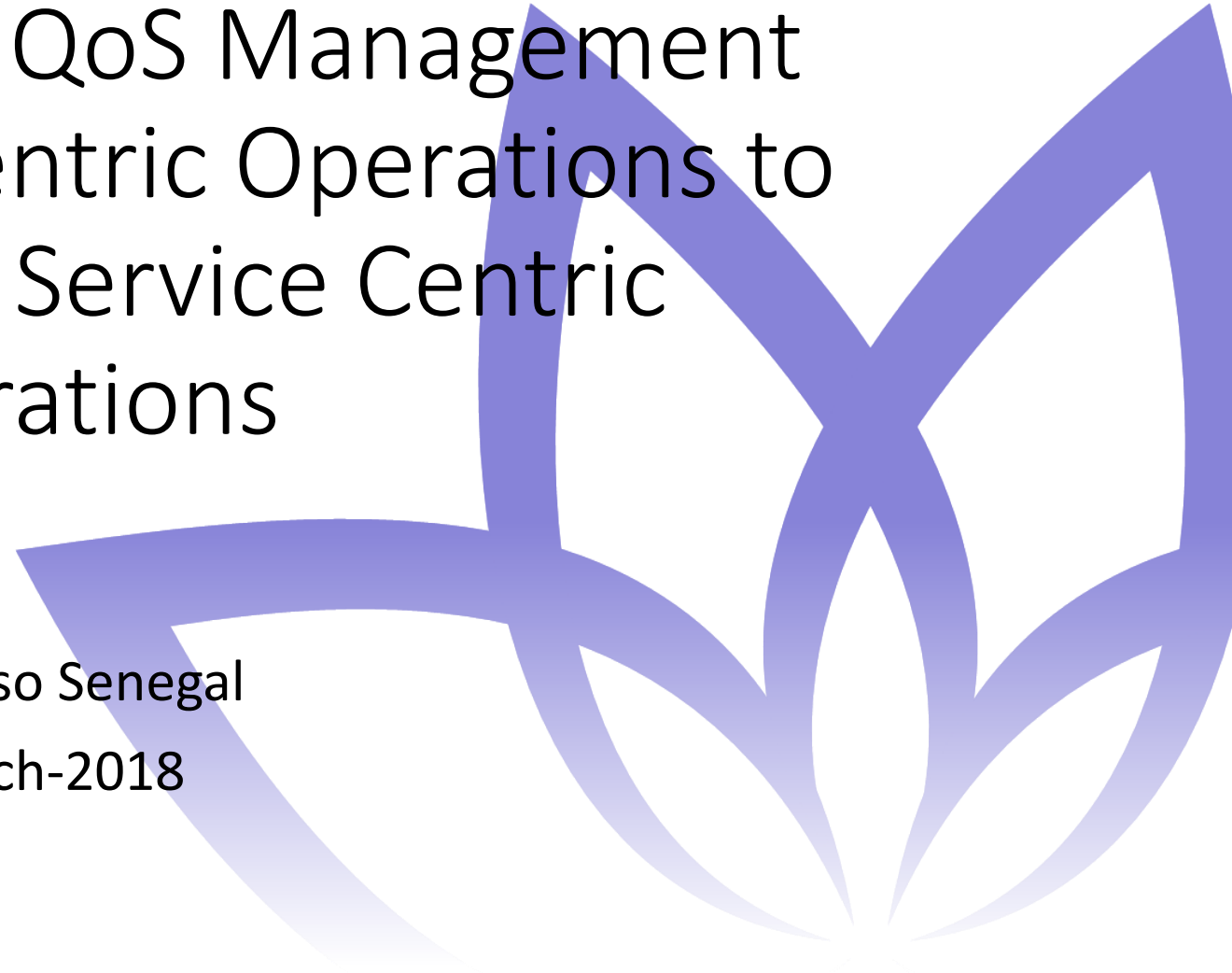




Mobile Network QoS Management From Network Centric Operations to Experience & Service Centric Operations

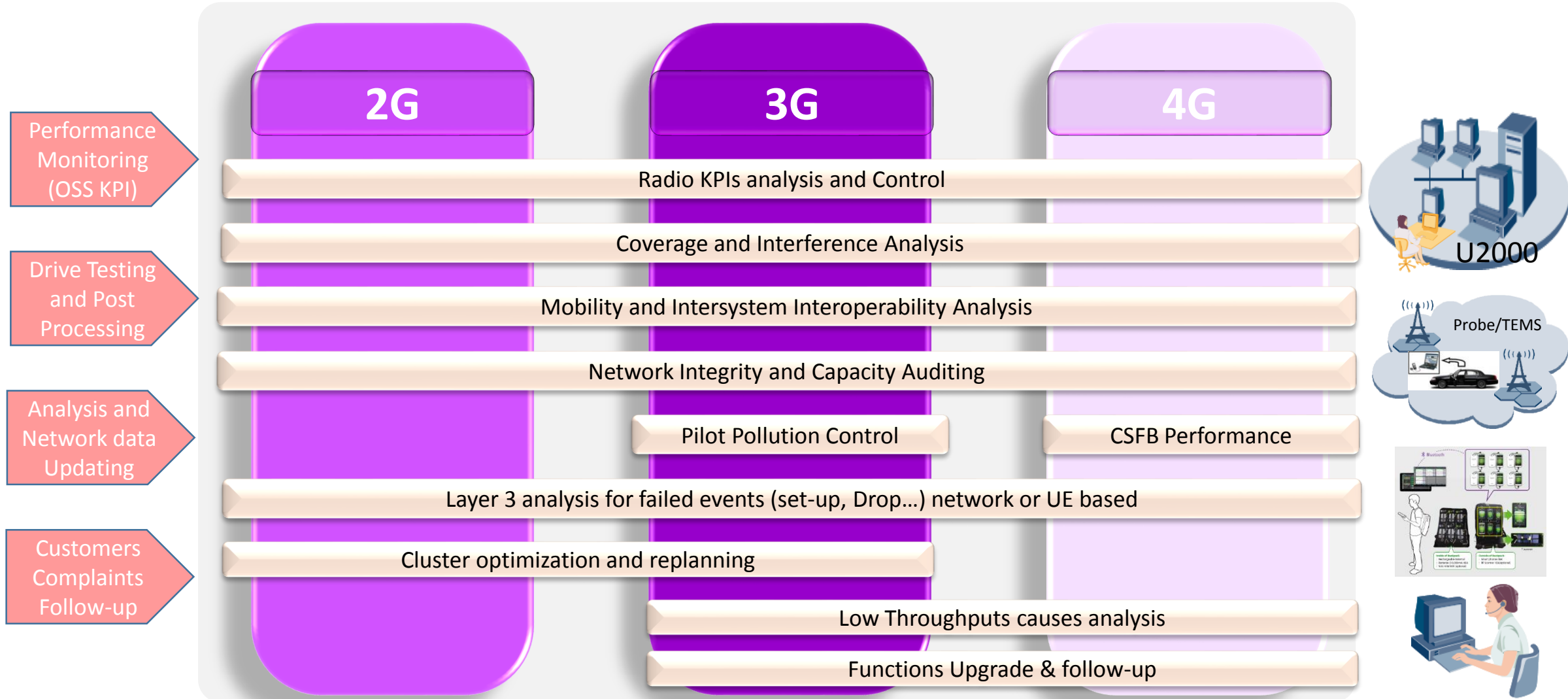
Expresso Senegal
March-2018



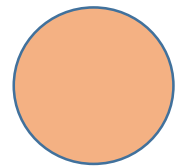
Introduction: Quality of Services Challenges for Operators

- Maximize the utilization of offered services.
- Increase the revenues.
- Stay better than competitors.
- Develop and experience new scalable services.
- Optimize the network performance.
- Ensure and improve the Return On Investment (ROI).

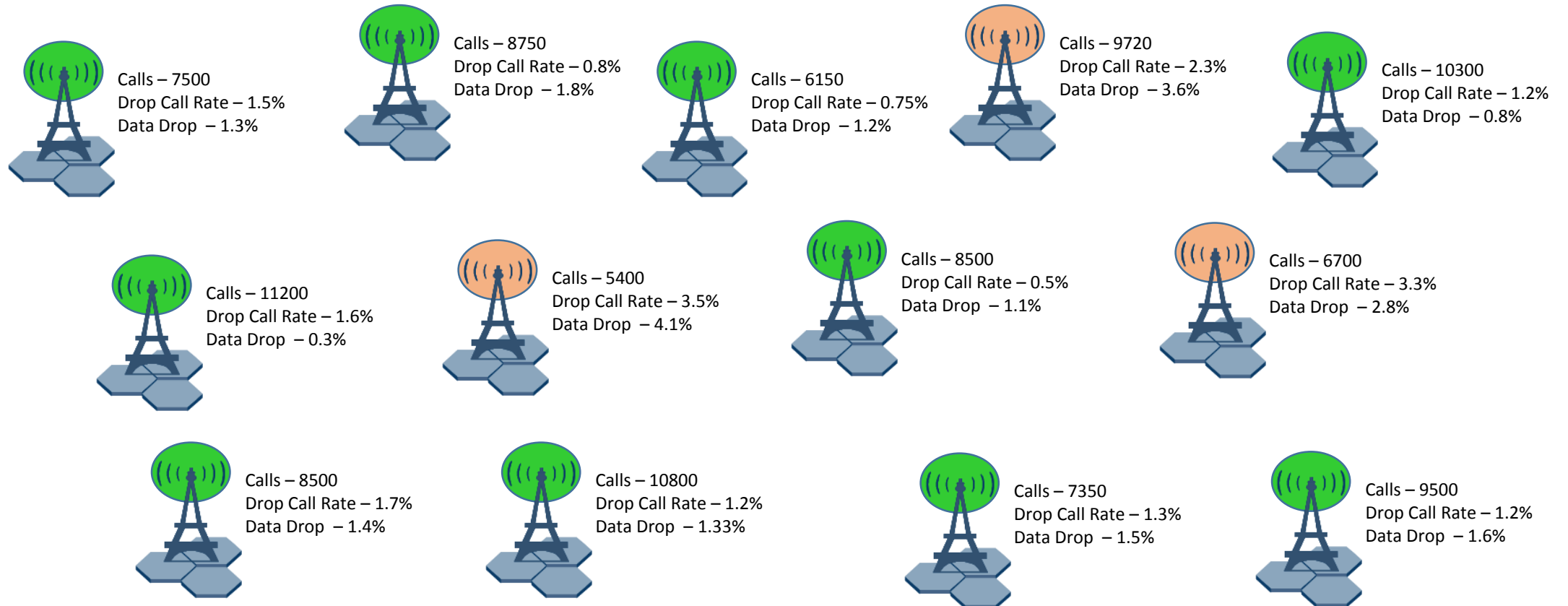
Traditional QoS Management: Network centric Operations



Performance Monitoring and root cause follow-up: KPI based

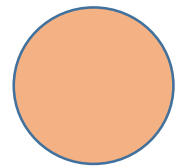


Focus of
Network
Engineer

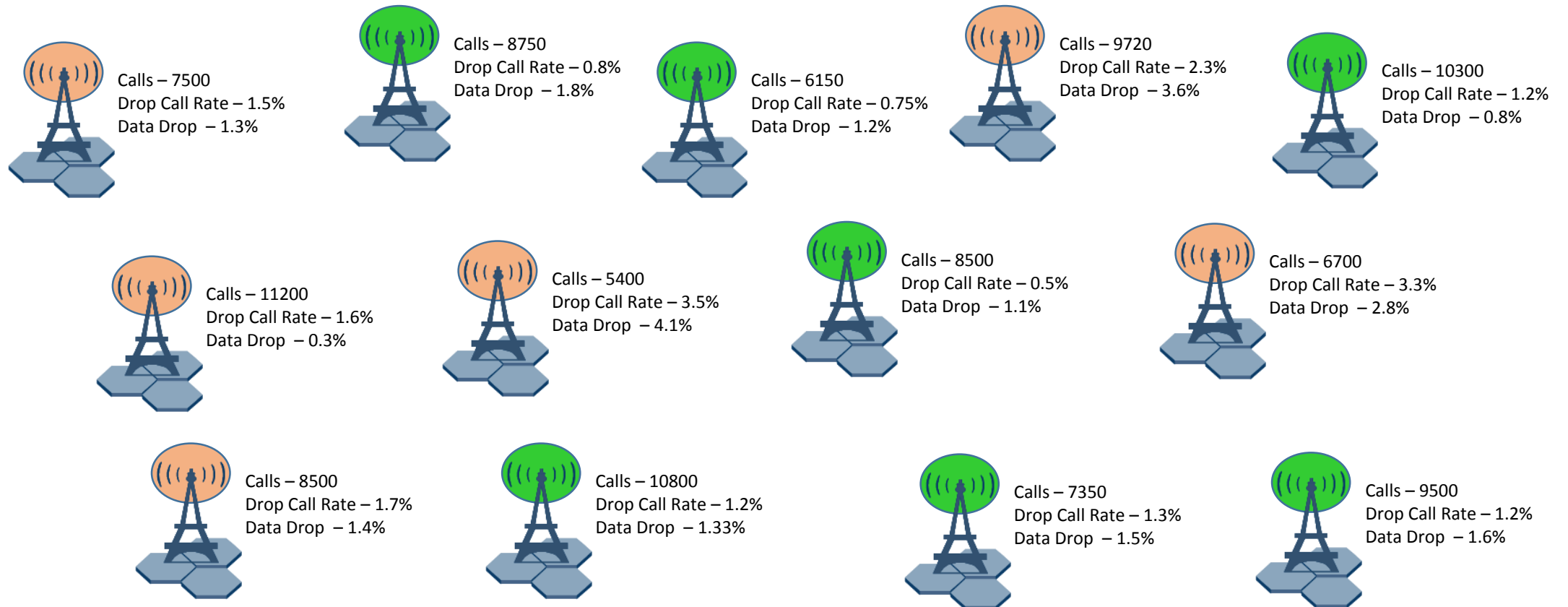


> 2% Drop Threshold
Set by SLA

PM and root cause follow-up: Enhanced KPI based, TopN



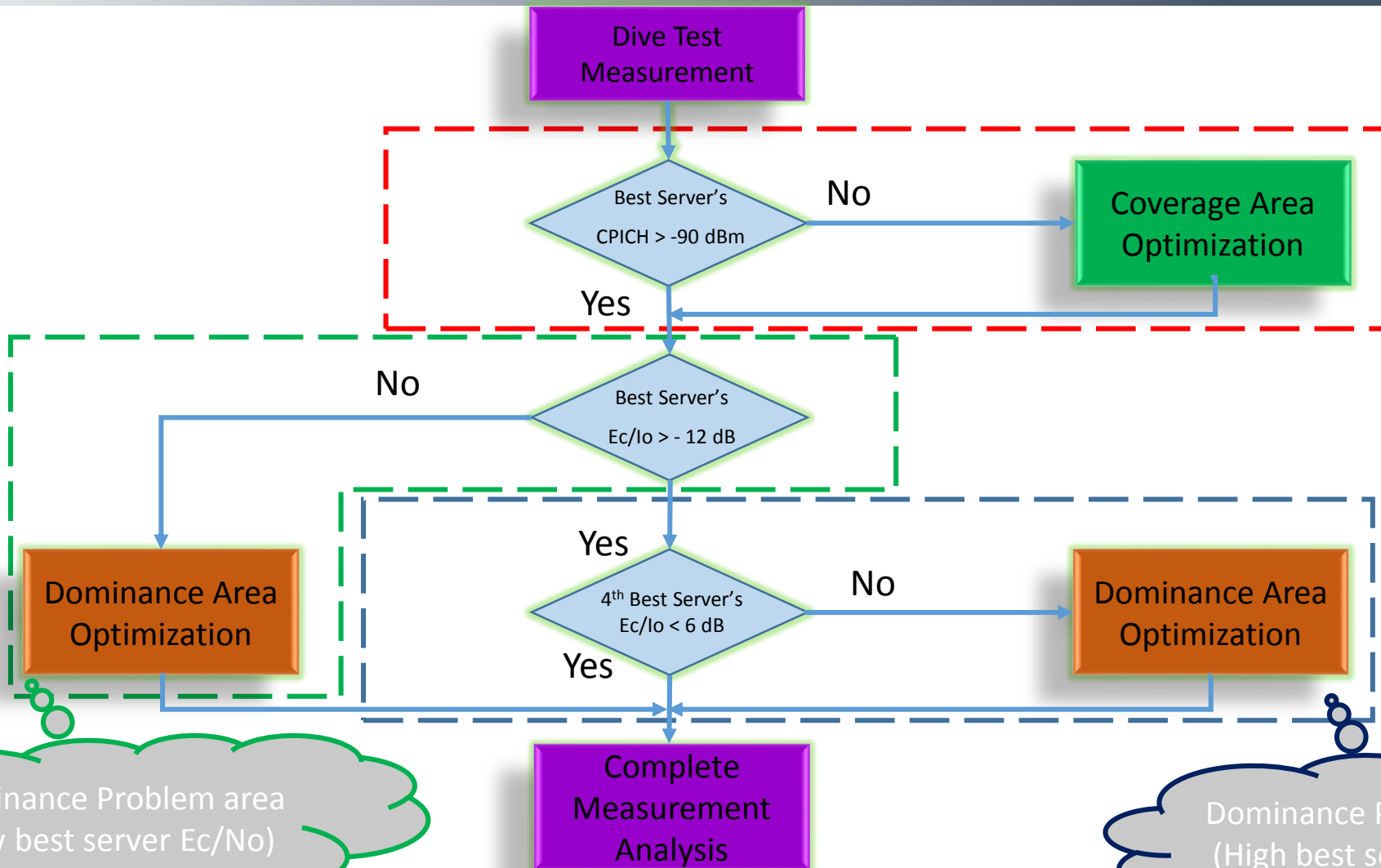
Focus of Network Engineer



TopN

TopN Cells/sites with Highest CDR

Drive Testing and Post Processing: Coverage Issue in 3G

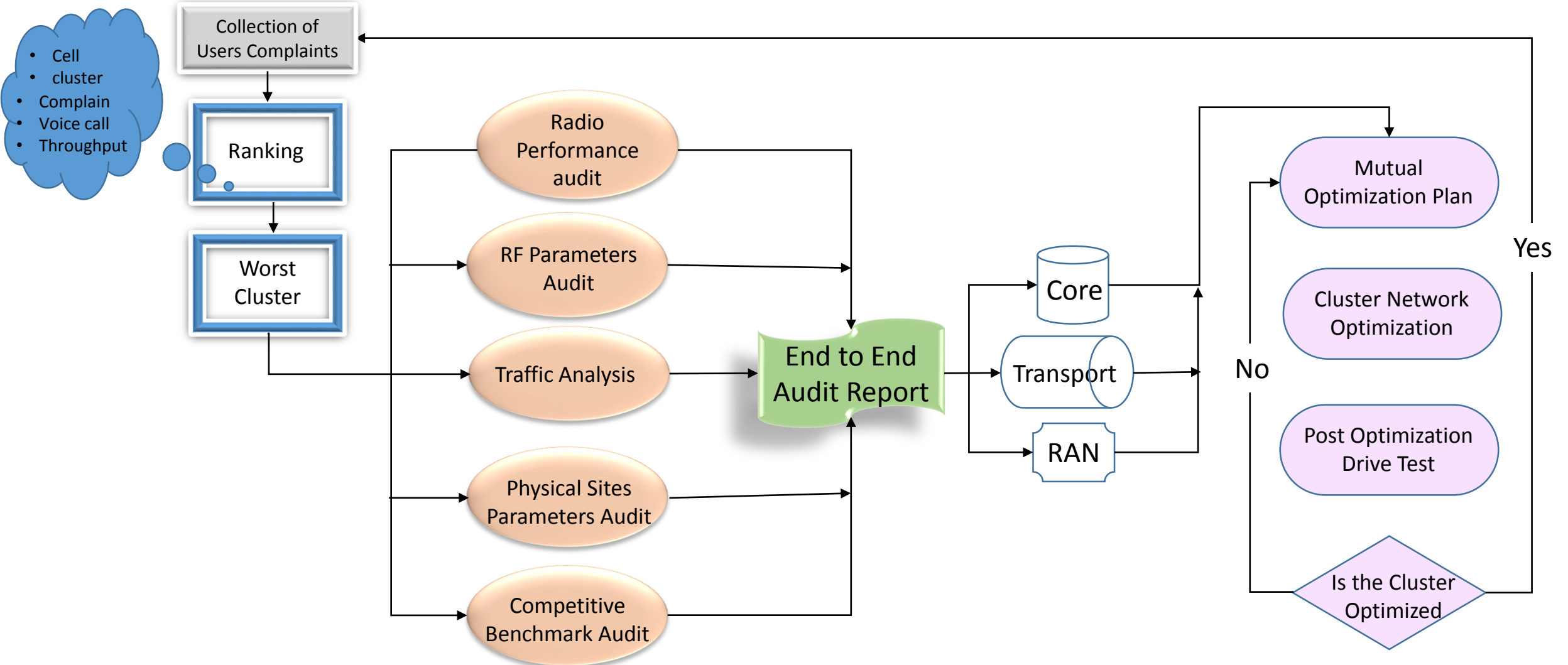


- ❖ Antenna Tilting/ High change
- ❖ Pilot Power increase
- ❖ Hardware Change
- ❖ Missing Neighbors analysis
- ❖ Pilot power of Neighbors analysis

Dominance Problem area
(Low best server Ec/No)

Dominance Problem area
(High best server Ec/No)

Analysis and Change Implementations

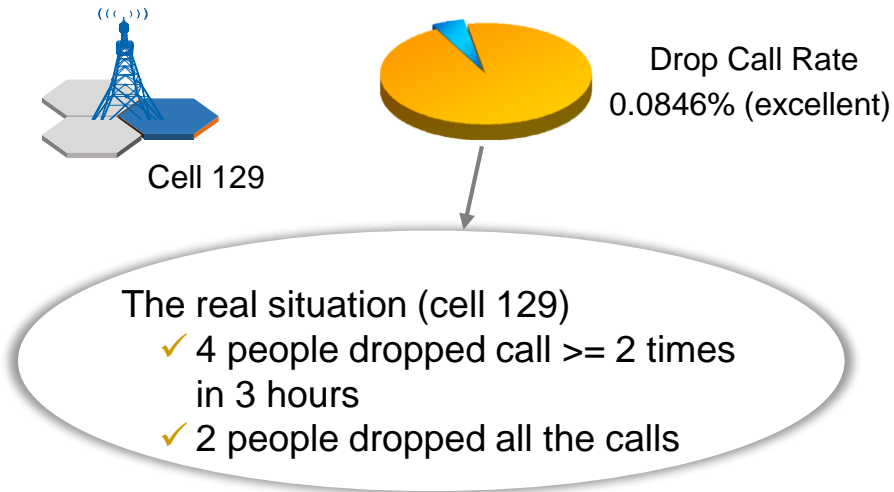


Enhanced QoS Management: Experience & Service Centric Operations

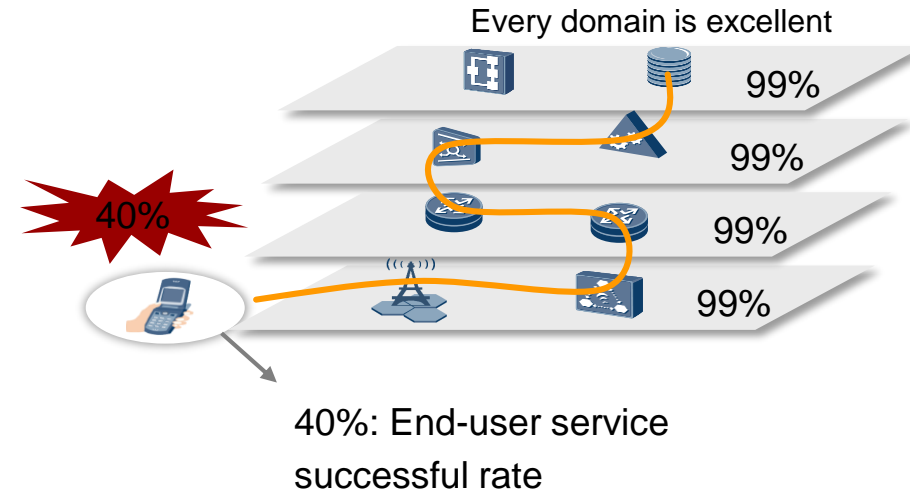
With the development of mobile networks, customer needs and behaviors have changed. Mobile communications means so much more than simple voice communication; there is now mobile Internet with web surfing, video phone, streaming media, and microblogging. Focusing on traditional KPIs only are no longer adequate for measuring the quality of mobile services. The objective of network optimization has gradually shifted from enhancing network performance to improving quality of experience (QoE). Therefore, assessing and optimizing QoE is the trend for optimizing today mobile networks.

Traditional Evaluation Method KPI ≠ End-users' Experience

■ Individual user experience is flooded in average KPI



■ Element KPI ≠ E2E service success rate



■ Lack of subjective service quality monitoring

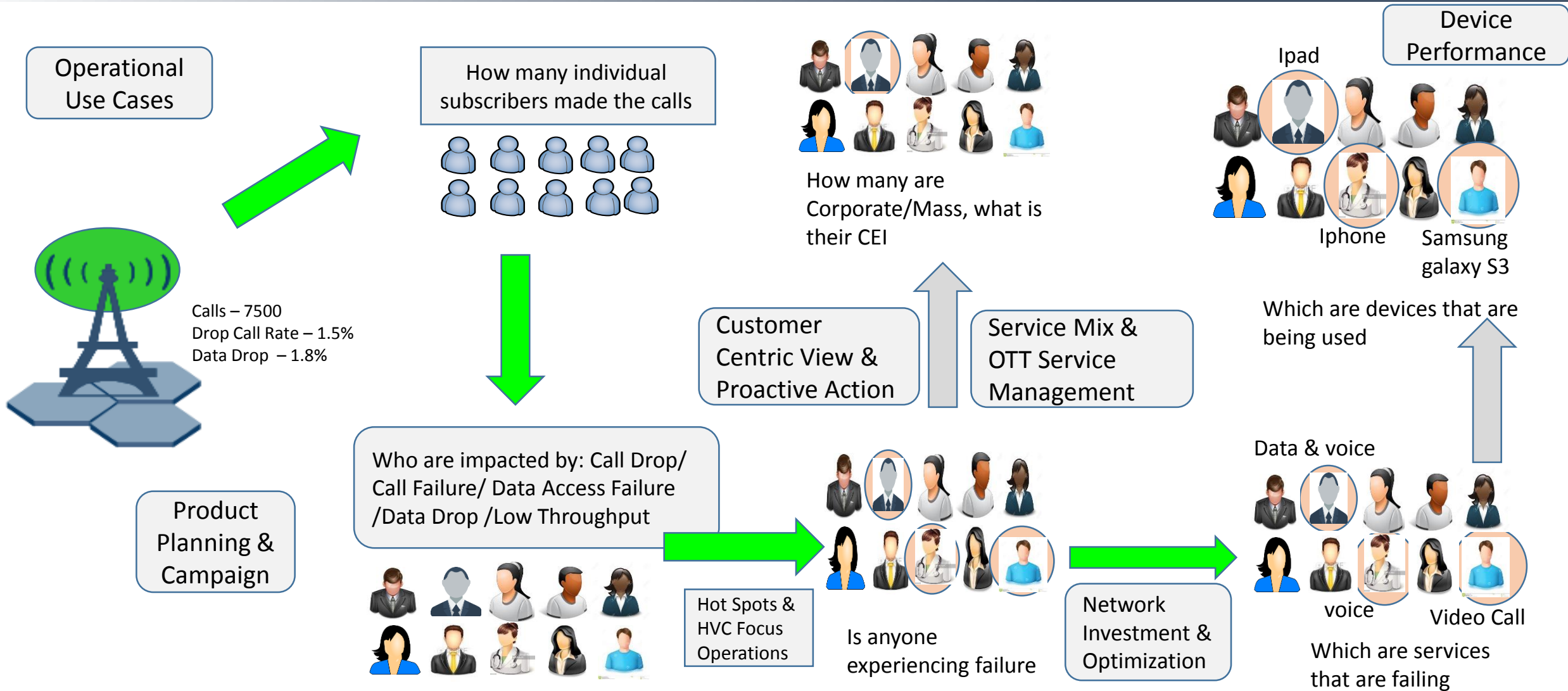
e.g. MOS(DT test) can evaluate end user's accurate experience directly, but just sample measurement. Many user's may have bad experience, such as noise, echo...still out of monitoring.

KPI	Value	Compliants	Example Times (GSM /a month)
MOS (DT test)	3.6 (Excellent)	Vague audio	288
		One-way audio/noise/echo/...	412

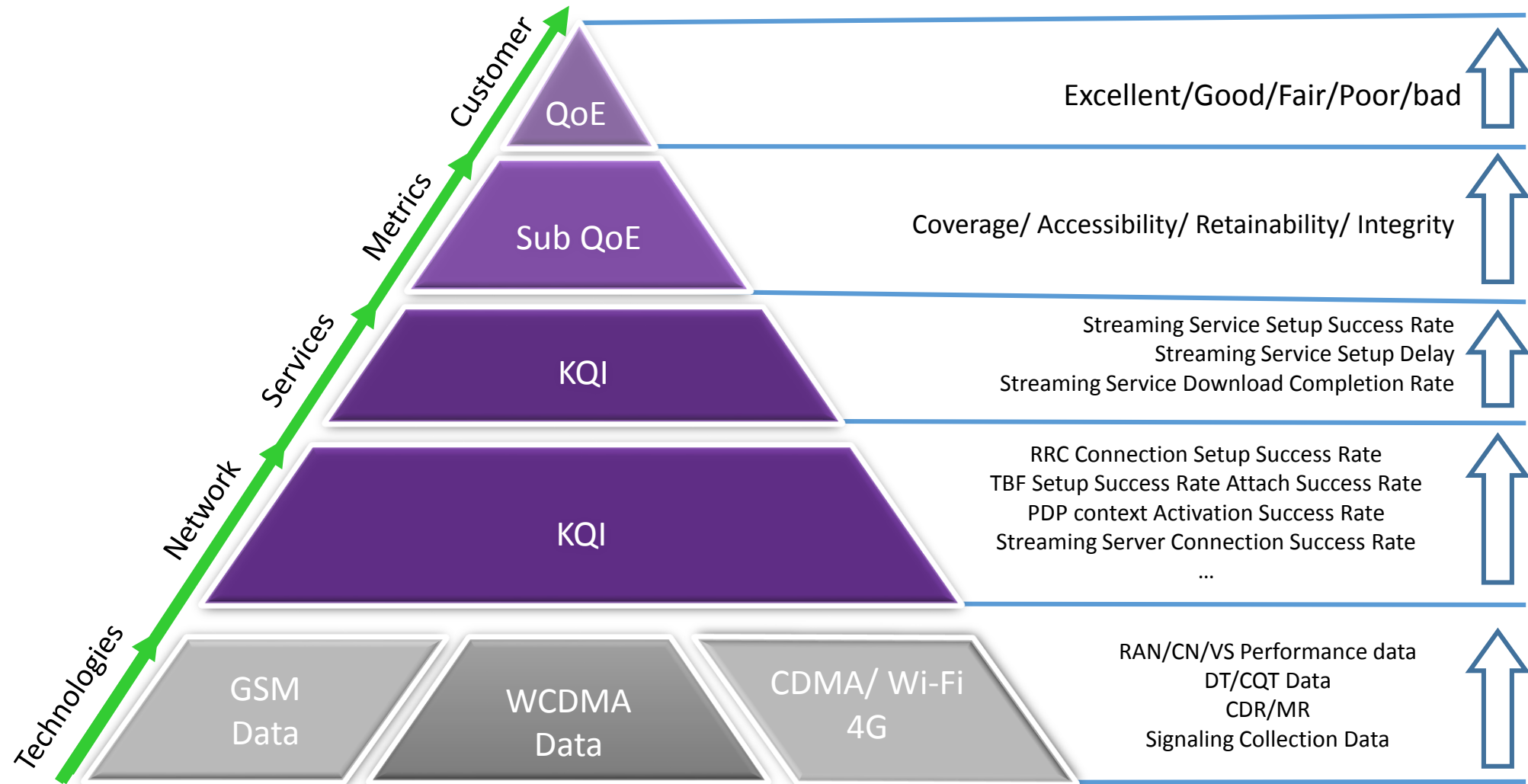
Example

How can we define and manage the end-users' experience?

Experience & Service Operations View



Assessment of a set of QoE KPIs(Technical)



What is the correlation between QoS and QoE ?

- Technical Correlation
 - Possible through convergent indicators
- Perception Correlation
 - Difficult but possible
- Methodology
 - Identify QoS indicators/parameters, technically measurable and influencing the QoE
 - Use intrusive measures (with a reference)
 - Evaluate both indicators and quality perceived by the user (QoE)
 - Establish formulas for calculating QoE through QoS indicators
 - Apply methods to non-intrusive measures
- Advantages
 - Estimate the QoE based on network indicators without the need for intrusive measures
- Limits
 - Requires adaptation to the effects external to the user (regulator)

Factors (aspects) Affecting the QoE

- **Technical**

- The specific expectation of the user in terms of quality indicators
- Technologies' trend
- Users' equipment

- **Users perception**

- The present particular context of the user (need, mood, physical state ...)
- Living standard (price)
- The social environment (culture, intellectual level, customs, ...)
- User experience in the network or other networks
- Fashion and trends
- Advertising offers/products (including those of competitors)

Exemple of Parameters

Voice quality

Parameters	Causes	Impact on QoE
Call Establishment Failure	Various causes (Radio or core network)	customer dissatisfaction
Echo	Transmission issue	Poor listening
Distortion	Interferences	Hearing difficulties
Background noise	Wrong network configuration Equipment out of date (EOM, EOS) Bad interconnection of network elements	Hearing difficulties
Call drops	Various causes (Radio or core network)	customer dissatisfaction

Exemple of Parameters

Data quality

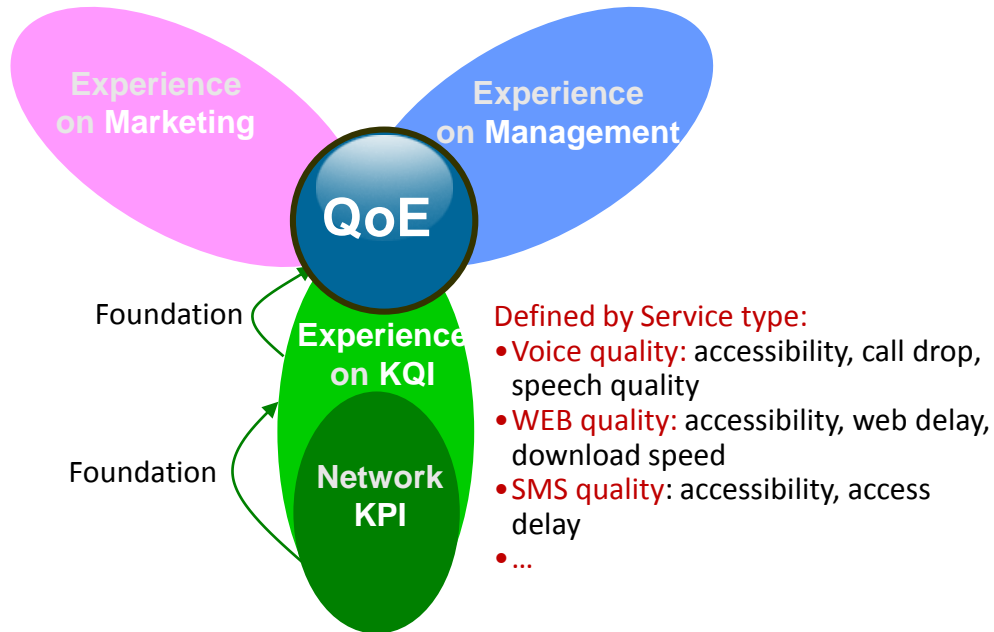
Parameter	Cause	Effect	Impact on QoE
Packets loss	Transmission error	Packets retransmission	Navigation delay Low download speed
Latency (end-to-end delay)	Queuing Congestion	Delay on real time application	Impossibility for online gaming Lag of image for video surveillance
Jig	Different root Algorithm different from network nodes	Packets arrive on wrong order Waiting reordering	Navigation delay Low download speed

Exemple of Parameters

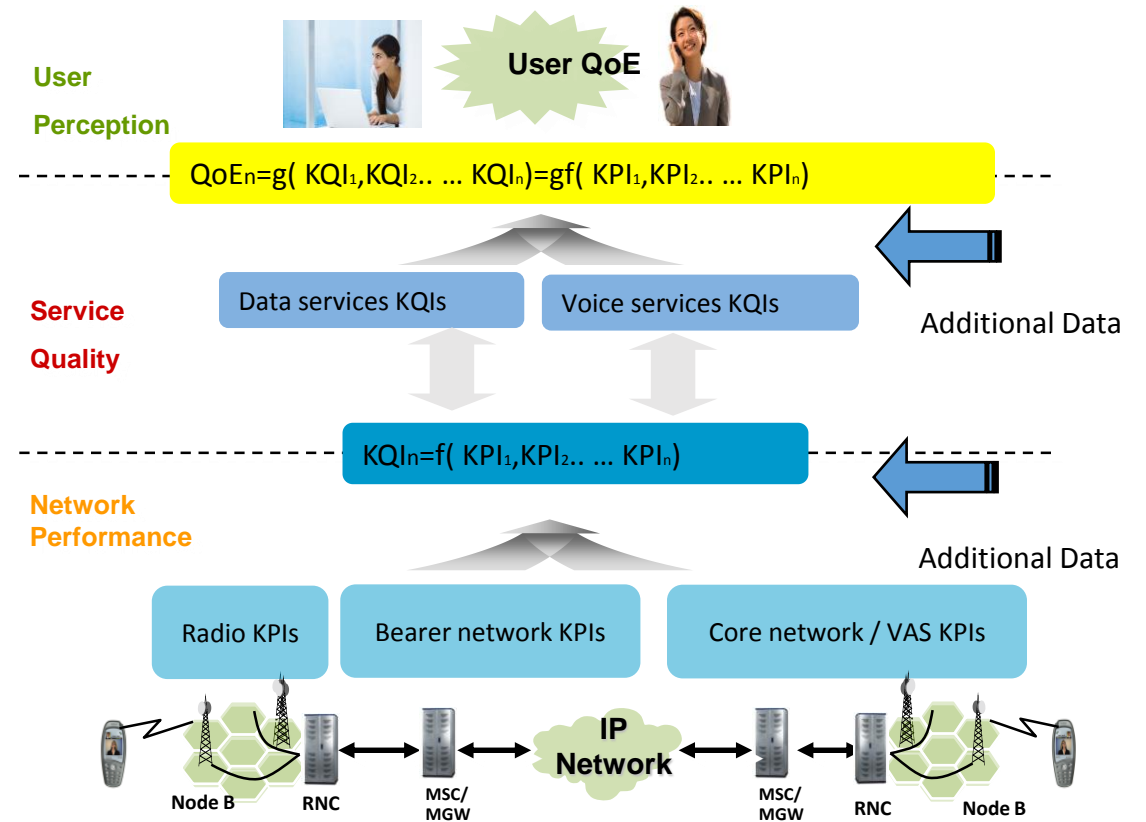
Video quality

Parameter	Cause	Effect	Impact on QoE
Time of first slow image appearance	Bad Buffer Sizing	Wide waiting before the image starting	Wide waiting before the image starting
Availability of the video	Server congestion Slow transmission link	Flow of video non continuous	Video stop Video shift
Resolution and Frame rate (Image per second)	Bad dimensioning of the resolution vs user bit rate	inadequate transmission channel to route video	Delays, stopping video
Codec used	Bad compression, so more data	inadequate transmission channel to route video	Delays, stopping video
Poor delivery of video	Wrong sizing/configuration of application reader	Poor flow synchronization	Cut-off/ stopping the video

Converting from KPI to QoE



- Defined by Network domain:**
- **Wireless network** performance
 - **Core network** performance
 - **IP network** performance
 - **Transmission network** performance
 - **Service system** performance
 - ...



- Establish QoE Evaluation System
- Set up QOE, KQI, KPI mapping relationships

- Focus more on KQI than KPI
- Transformate from Objective KPIs to Subjective QoE

Category	KQI name	Mapping		Weight
		KQI value	QoE score	
Accessibility	first page loading success ratio	≥ 99%	5	40%
		95%~99%	4	
		80% ~ 95%	3	
		70% ~ 80%	2	
	average first page loading speed	< 70%	1	10%
		≥ 512kbps	5	
		256~512kbps	4	
		128~256kbps	3	
Retainability	web browsing data transfer cut-off ratio	64~128kbps	2	10%
		< 64kbps	1	
		≤ 0.1%	5	
		0.1% ~ 0.5%	4	
		0.5% ~ 1%	3	25%
		1% ~ 2%	2	
		> 2%	1	
		≥ 99%	5	
Integrity	web page refreshing success ratio	95%~99%	4	25%
		80% ~ 95%	3	
		70% ~ 80%	2	
		< 70%	1	
	average page refreshing speed	≥ 512kbps	5	15%
		256~512kbps	4	
		128~256kbps	3	
		64~128kbps	2	
	< 64kbps	1		

QOE score	QoE grade	User perception
≥ 4.5	Excellent	Very satisfied
4~4.5	Very good	Satisfied
3.5~4	Good	Little unsatisfied
3~3.5	Fair	Much unsatisfied
< 3	Poor	Most unsatisfied

$$QoE = 4 * 40\% + 3 * 10\% + 4 * 10\% + 3 * 25\% +$$

$$4 * 15\% = 3.65, \text{ Good}$$

- Initialized with default weight value & benchmark for KQIs , yet need to get agreement with operator
- Automatically generate optimization report and send out alarm information immediately for poor QoE status

Estimate the global QoE

Example of weighting by Indicator

- Identify consumer preferences (surveys):

	Voice	QoS	QoE
Coverage	30%	80.0%	24.00%
Accessibility	25%	97.18%	24.30%
Retainability	25%	98.58%	24.65%
speech quality	20%	90.87%	18.17%
			91.11%

	SMS	QoS	QoE
Originating Successful	40%	97%	38.80%
Terminating Successful	40%	95%	38.00%
Reception duration	20%	90%	18.00%
			94.80%

	Video (streaming)	QoS (DT)	QoE
Time of video starting	40%	85%	34.00%
Intermittent Stop of Video	30%	90%	27.00%
Video image quality	20%	96%	19.20%
Voice quality of the video	10%	98%	9.80%
			90.00%

	Data (DT)	QoS	QoE
Data Connection establishment	30%	95%	28.50%
email reception successful	20%	98%	19.60%
email sending successful	20%	93%	18.60%
continuous http navigation	15%	95%	14.25%
download speed	15%	85%	12.75%
			93.70%

- Establish a weighting grid by service to obtain an assessment of the client's feel (QoE)

Field Measurements Template

	KQI_1	KQI_2	KQI_3	KQI_4
Information	Accessibility	Reliability	Transparency	
Sales approach	Agencies	sales	others	
Products and offers	Product	Offers	Promotion	
After Sales	Accessibility	Support	Waiting Time	Follow-up
Network	Coverage	Voice Call	SMS	Internet Mobile

Each level have around 3 KQI, and each of the KQI will be evaluated subjectively with attached template

KQI: Key Quality Indicator

		KQI_1	KQI_2	KQI_3	KQI_4
Services SMS Durée de notification <input type="text"/> Internet Mobile Site web <input type="text" value="www."/> Chargement de la page rapide <input type="text"/> Qualité images <input type="text"/> Qualité vidéo <input type="text"/> Qualité voix de la vidéo <input type="text"/>	Qualité Appel <input type="text"/>				
	Excellent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Bonne	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Acceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Mauvais	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Médiocre	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



QoE Monitoring Tools

- Application layer tools
 - E.g. Ping, FTP, HTTP browsing, MMS, SIP, WAP, etc...
- Field measurement tools
 - Radio measurements + application layer performance
- Protocols analyzers
 - Protocol stack performance analysis at any interface
- Mobile QoS Agents
 - L1-L7 measurements, position and location
 - Active and passive measurements

Mobile Quality Agent (MQA)

- **Measuring** mobile multimedia service quality, radio parameters, and producing **and reporting performance** statistics to central management servers
- **Active probing** and/or **passive monitoring**, which turns thousands of commercial mobile phones into (secure and non intrusive) service quality probing stations
- A **central management server** derives KPIs out of the reports from QoS agents, and manages QoS agents, i.e. dynamically dispatches, installs, and activates or deactivates them

Mobile Quality Agent: Nemo CEM

RADIO CONDITIONS

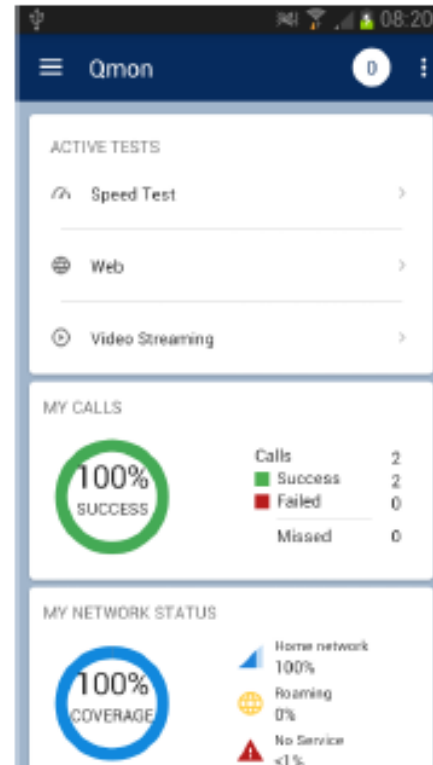
- No Coverage detection
- WIFI Connectivity

LOCALISATION

- GPS or Network
- Indoor/outdoor

DEVICE INFORMATION

- Brand/Model
- OS
- SIM information and status
- Battery, Storage, RAM, CPU



CROSS OPERATORS

- Benchmark
- Roaming

DATA

- Performances from device
- Volume per application

USER INTERACTION

- Ticketing
- Surveys

Mobile Quality Agent: Nemo CEM

Privacy protection



USER OPT-IN REQUIRED TO INSTALL AGENT

NO CONTENT AND PERSONAL DATA COLLECTION

OPTION TO ACTIVATE FULL ANONYMOUS MODE

USER CAN UNINSTALL AGENT ANYTIME

USER CAN DEACTIVATE DATA COLLECTION

USER CAN DEACTIVATE GEOLOCATION

NEMO CEM is under full user's control

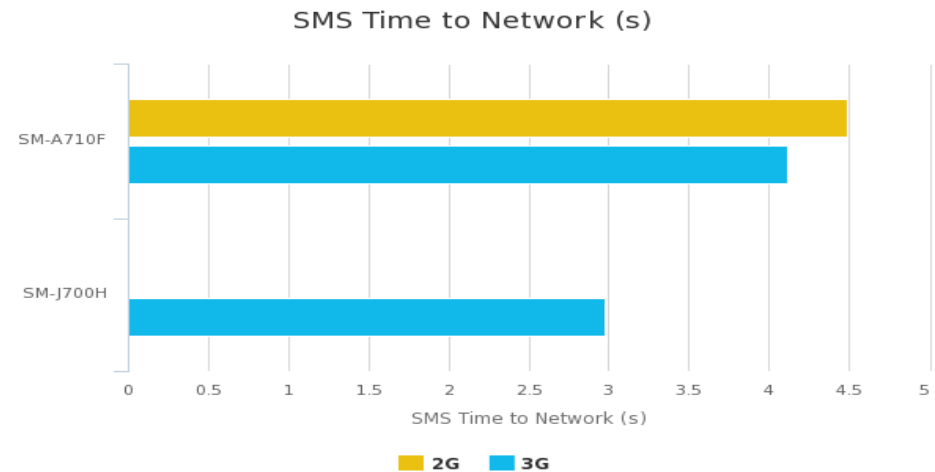
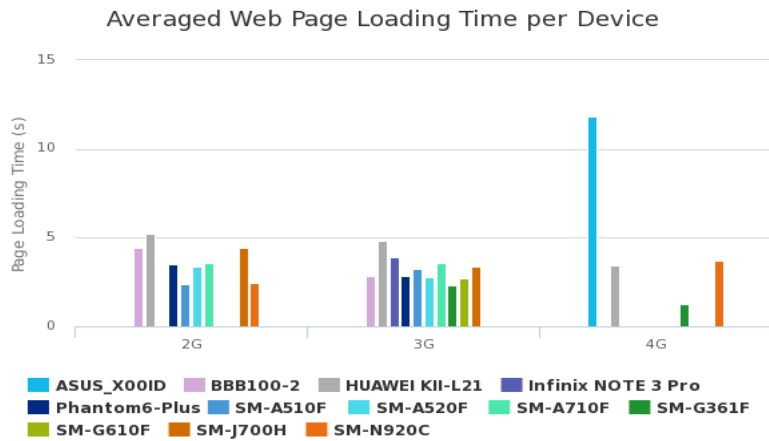
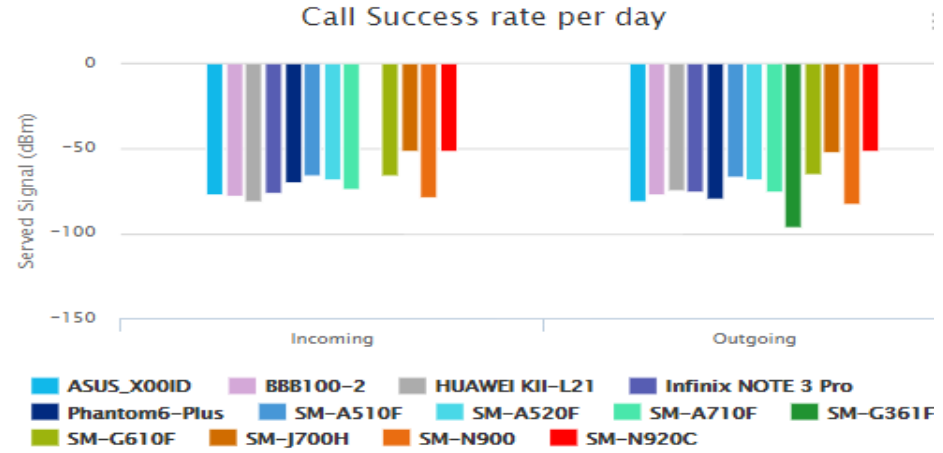
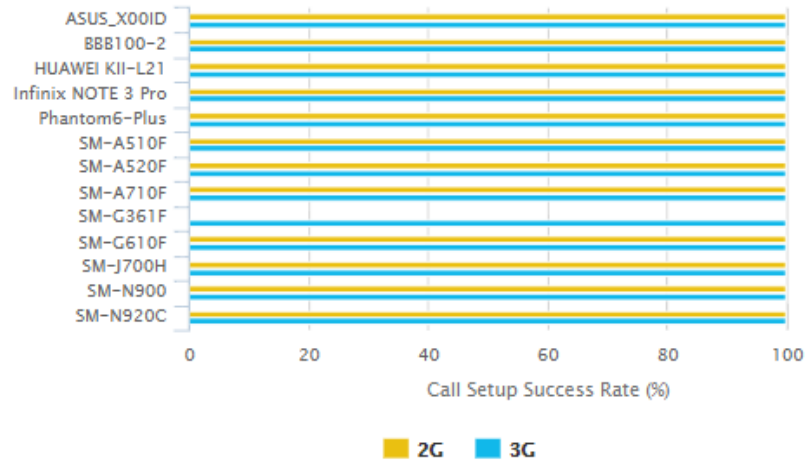
Device Performance Analysis

Signal Coverage	2593
Network Connectivity	1377
Radio Access Tech.	7994
Data Access Tech.	0
Data Sessions	0
Web All	47k
Voice All	8010
Voice Success	7710
Voice Drop	381
Voice Failed	131
Application Statistics	0
HTTP DL > 3 MBps	87
HTTP DL	9691
App. Volume	0
App. Usage	2042

This documents presents results of the Nemo Customer Experience Monitor trial perform by Espresso Senegal between January 1st 2018 and February 20th 2018.

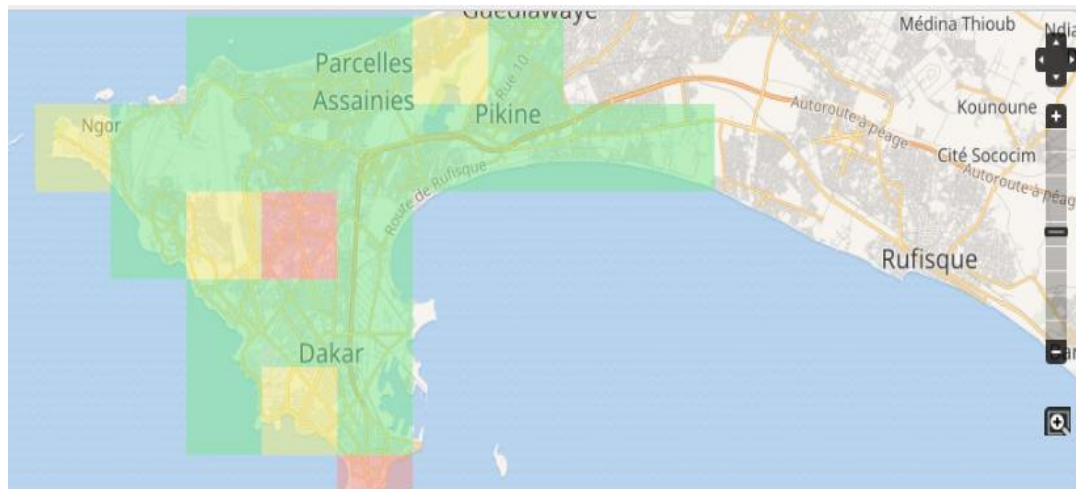
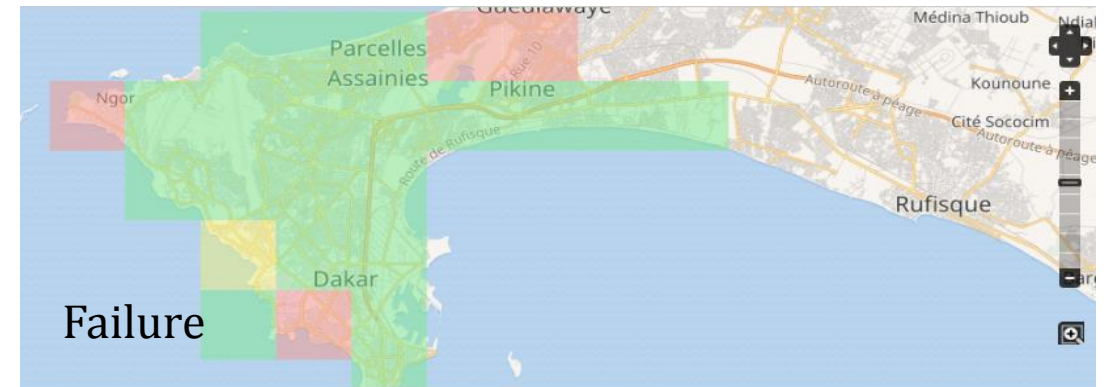
During that period, following number of samples have been collected:

Device Performance Analysis



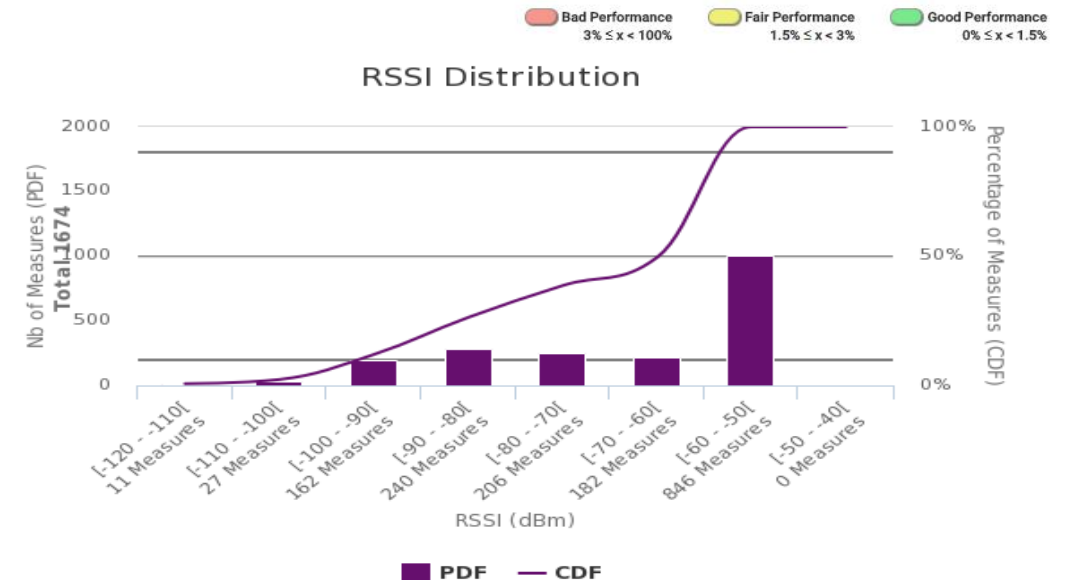
Device Performance Analysis

Best Technology available



Voice Call Success

Bad Performance $0\% \leq x < 93\%$ Fair Performance $93\% \leq x < 97\%$ Good Performance $97\% \leq x < 100\%$



Think, work and act as one team to meet our customers' dreams



Thank You