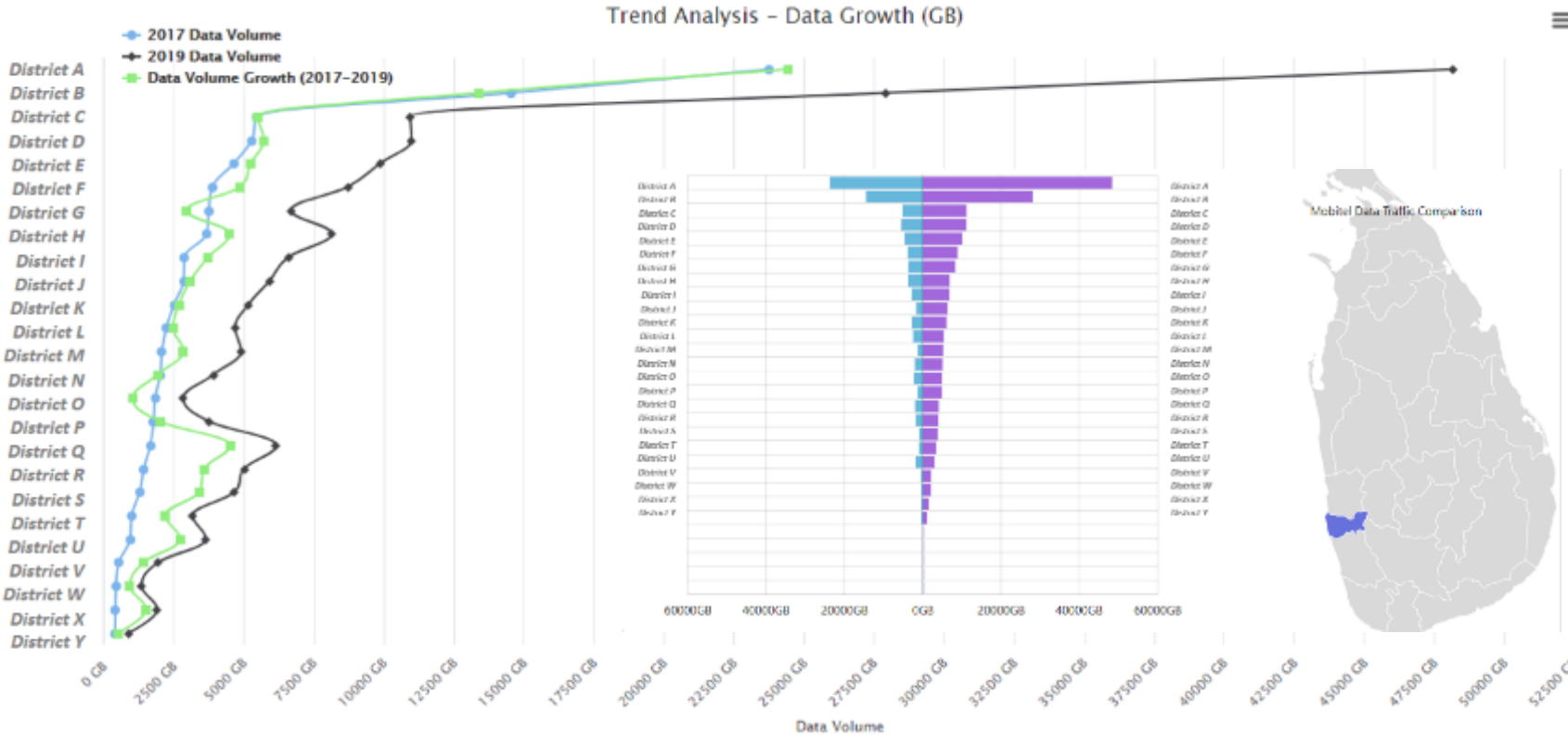


- Dark red BIN : Negative Traffic growth
- Addition of 21GB daily from a 2.4km LTE cell
- IBS configured only with 3G and No LTE.
- 3G IBS traffic reduction with increased LTE traffic
- Low data speed experiencing inside IBS



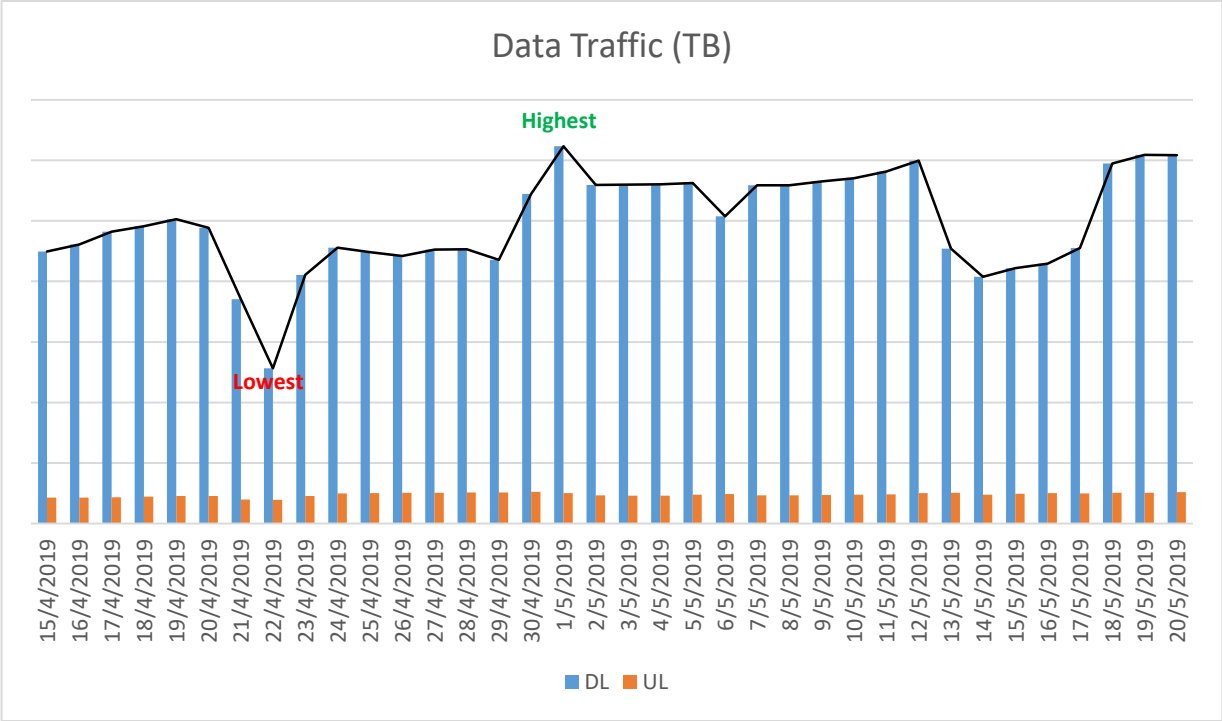
Data Traffic Growth Analysis

- Completion of Island wide LTE Expansion project
- Comparison of Data Traffic growth for two years
- Analysis for Districts and DSDs
- Identification of strong and weak areas
- Insights for Sales & Marketing promotions
- Capacity and bandwidth increment
- LTE device penetration



Data Traffic Demand Pattern

- Aftermath of Easter attack (21/04/2019)
- Social media ban lift – highest data download per day



BENCHMARKING & DRIVE TESTING

Web Page Loading

- Web browsing : Plays important QoE in MBB
- Benchmark of Webpage Loading Time
- Testing of popular websites
- Dynamic content changes
- Accuracy of test results

Suggestion:

A Sample Webpage for Objective testing hosted in different geographical locations, to be introduced

Parameters:

- Web Page loading time
- Downlink/uplink bandwidth
- RTT
- Device dependency
- A Web Page MOS

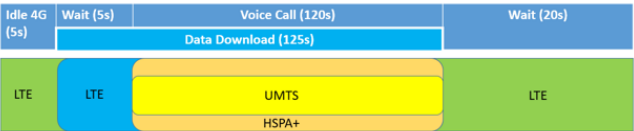


Web Site / Loading Time (s)	Walawa Girls Hostel					Social Canteen				
	Mobitel	Opr2	Opr3	Opr4	Opr5	Mobitel	Opr2	Opr3	Opr4	Opr5
www.hirufm.lk	34.6	22.8	23.5	82.9	121.8	36.8	44.0	28.1	77.7	139.9
www.ananmanan.lk	12.8	11.3	9.7	75.8	44.1	12.0	10.5	7.9	35.0	41.7
www.ikman.lk	6.9	3.1	2.6	10.8	11.0	7.2	2.9	2.7	9.3	5.3
www.kaymu.lk	7.5	3.3	5.3	24.3	18.2	6.8	6.2	5.7	15.1	14.1
www.mobitel.lk	11.5	7.1	9.0	50.2	16.0	24.3	9.6	15.7	39.8	22.2

Server Location	DNS Host Resolution Latency (milliseconds)					Average Webpage Download Time (seconds)				
	Mobitel	Operator2	Operator3	Operator4	Operator5	Mobitel	Operator2	Operator3	Operator4	Operator5
USA	8.0	29.0	127.9	8.2	2.6	12.5	8.5	36.9	17.3	40.8
Europe	17.4	29.4	2080.4	7.9	17.2	8.4	7.2	42.5	12.4	30.0
Asia	8.1	49.2	427.4	17.2	20.4	7.5	5.0	24.9	5.2	48.2

Data Experience with Continuing Voice

- Receiving or making a CS call with background data
- Data disconnection
- Reduction of data speed

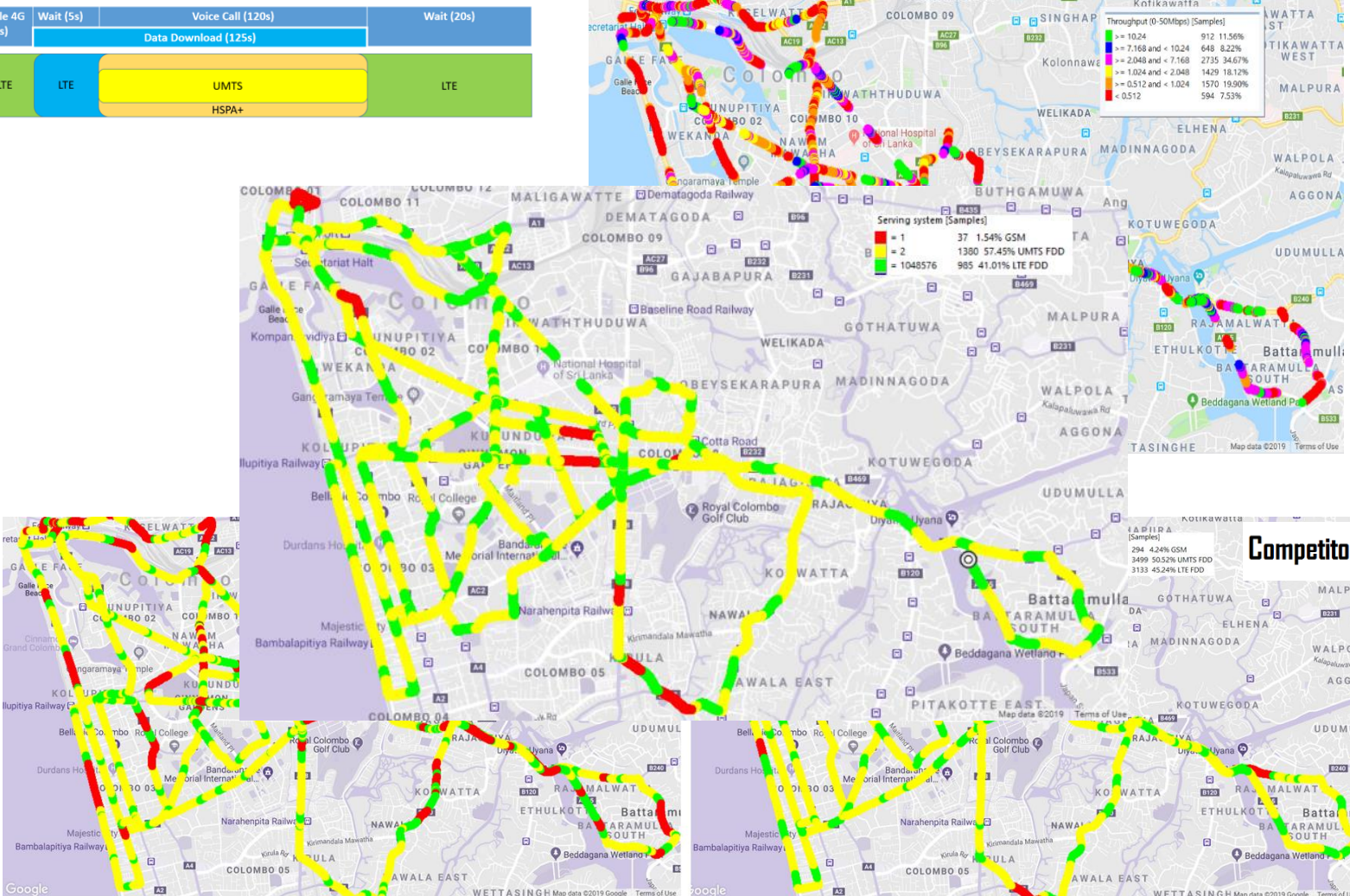


Cause

- Multi RAB scenario
- CSFB to direct 2G
- 3G to 2G handover
- Data disconnection in 2G

Rectification

- I-RAT handover audit
- Activation of Voice Service Optimization for Multi RAB Feature

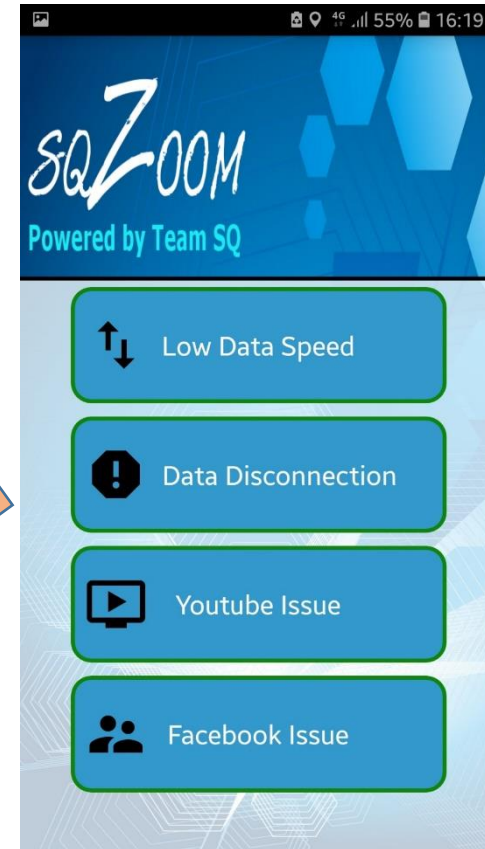
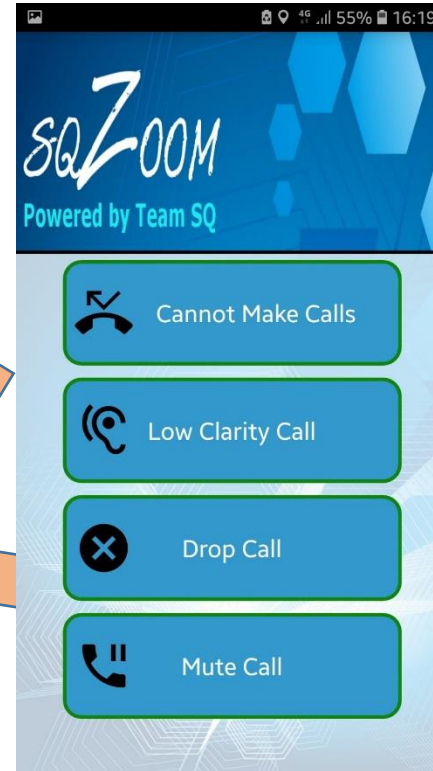
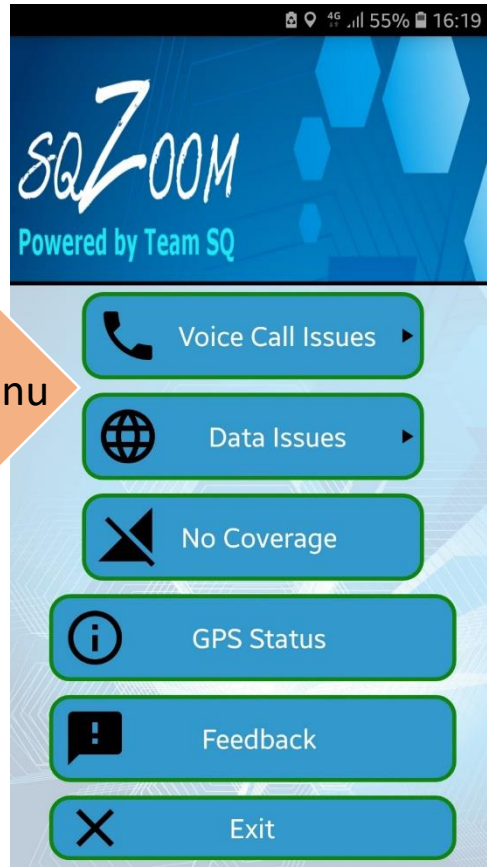


SQ Zoom Mobile App

Android application developed to collect service quality related voice and broadband issues as well as no coverage issues using end users' location data

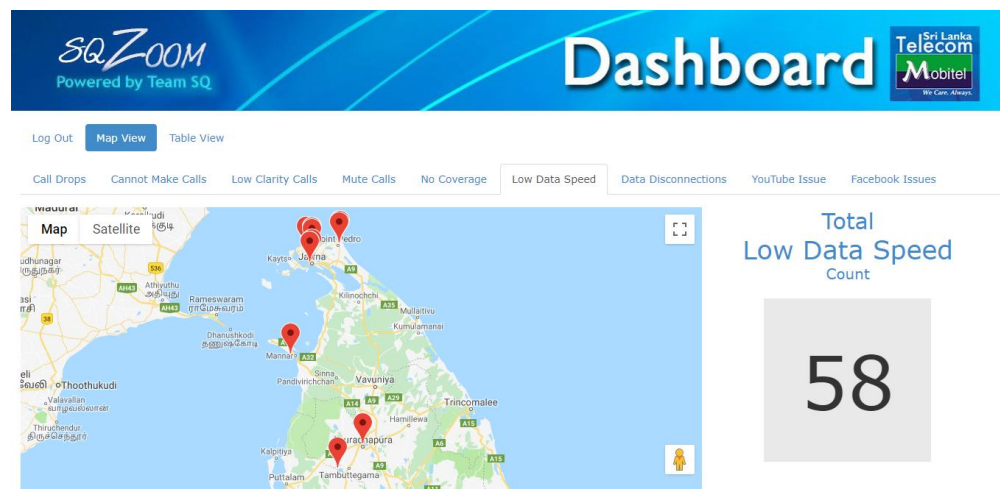


Main Menu



SQ Zoom Mobile App

GUI to monitor and rectify collected end user issues

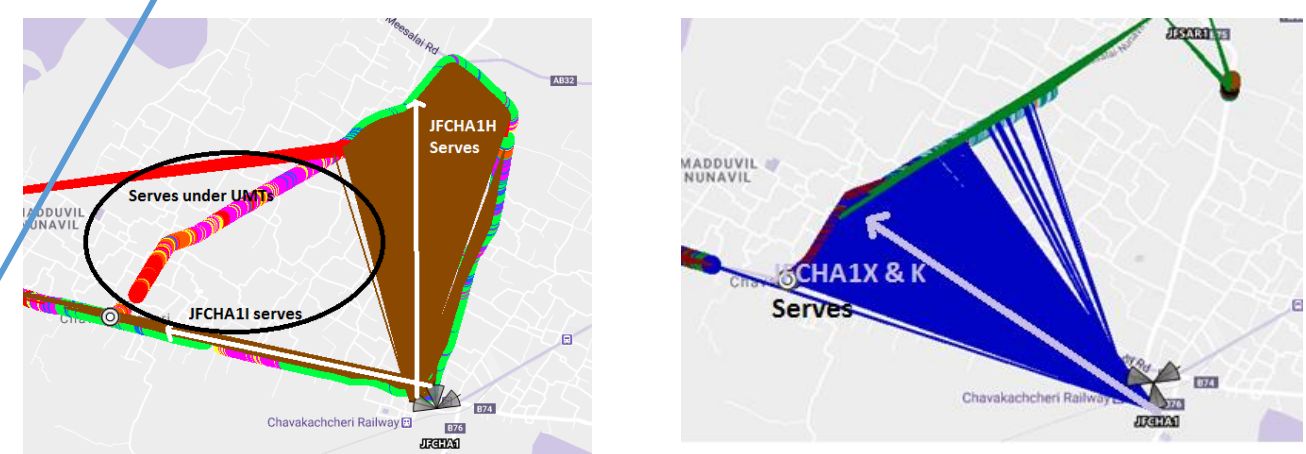
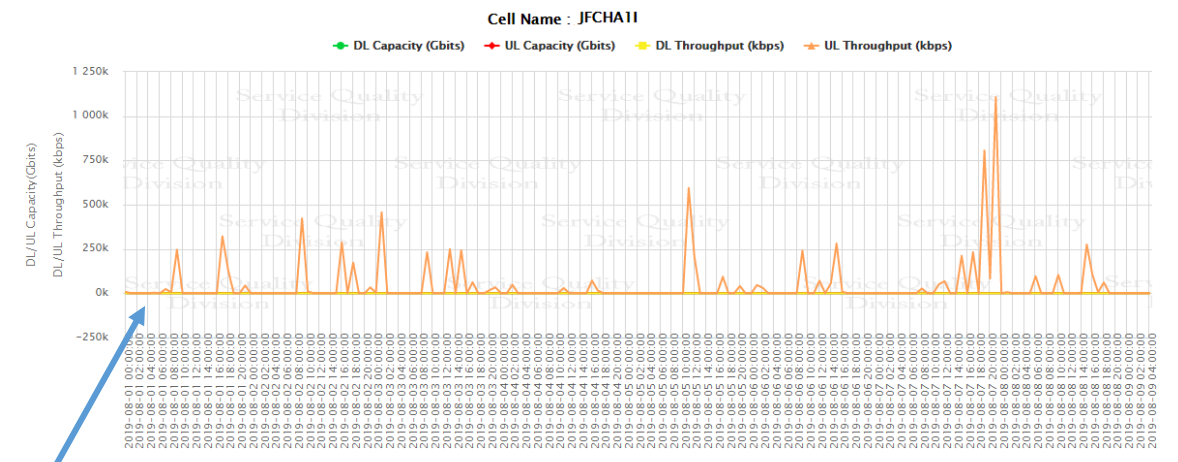


SQ ZOOM Dashboard
 Powered by Team SQ

Log Out | Map View | Table View | Download table as CSV

ID	Fault	Latitude	Longitude	IMEI	IMSI	Network	Cell ID	LAC	PSC	PCI	Signal Strength	BER	TA	TAC	Date & Time	Comment
1084	Drop Call	8.9769	79.914	864180043996014	41301262066322	LTE	878584	40823	-1	353	0	-1	0	40823	2019-07-23 15:05:25	
1081	Drop Call	8.97825	79.9186	864180043996014	41301262066322	HSPA+	576489	30820	0		0	-1	0	0	2019-07-22 12:18:25	
1078	Mute Call	8.97819	79.9178	864180043996014	41301262066322	HSPA+	588753	30820	0		0	-1	0	0	2019-07-17 14:07:46	
1074	Drop Call	8.98329	79.9126	864180043996014	41301262066322	EDGE	34706	62830	-1		-249	-1	0	0	2019-07-15 14:26:31	
1075	Mute Call	8.98329	79.9126	864180043996014	41301262066322	EDGE	34706	62830	-1		0	-1	0	0	2019-07-15 14:26:27	
1071	Drop Call	8.98327	79.913	864180043996014	41301262066322	LTE	888322	40823	-1	203	0	-1	0	40823	2019-07-11 17:43:55	
1070	Drop Call	8.92133	79.8812	357056090033227	413016688065525	LTE	936961	43763	-1	229	0	-1	0	43763	2019-07-08 18:09:18	Wellkada Eng
1067	Low Data Speed	9.81952	80.2318	356646101417657	413011620001107	HSPA+	379806	30540	0		0	-1	0	0	2019-07-07 13:16:50	
1066	Drop Call	9.67727	80.0139	357224078434440	413011688004389	LTE	879105	40543	-1	498	0	-1	0	40543	2019-07-06 12:03:15	Jaffna Hindu College Junction
1065	Low Data Speed	8.15315	80.2206	867245031825824	413010688103688	EDGE	10242	62840	-1	0	0	-1	0	0	2019-07-03 15:41:29	
1064	Low Data Speed	9.78061	79.9882	867419030313989	413016688003540	UMTS	382014	30540	0		0	-1	0	0	2019-07-03 10:18:48	Iivatal
1061	Drop Call	8.94556	79.9668	864180043996014	41301262066322	LTE	888320	40823	-1	201	0	-1	0	40823	2019-07-02 19:17:50	

Issue Rectification process



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