

ITU Workshop on "Network Performance, Quality of Service and Quality of Experience", (Kigali, Rwanda, 4-5 March 2019)

MNO Network Performance, QoS , QOE Enforcement

Rwanda's experience

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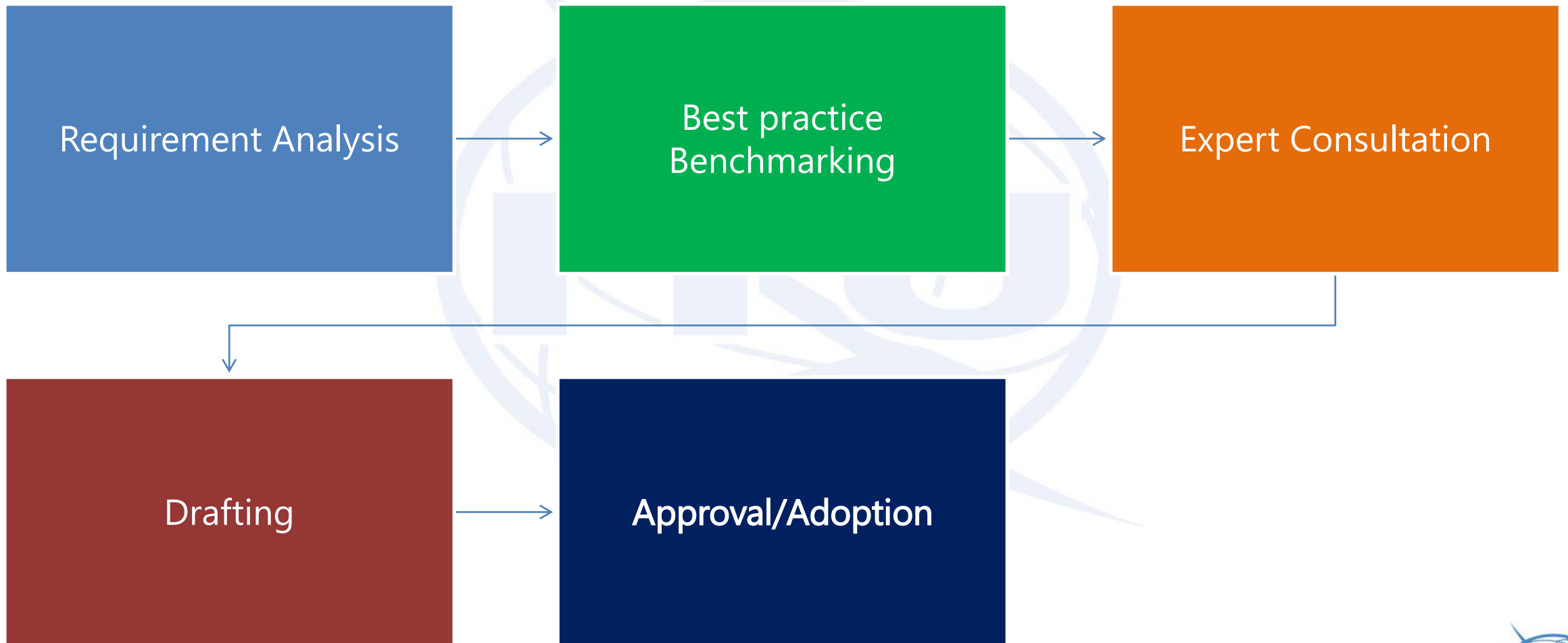
Objective

- To share experience on how RURA enforces MNO QoS compliance
- Understand the different elements required for an effective DT program
- Understand how all aspects of DT can be used to obtain a view of UX/NP
- Understand the KPIs that can be obtained
- Discuss various options and Best Practices

Legal and regulatory aspects

- The QoS License parameters/thresholds were first introduced during telecom operators licensing process (Before 2010)
- Due to fast technological trends and enhanced user requirements, these QoS parameters/ thresholds were becoming obsolete
- RURA had to amend the QoS License obligations as well as procure QoS Monitoring platform in order to legally enforce QoS Obligations

Amendment Process



Drive Test



Drive Test Process

Cluster Preparation

- Define Cluster
- Define Drive Route

Data Preparation and Collection

- Services to test
- KPI definitions
- Equipment
- Exclusions
- Call Patterns
- OSS Alarms
- Network Stats

Data Analysis

- Levels of Reporting
- Failure Type Breakdown
- Post Processing functionality
- KPI Gap Analysis

Trouble Shooting

- Root Cause Analysis
- Corrective Action
- Further data logging (maybe)

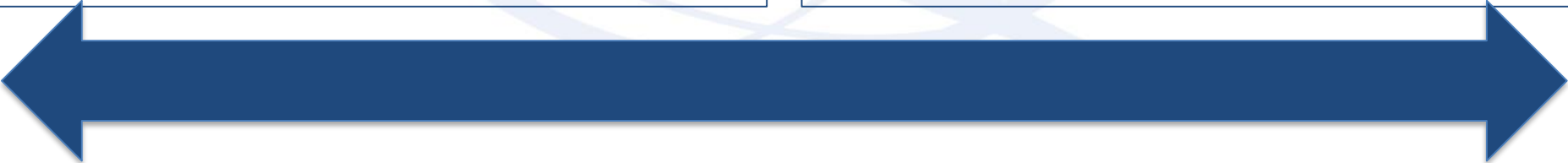
Why Drive the network?

Operators

1. New Site Integration
2. RF Tuning
3. Network Optimization
4. Network Benchmarking (Golden Routes)

Regulators

1. Performance Benchmarking
2. User experience
3. Compliance
4. Enforcement
5. KPI commitments

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- Efficiency
 - QoS Optimization
 - ROI

- Maximize UX Quality
- Investigative

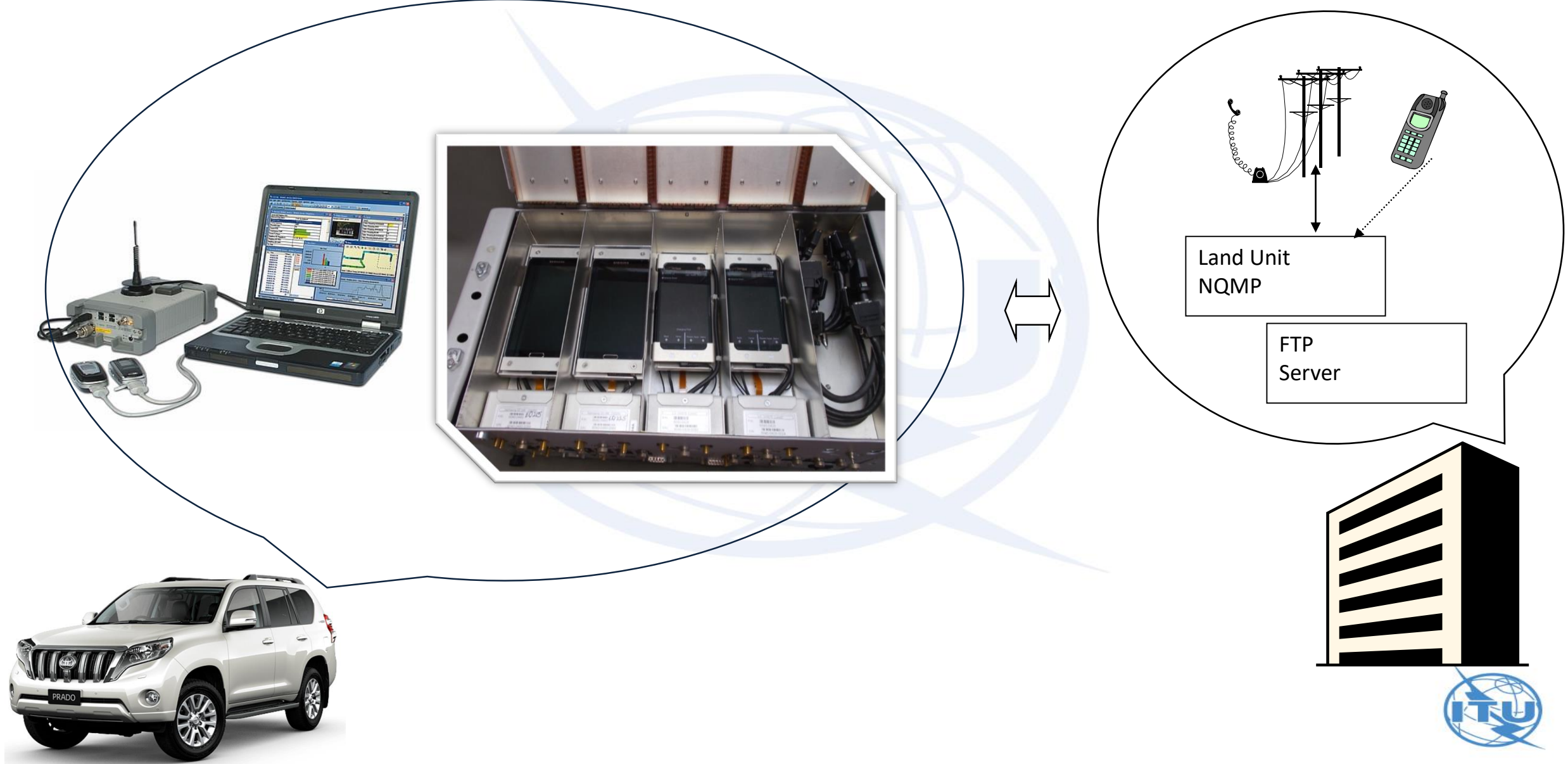


Measurement Setup

- Measurement Tools
- Analysis Software
- UE
- GPS
- Scanner



Benchmarking Equipment Setup



Test Cases

Test Case 1:	"Voice and SMS, 2G" using mobile devices locked to 2G networks in order to monitor voice and SMS QoS of those users who have a 2G-only mobile phone. NOTE!!! , this test case is important as the number of 2G-only mobile phones in Rwanda is still quite big!
Test Case 2:	"Voice and SMS, 2G/3G" using mobile devices that are freely selecting between 2G and 3G networks in order to monitor voice and SMS QoS of those mobile users, who have a 3G mobile phone
Test Case 3	"CS Fall Back, LTE" using a 4G/LTE capable mobile devices, that are falling back to 2G or 3G network when making a voice call in order to monitor CSFB QoS of those users who have a 4G mobile phone.
Test Case 4	"Packet Switched Data, 4G" using mobile devices locked to 4G networks in order to monitor KTRN direct service.
Test Case 5	"Packet Switched Data, 2G/3G" using mobile devices freely selecting between to 2G and 3G networks in order to monitor PS data QoS as perceived by those users who have a modern 3G mobile device.
Test Case 6	"Packet Switched Data, 2G/3G/4G" using mobile devices freely selecting serving system between 2G, 3G and 4G networks in order to monitor PS data QoS as perceived by those users who have a modern 4G mobile device.
Test Case 7	- "Network Coverage and Quality" using a scanner to measure coverage and quality of all frequency bands independently and separately.

Service	Network Availability	Network Accessibility	Service Accessibility	Service Retainability	Service Integrity
CS Voice 2G	Network Availability (time/area)	Call Setup Time	Call Setup Success Rate	Call Completion Rate/ Call Drop Rate	Voice Quality MOS
CS Voice 2G/3G	Network Availability (time/area)	Call Setup Time	Call Setup Success Rate	Call Completion Rate / Call Drop Rate	Voice Quality MOS
SMS 2G	Network Availability (time/area)		SMS Service Accessibility	SMS Completion Ratio	SMS End-to-end Delivery Time
SMS 2G/3G	Network Availability (time/area)		SMS Service Accessibility	SMS Completion Ratio	SMS End-to-end Delivery Time
CS Fallback LTE	Network Availability (time/area)	Call Setup Time	Call Setup Success Rate	Call Completion Rate / Call Drop Rate	

Service	Network Availability	Network Accessibility	Service Accessibility	Service Retainability	Service Integrity
PS Data 2G	Network Availability (time/area)	Attach Setup Time	PDP Context Activation Failure Ratio Attach Failure Ratio PDP Context Activation Time	PDP Context Cut-off Ratio	DL Application Throughput Latency
PS Data 2G/3G	Network Availability (time/area)	Attach Setup Time	PDP Context Activation Failure Ratio Attach Failure Ratio PDP Context Activation Time	PDP Context Cut-off Ratio	DL Application Throughput Latency
Coverage and Quality	Signal Strength (RxLev, RSCP, RSRP)	Signal Quality (Ec/N0, RSRQ)			

Key Performance Indicators



Voice services (2G & 3G):

- Call Setup Success Rate (CSSR)
- Dropped Call Rate (DCR)
- CS Fallback Success Rate (CS FB SR)
- Voice Quality (MOS)
- Call Setup Time (CST)
- Coverage & Quality



Data Services: (2G, 3G & 4G)

- DL Throughput (Application)
- SMS Success Rate
- SMS e2e Time
- Latency (Ping)
- Coverage & Quality

Drive Test Analysis – Call Patterns

- Enough call samples have to be made to make the measurement statistically valid.
 - In a 50 call sample one dropped call will cause a change in performance of -2%
 - In a 500 call sample one dropped call will cause a change in performance of -0.2%
- Call length should be defined at the beginning
- We can use different call testing patterns for different optimisation techniques
 - Short Calls (for Calls setup performance and delay)
 - Long calls (for Drop call performance and SHO performance)

AMR Call

Mobile Originated Calls (MOC)

- 2 min calls
- 10 sec idle
- UE in Dual mode (2G/3G)

Mobile Terminated Calls (MTC)

- 2 min calls
- 30 sec idle
- UE in dual mode (2G/3G)

PS Call

- GPRS Attach,
- PDP Context Activation
- FTP Download (1MB file) /FTP Upload (500 KB file)
- PDP Context Deactivation
- GPRS Detach
- Alternate download and upload with 30 sec idle time
- Session is upload or download
- UE in Dual mode (2G/3G)



Defining KPIs

AMR Statistics

Threshold KPIs		
MOC Setup time	5	sec
MOC CCR	99	%

Event	RAW		END USER	
	Count	Ratio	Count	Ratio
Call Attempts	132		122	
Call Setup Success Rate	108	81.8%	108	88.5%
Call Setup Failure Rate	24	18.2%	14	11.5%
Failures due to Tool (TSF)	10	41.7%		
Failures due to Core Problem	10	41.7%	10	71.4%
Failure ASU (Sync) Problem	2	8.3%	2	14.3%
Failure due to Low Coverage Levels	2	8.3%	2	14.3%
Call Setup Success and Setup Time > 5s	7	6.5%	7	6.5%
Long Setup due to slow cell reselection		0.0%	0	0.0%
Long Setup due to clash with InterRAT reselection		0.0%	0	0.0%
Long Setup due to Unknown (suspect UE)		0.0%	0	0.0%
Long Setup due to Unknown		0.0%	0	0.0%
<i>Average Call Setup Time</i>		3.66		3.66
Call Completion Rate	105	97.2%	105	97.2%
Call Drop Rate	3	2.8%	3	2.8%
Call Drop Poor 3G Coverage	1	33.3%	1	33.3%
Call Drop on GSM due to Interference	2	66.7%	2	66.7%
Overall Call Completion Rate	105	79.5%	105	86.1%
ISHO Attempt	14		14	
ISHO Success	14	100.0%	14	100.0%
ISHO Failed	0	0.0%	0	0.0%
ISHO Failed cause physical channel failure	0	N/A	0	N/A

KPI Thresholds	Value	Unit
Attach Time	4	sec
PDP Activation Time	2	sec
FTP Download Throughput	110	kbit/s
FTP Upload Throughput	55	kbits

Signalling Statistics	Count	Success rate
Attach Attempt	155	
Attach Success	140	90.32%
Attach Time more than threshold	5	3.57%
Attach Time less than threshold	135	96.43%
Attach Failed	15	9.68%
<i>Average Attach Setup Time</i>		1.36
Activate PDP Context Attempt	124	
Activate PDP Context Success	124	100.00%
Activation Time more than threshold	2	1.60%
Activation Time less than threshold	123	98.40%
Activate PDP Context Failed	0	0.00%
<i>Average PDP Context Activation Time</i>		0.96
FTP Download Attempts	51	
FTP Download Success	48	94.12%
FTP Download throughput more than threshold	25	52.08%
FTP Download throughput less than threshold	23	47.92%
<i>Average FTP Download Throughput</i>		107.02
FTP Upload Attempts	32	
FTP Upload Success	30	93.75%
FTP Upload throughput more than threshold	20	66.67%
FTP Upload throughput less than threshold	10	33.33%
<i>Average FTP Upload Throughput</i>		55.53
Data Transfer Cut-off Ratio		6.02%
PDP Context Dropped	4	3.23%
Deactivate PDP Context Request	121	
Deactivate PDP Context Accept	121	100.00%
Deactivate PDP Context Failure	0	0.00%
Detach Request	281	
Detach Accept	129	45.91%
Overall Data Session Completion Rate	78	62.90%

RAU Statistics	Count	Success rate
RAU Attempt	22	
RAU Success	13	59.09%
RAU Failed	9	40.91%

Cell Reselection Statistics	Count	Success rate
Cell Reselection from UMTS to GSM Attempts	2	
Cell Reselection from UMTS to GSM Success	1	50.00%
<i>Cell Reselection from UMTS to GSM Delay E2E</i>		15.27
<i>Cell Reselection from UMTS to GSM Delay Signalling</i>		N/A
Cell Reselection from GSM to UMTS Attempts	1	
Cell Reselection from GSM to UMTS Success	0	0.00%
<i>Cell Reselection from GSM to UMTS Delay E2E</i>		N/A

Time in System	Seconds	Ratio
GSM	171	1.02%
UMTS	16559	98.98%



Need to Define the KPI measurement

- Call Setup Success - CSSR (voice, circuit switched data)
 - Successful call setup means that “DL/UL Direct Transfer (CC: Alerting)” message is received by UE.
- Call Setup Time (voice, circuit switched)
 - Call setup delay is measured from L3 messages, starting from “RRC Connection Setup” message to “DL Direct Transfer (CC: Alerting)” message.
- Call Drop (voice, circuit switched)
 - A dropped call occurs. The call will be dropped in case RRC connection release (not normal release) message has been send from RNC to UE.
- Session Setup Success (packet switched)
 - This is related to PDP context activation. Successfully activated PDP context means that activate PDP context accept message has been sent from RNC to UE
- Session Setup Time (packet switched)
 - The “session setup time” is the delay between the time the UE sends the data session activation request until GPRS attach and PDP context activation has been successfully completed.
- Session Drop (packet switched)
 - Session drop rate can be defined as the number of successful PDP deactivations against number of successful PDP activations.

Sources: ETSI, ITU,..



Failure Breakdown

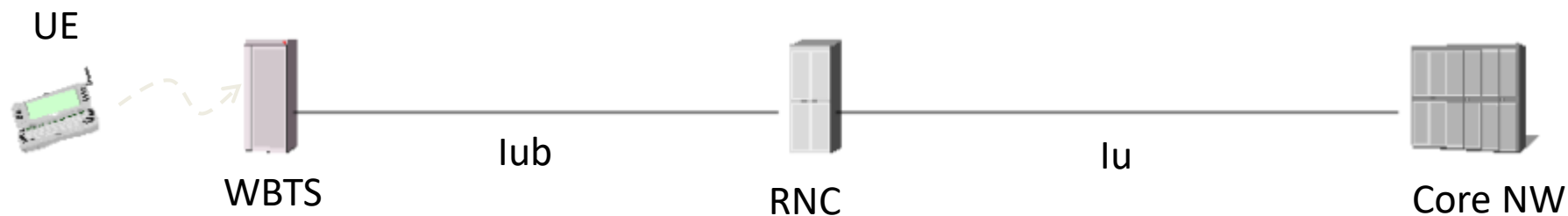
■ Non-genuine failures

- Measurement system fault (Collection Tool or Analysis)

■ Genuine failures

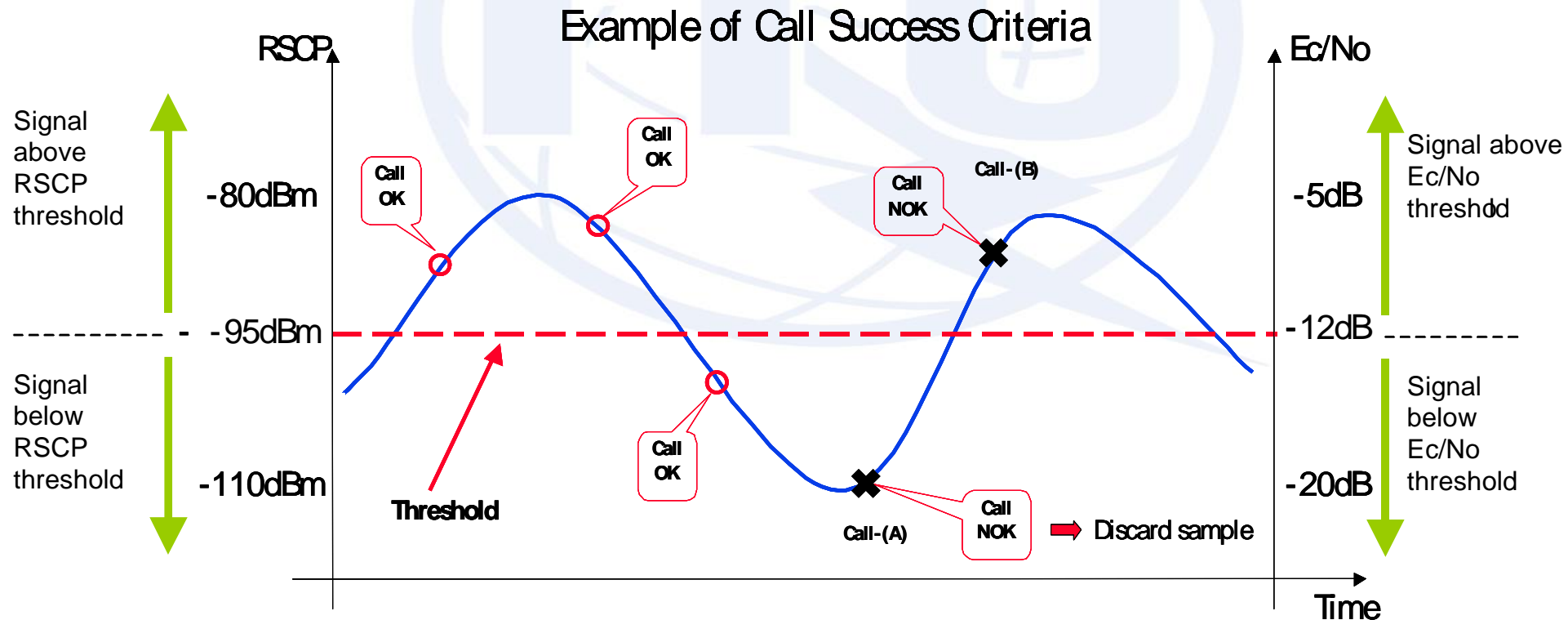
- RF issue (Coverage / Interference / Poor dominance)
- Missing neighbour
- System issue WBTS
- System issue RNC
- Core network issue
- System
- (Unknown)

Categorise call failures during the analysis and reporting

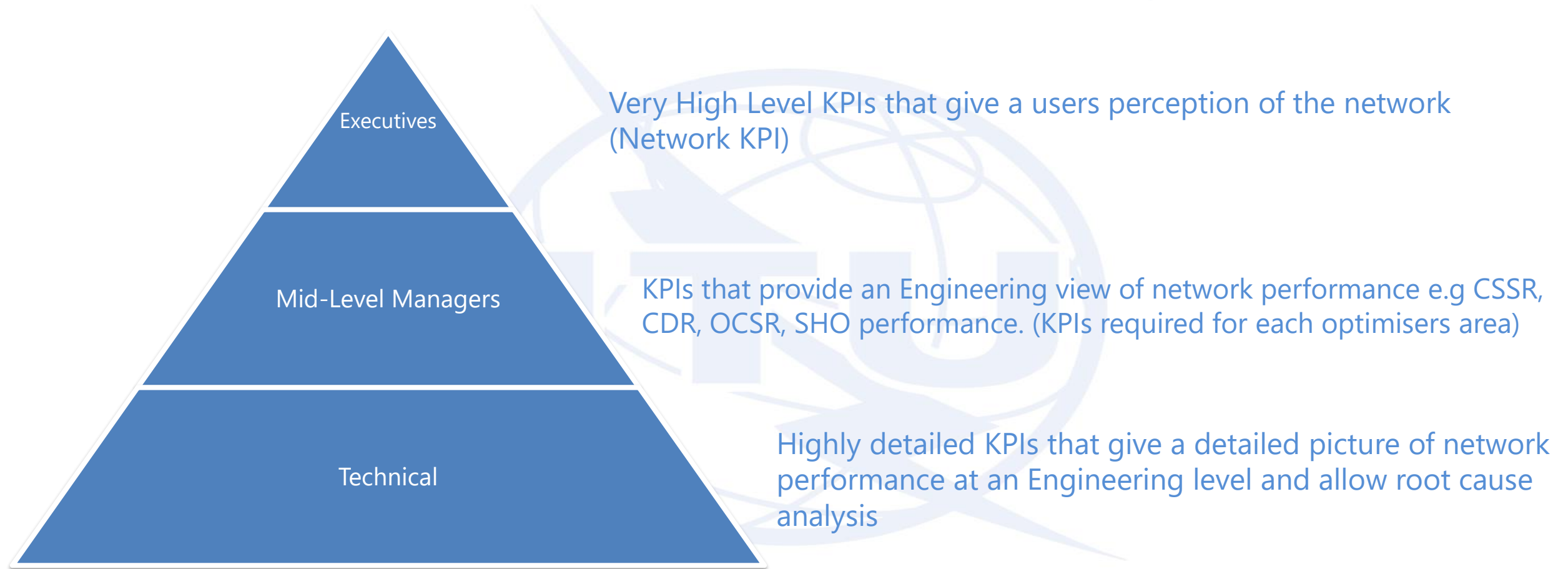


Failure Breakdown

- The KPI measurement conditions should be used to define exclusion areas during drive test for acceptance of a cluster.
- All failures happening in those area, that do not respect the coverage requirements should be discarded.



Drive Test Analysis – Reporting Levels



The different reporting levels may want to see KPIs based on different cuts of the data (e.g. logs, raw or end user)

Key Considerations



Technical Challenge

- Measurement platforms configuration varies depending on:
 - Number of Operators
 - Technologies on the market (GSM family, 3G family, 4G-LTE, ...)
 - Services required to measure (Voice OnNet, Interconnection, Data,.....),
- The Measurement system requires continuous upgrades / Cost implications

Skills Challenge

- Regulators are normally not familiar with Network troubleshooting, Planning & Optimization techniques.
- In order to publish measurement findings/results, it is a MUST to have confidence in the findings, network problems, possible causes,....
- In order to increase the reliability of results , the QoS Monitoring Team has to have necessary skills in Technology and Monitoring System

Conclusions and Recommendations

- Legal tools need to evolve as new services are introduced
- The Measurement methodologies/Tools need continuous improvements
- Training is a continuous process to stay on track
- Services to be measured and KPIs to be calculated need to be clearly defined
- Various call patterns exist to exercise the KPIs
- Test cases coverage is Key
- Reporting Levels should be understood
- Define and agree exceptions in advance

Thank you!

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