SIGOS Mobile roaming testing tool

Project handled by

Sarmad Mohamad Abdul-Hakim

Hardware installation and service testing

2025

SIGOS (Service Integration and Global Optimization System).

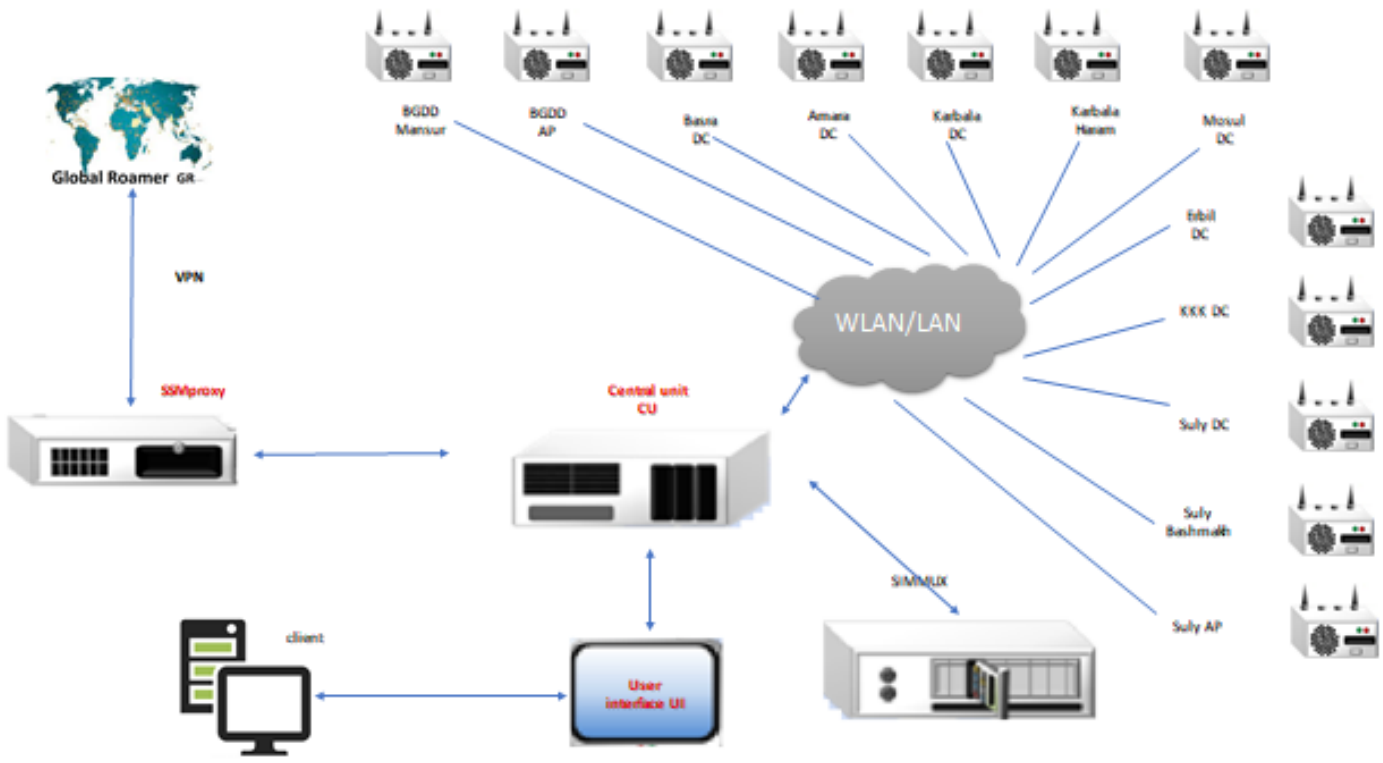
System Brief: SIGOS testing tool is used to run periodic and ad-hoc mobile roaming tests that are used to measure the quality of services and speed us testing process by automating the process and handle it without depending on roaming partners or other operators.

Core Function and Service(s):

- **Site CU server: The central server which controls the testing process and communicates with all other equipment's functions to facilitate the test.**
- **UI: User Interface to access the SITE portal and run the needed tests**
- **SIMMUX: A box that hold the physical test SIM cards that are selected prior performing the tests**
- **CLU Probes: connect to Asiacell radio network (similar to mobile) and used to run and simulate the required quality tests. They are connected to CU server through Asiacell local network.**
- **GRP SSM-Proxy: Used to connect with Sigos Global Roamer server in Germany, it facilitates the outbound and international testing with other countries by using Sigos worldwide distributed probes.**

- The Architecture and Network Design including:
    - **High Level Design (HLD):** a diagram that shows the overall system/service design describing the relation between various modules and functions of the system/service
    - **Low Level Design (LLD):** dig down diagram, tables, sheets that defines the actual logic for each and every component of the system/service, including interfaces, connections, IP addresses, etc. between them.
- **Data Flow Diagram (DFD):** a sequential flow diagram with table or matrix sheets that shows how each component of the system / service is communicating with each other for common uses cases.

High Level Design (HLD)



System elements description and OS

Elements	Description / Functionality	Operating System
sitecu	Center unit that control the testing process	Linux SUSE v.10
siteui	User Interface to allow access to SITE portal	Linux SUSE v.10
simmux	SIM cards box handler	Linux SUSE v.10
ssmProxy	Proxy server to allow access to SIGOS GR	Linux SUSE v.10
backup	Backup CU for redundancy	Linux SUSE v.10

clu-fermanday	Probe with antennas to perform the scheduled tests (act as a mobile)	Linux SUSE v.10
clu-bgd-ap	Probe with antennas to perform the scheduled tests (act as a mobile)	Linux SUSE v.10
clu-bgd-mt	Probe with antennas to perform the scheduled tests (act as a mobile)	Linux SUSE v.10
clu-kkk-rehemawa	Probe with antennas to perform the scheduled tests (act as a mobile)	Linux SUSE v.10
clu-erbil-newbuilding	Probe with antennas to perform the scheduled tests (act as a mobile)	Linux SUSE v.10
clu-bas-barathya	Probe with antennas to perform the scheduled tests (act as a mobile)	Linux SUSE v.10
clu-bas-amara	Probe with antennas to perform the scheduled tests (act as a mobile)	Linux SUSE v.10
clu-Karbula	Probe with antennas to perform the scheduled tests (act as a mobile)	Linux SUSE v.10
clu-bashmakh	Probe with antennas to perform the scheduled tests (act as a mobile)	Linux SUSE v.10
CLU-Suly Airport	Probe with antennas to perform the scheduled tests (act as a mobile)	Linux SUSE v.10

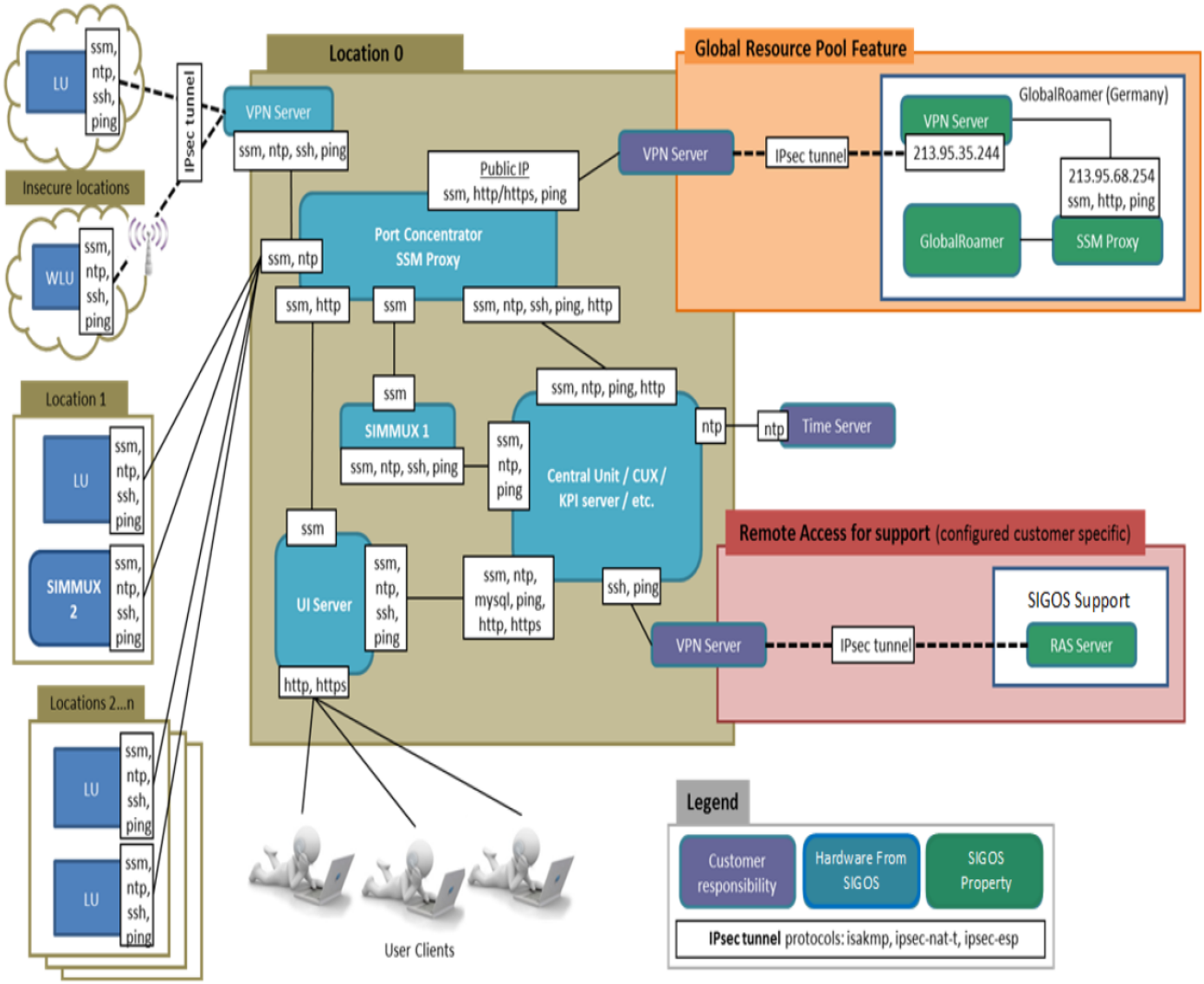
CLU-Karbala-Haram	Probe with antennas to perform the scheduled tests (act as a mobile)	Linux SUSE v.10
CLU Mosul	Probe with antennas to perform the scheduled tests (act as a mobile)	Linux SUSE v.10
SNMP	The O&M manager checks system components regularly and generates an alarm	Linux SUSE v.10
GRP	SIGO GR connected to probes in other countries (Located in Germany)	Linux SUSE v.10

IP configuration: With cooperation from IP-planning colleagues, each element is assigned an IP according to location and available range using Linux command by vendor.

System	IP Address	Type
sitecu	10.75.160.105	Virtual
siteui	172.16.165.208	Virtual
simmux	192.168.101.183	Physical
ssmProxy	10.75.164.122	Virtual
backup	192.168.101.187	Virtual
clu-fermanday	192.168.101.184	Physical

clu-bgd-ap	192.168.0.181	Physical
clu-bgd-mt	192.168.50.181	Physical
clu-kkk-rehemawa	192.168.88.181	Physical
clu-erbil-newbuilding	192.168.32.181	Physical
clu-bas-barathya	192.168.16.181	Physical
clu-bas-amara	192.168.20.181	Physical
clu-Karbula	192.168.24.181	Physical
clu-bashmakh	172.22.157.30	Physical
WLU-Suly Airport	172.31.118.1	Physical
CLU-Karbala-Haram	172.17.115.196	Physical
CLU Mosul	192.168.70.81	Physical
SNMP	192.168.165.149	Physical

Low Level Design (LLD)



Data Flow Design (DFD)

Source IP address	Destination IP address	Service / port / protocol
10.75.160.105	172.16.165.208	ssm, ssh, ping
10.75.160.105	192.168.101.183	ssm, ssh, ping
10.75.160.105	192.168.101.184 192.168.60.181 192.168.0.181 192.168.50.181 192.168.105.181 192.168.88.181 192.168.32.181 192.168.8.181 192.168.16.181 192.168.20.181 192.168.24.181 172.22.157.30 172.31.118.1	ssm, ssh, ping
172.16.165.208	10.75.160.105	ssm, ntp, mysql, http, ping
172.16.165.208	10.75.164.122	ssm, http
192.168.101.184 192.168.60.181 192.168.0.181 192.168.50.181 192.168.105.181 192.168.88.181 192.168.32.181 192.168.8.181 192.168.16.181 192.168.20.181 192.168.24.181 172.22.157.30 172.31.118.1	10.75.160.105	ssm, ntp, ping

192.168.101.184 192.168.60.181 192.168.0.181 192.168.50.181 192.168.105.181 192.168.88.181 192.168.32.181 192.168.8.181 192.168.16.181 192.168.20.181 192.168.24.181 172.22.157.30 172.31.118.1	192.168.101.183	ssm
192.168.101.183	10.75.160.105	ssm, ntp, ping
any computer (Client)	172.16.165.208	http, https
10.75.160.105	10.75.164.122	ssm, ntp, ssh, ping,http
10.75.164.122	192.168.101.183	ssm, ntp
10.75.164.122	192.168.101.184 192.168.60.181 192.168.0.181 192.168.50.181 192.168.105.181 192.168.88.181 192.168.32.181 192.168.8.181 192.168.16.181 192.168.20.181 192.168.24.181 172.22.157.30 172.31.118.1	ssm, ntp, ssh, ping

192.168.101.184 192.168.60.181 192.168.0.181 192.168.50.181 192.168.105.181 192.168.88.181 192.168.32.181 192.168.8.181 192.168.16.181 192.168.20.181 192.168.24.181 172.22.157.30 172.31.118.1	10.75.164.122	ssm, ntp, ping
192.168.101.183	10.75.164.122	ssm, ntp

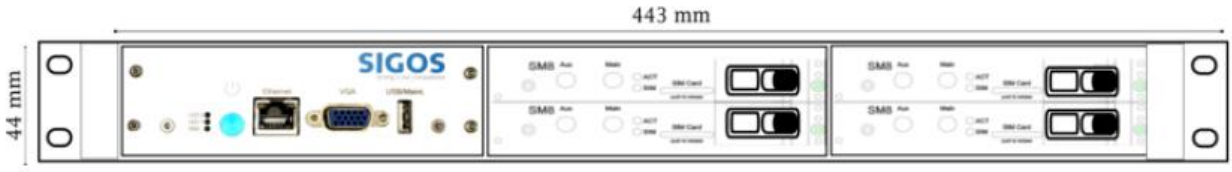
Physical installation

SIMMUX : server installed in Fermandayee Asiacell data centre with 15 SIM boxes, each box can handle 15 SIM cards. Below is the picture of the SIMMUX.

(SIMMUX)

CLUs (Probes):

The dimensions of the CLU are 443x44x270 mm3. The total height equals 4 high units of a rack. For the wiring of the Test Interfaces at the front and powering at the rear free space of at least 100 mm is required. The weight of a CLU5 is 4kg. Detailed dimensions is below.



Requirements and locations of CLUs installation:

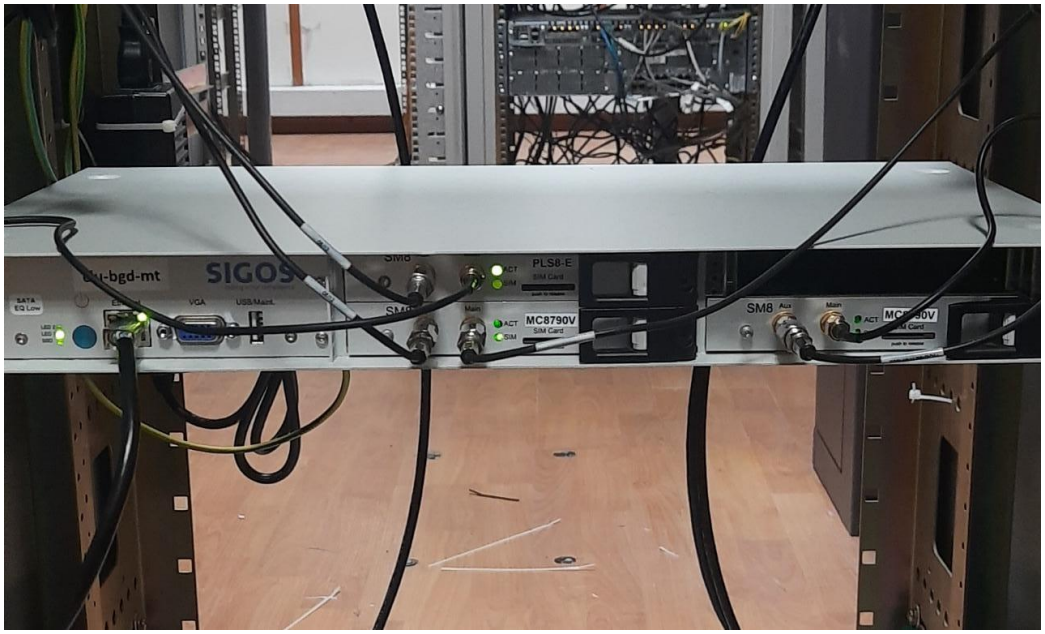
12 units installed in different location with below requirements for each unite:

- Coverage strength (-50 dBm to -90 dBm)
- RF cabinet with 4 high units in rack.
- Network connection with CU (Normal LAN connection RJ45): the connectivity is handled by IPNO
- Power source AC(220-240V).
- Environment (Temp 20- 40 °C)

Table for CLUs Location

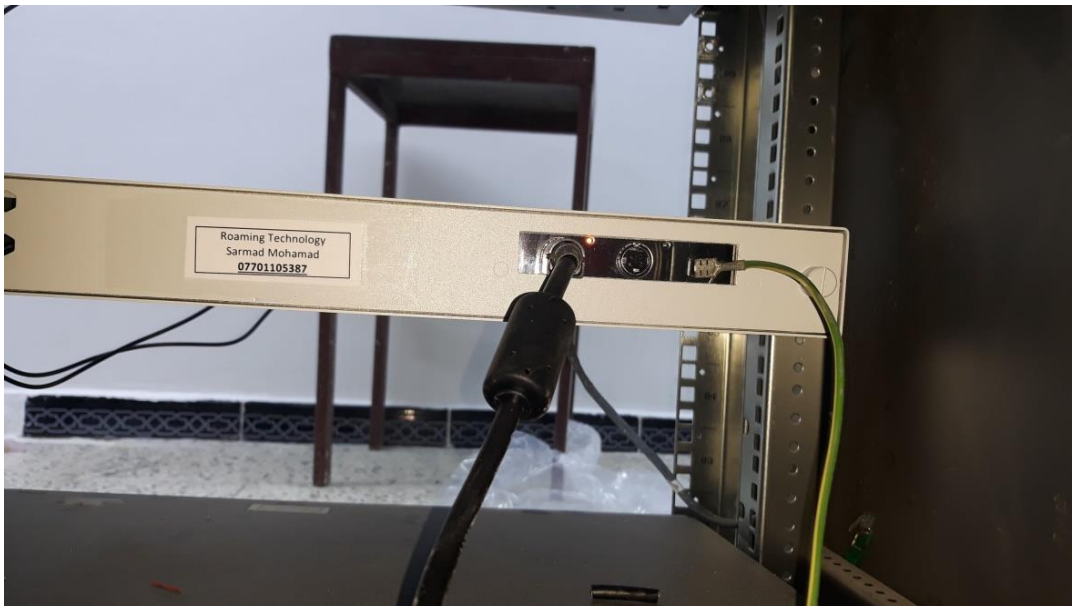
No	CLU name	CLU Location
1	Baghdad	Wazeriya (مكتب الوزيرية)
2	Baghdad AP	Airport (مطار بغداد)
3	Suly Fermandayee	Fermandayee (فرماندي داتا سنتر)
4	Suly Bashmakh	Bashmakh (مقر شرطة باشماخ)
5	Suly AP	Airpor (مطار السليمانية)
6	Erbil	Asiacell Bulding (بناية اسيا سيل)
7	Kirkuk	Rahemawa (اسياسيل داتا سنتر)
8	Basra	Brathiya (براضعية داتا سنتر)
9	Karbala Haram	Haram (حرم الحسين)
10	Karbala	BSC shelter (حي العسكر)
11	Mosul data center	Data center (المنطة الحرة داتا سنتر)
12	Amara	BSC (الحي الصناعي)

Pictures of each CLU after installation.



Baghdad Wazeriya

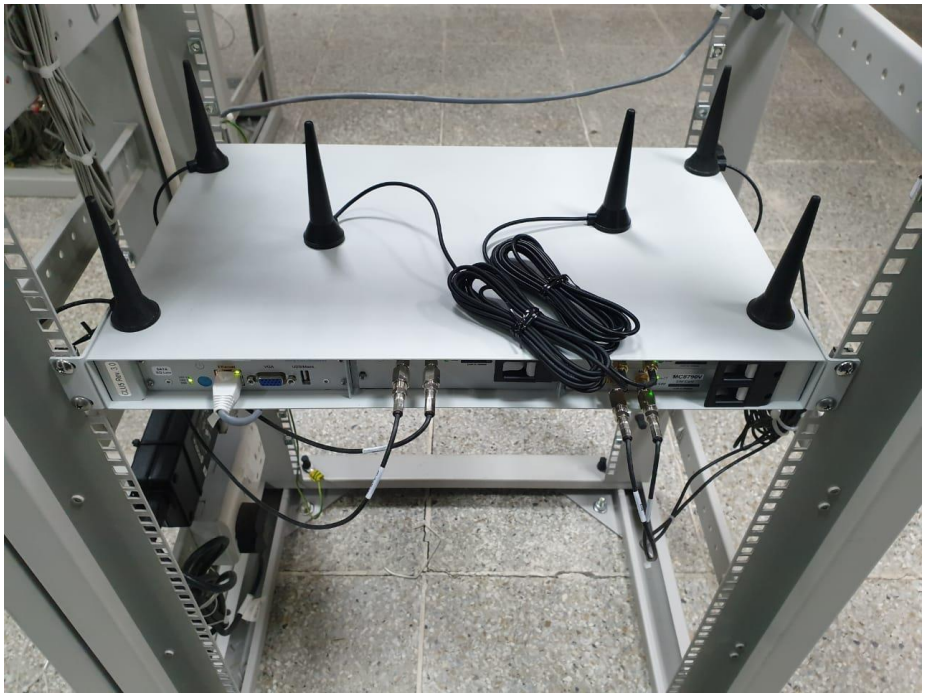
Baghdad Airport



Suly Fermandayee

Suly Bashmakh

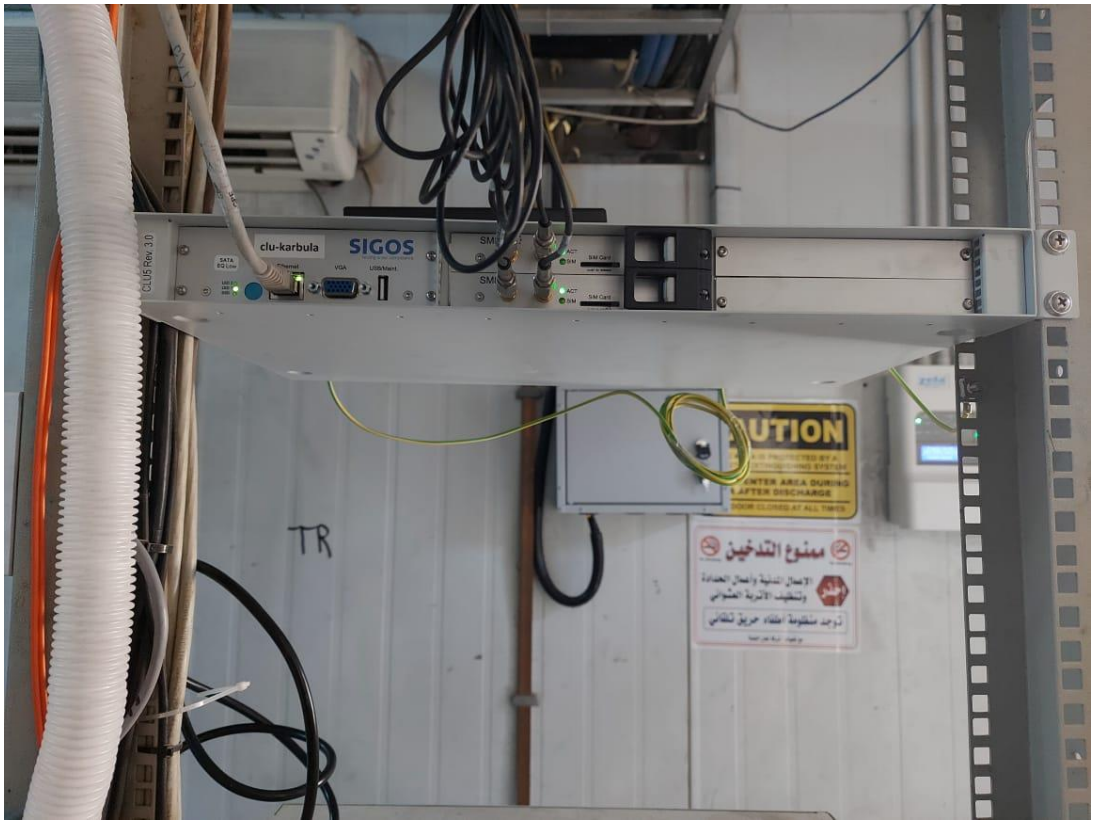
Suly Airpot


Erbil

Kirkuk

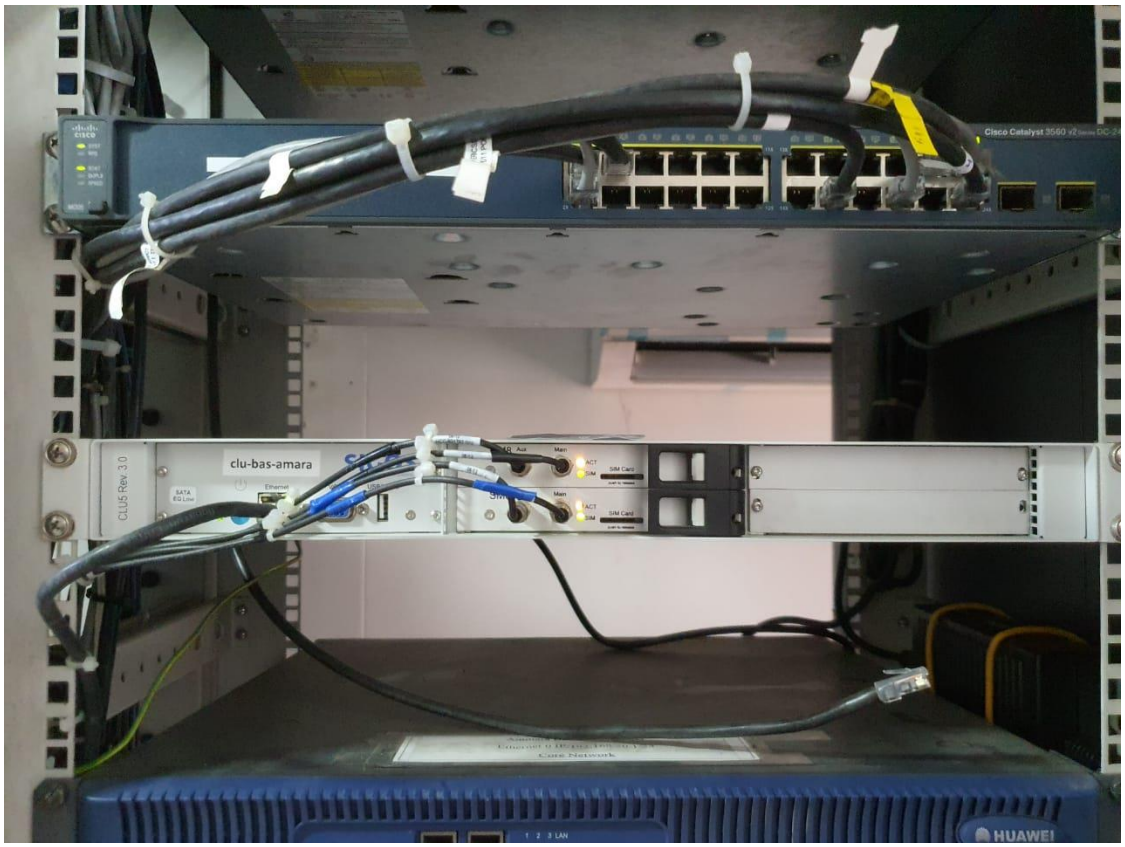
Basra

Karbala Haram



KarbalaBSC shelter

Mosul data center



Amara

SIM cards configuration:

After inserting the SIM cards physically into SIMMUX, go to siteUI data base, then CU and click on “SIM cards” table. Follow below steps

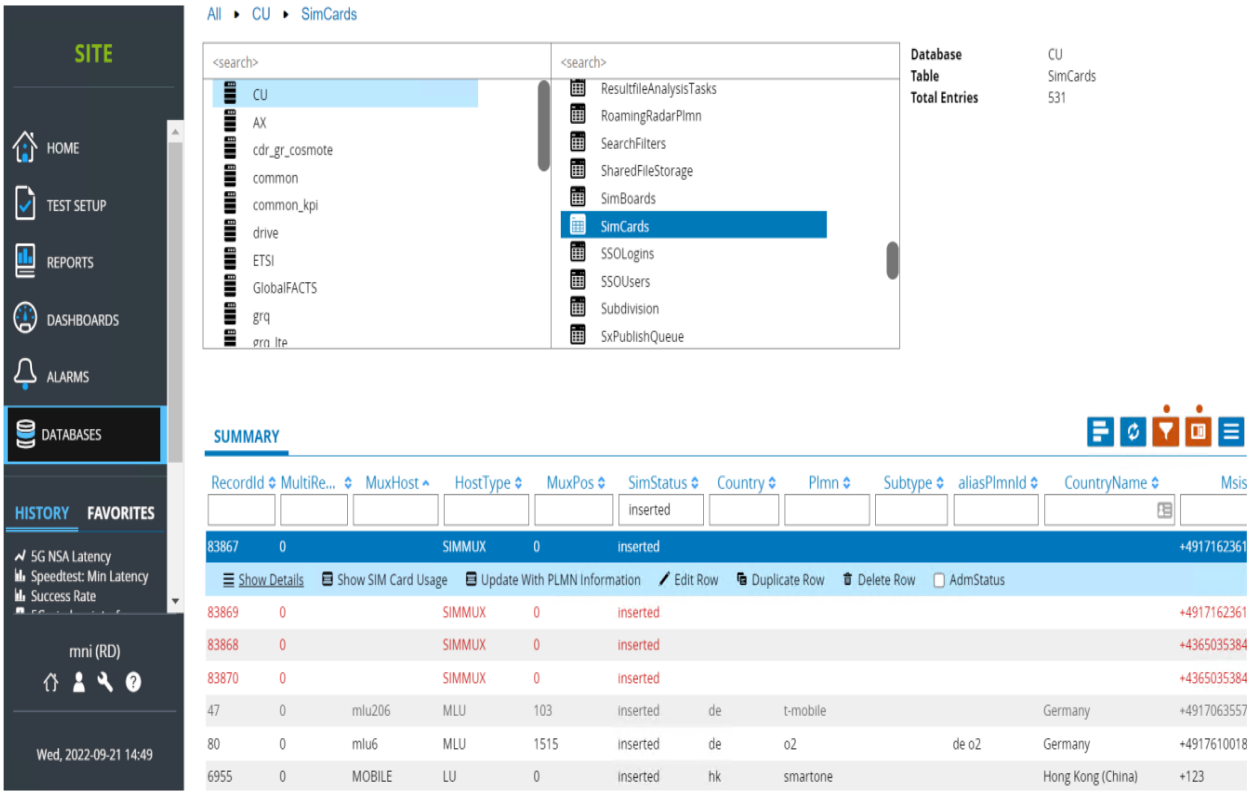
1. Define a user or a group of users in the Restricted To field

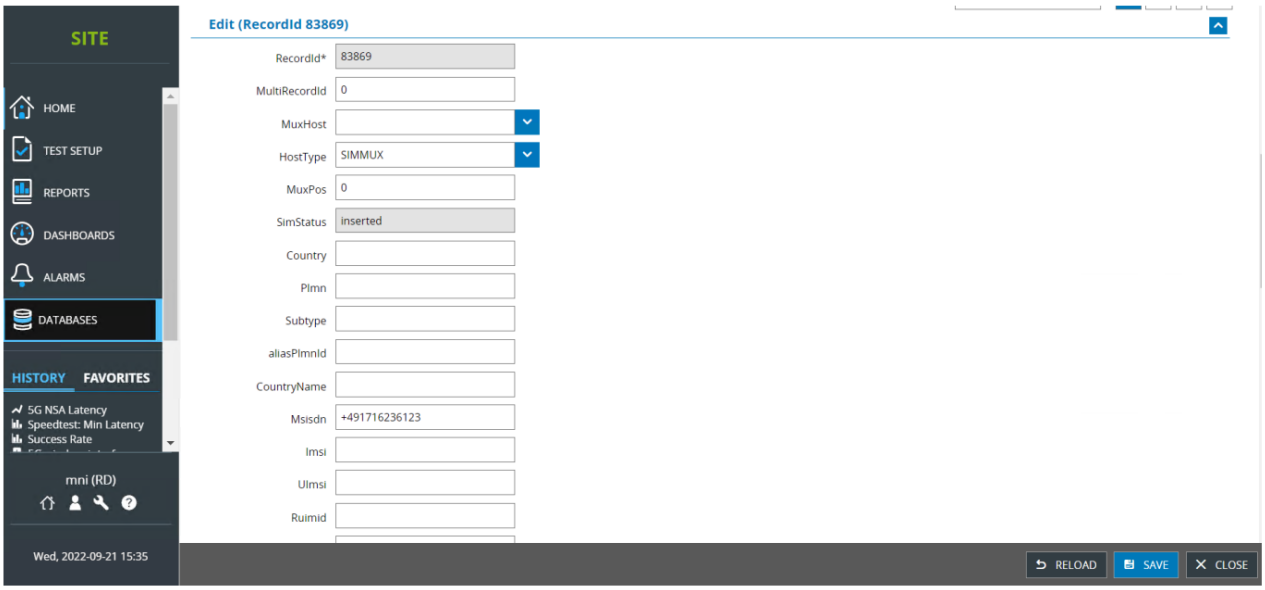
2. Define a subtype that is used to identify this new batch of SIM cards in test cases like "postpaid_trials" (operator name already given in PLMN/Country)

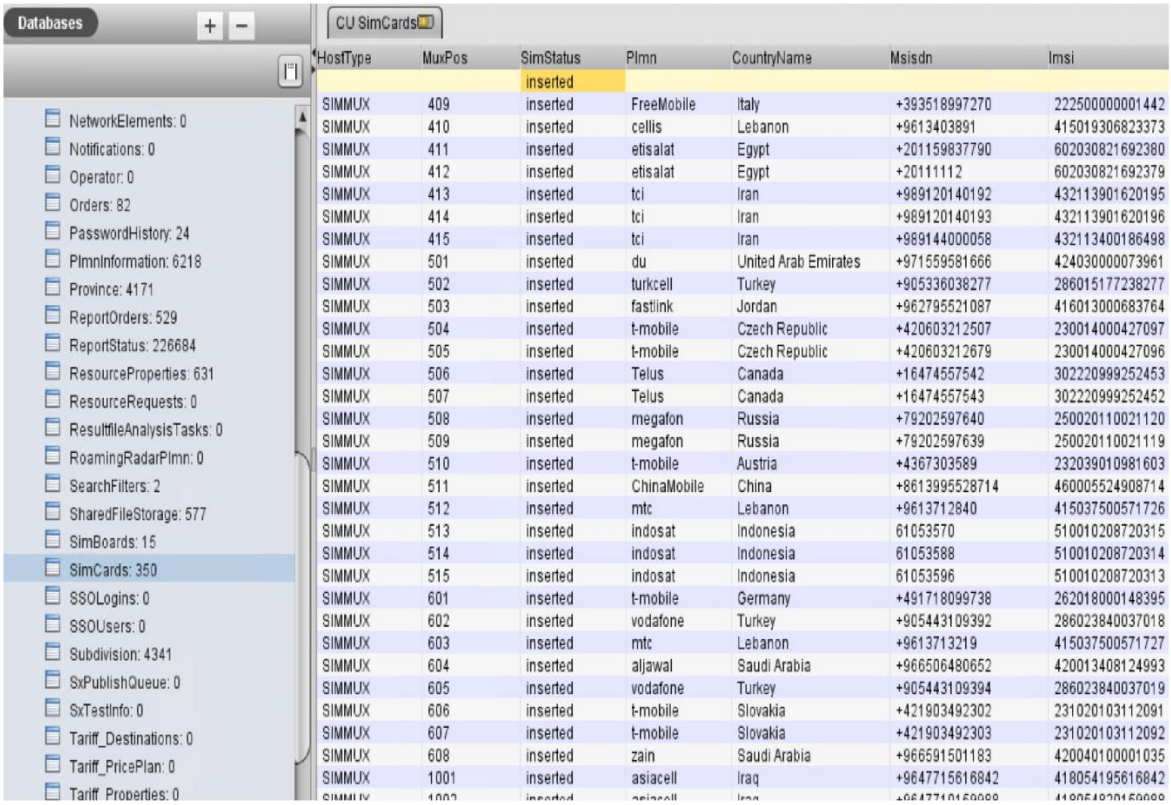
3. Add a comment with information on the intended use of these SIM cards

5. Enter the MSISDN (starting with country code).

6. Click on SAVE to save the configuration.







HostType	MuxPos	SimStatus	Plmn	CountryName	Msisdn	Imsi
		inserted				
SIMMUX	409	inserted	FreeMobile	Italy	+393518997270	222500000001442
SIMMUX	410	inserted	cellis	Lebanon	+9613403891	415019306823373
SIMMUX	411	inserted	etisalat	Egypt	+201159837790	602030821692380
SIMMUX	412	inserted	etisalat	Egypt	+20111112	602030821692379
SIMMUX	413	inserted	tci	Iran	+989120140192	432113901620195
SIMMUX	414	inserted	tci	Iran	+989120140193	432113901620196
SIMMUX	415	inserted	tci	Iran	+989144000058	432113400186498
SIMMUX	501	inserted	du	United Arab Emirates	+971559581666	424030000073961
SIMMUX	502	inserted	turkcell	Turkey	+905336038277	286015177238277
SIMMUX	503	inserted	fastlink	Jordan	+962795521087	416013000683764
SIMMUX	504	inserted	t-mobile	Czech Republic	+420603212507	230014000427097
SIMMUX	505	inserted	t-mobile	Czech Republic	+420603212679	230014000427096
SIMMUX	506	inserted	Telus	Canada	+16474557542	302220999252453
SIMMUX	507	inserted	Telus	Canada	+16474557543	302220999252452
SIMMUX	508	inserted	megafon	Russia	+79202597640	250020110021120
SIMMUX	509	inserted	megafon	Russia	+79202597639	250020110021119
SIMMUX	510	inserted	t-mobile	Austria	+4367303589	232039010981603
SIMMUX	511	inserted	ChinaMobile	China	+8613995528714	460005524908714
SIMMUX	512	inserted	mtc	Lebanon	+9613712840	415037500571726
SIMMUX	513	inserted	indosat	Indonesia	61053570	510010208720315
SIMMUX	514	inserted	indosat	Indonesia	61053588	510010208720314
SIMMUX	515	inserted	indosat	Indonesia	61053596	510010208720313
SIMMUX	601	inserted	t-mobile	Germany	+491718099738	262018000148395
SIMMUX	602	inserted	vodafone	Turkey	+905443109392	286023840037018
SIMMUX	603	inserted	mtc	Lebanon	+9613713219	415037500571727
SIMMUX	604	inserted	aljawal	Saudi Arabia	+966506480652	420013408124993
SIMMUX	605	inserted	vodafone	Turkey	+905443109394	286023840037019
SIMMUX	606	inserted	t-mobile	Slovakia	+421903492302	231020103112091
SIMMUX	607	inserted	t-mobile	Slovakia	+421903492303	231020103112092
SIMMUX	608	inserted	zain	Saudi Arabia	+966591501183	420040100001035
SIMMUX	1001	inserted	asiacell	Iraq	+9647715616842	418054195616842

SIM card DB

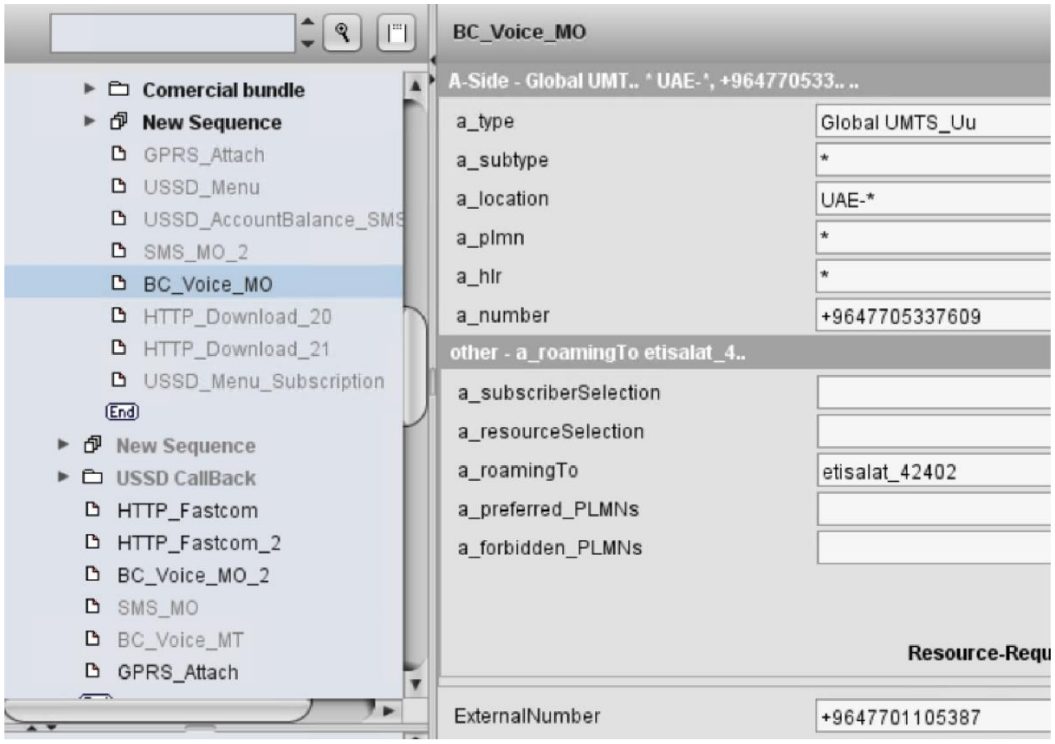
Service testing

Test cases

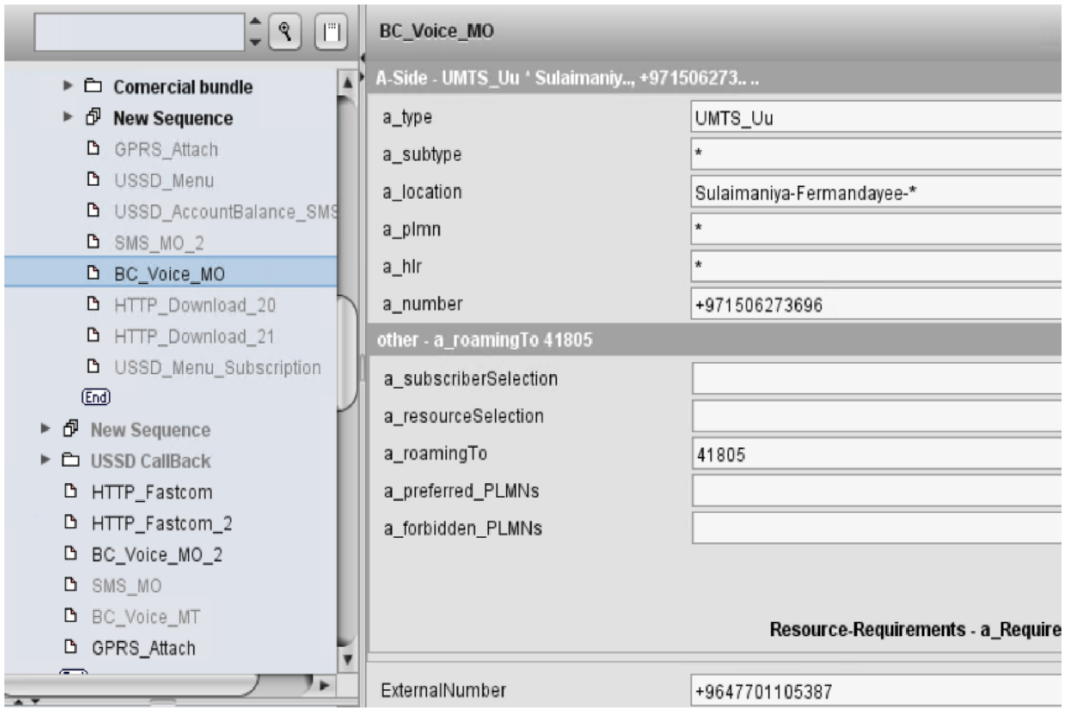
The system support hundreds of mobile network service tests, below are some basics:

Test Case Name	Description
Location Update	Registration on network
BC_Voice_MO	Basic voice call establishment to an external party
BC_Voice_MT	Basic voice call establishment from an external party
SMS_MO	Send SMS to any external number
SMS_MT	Receive an SMS from an external source
GPRS_Attach	Check whether a GPRS attach can be performed (2G/3G/4G).
HTTP_ps	Access URL and check the downloaded content for specified keywords.
USSD_AccountBalance	Send USSD Command to check the account balance.
Ookla_Speedtest	This test case uses Ookla's official command-line client for measuring the speed of Internet connection.
Forwarding_CFU	forwarding unconditional
BAOC	Activating Barring all outgoing calls and testing it
SMS_check_bill	Sending SMS and waiting for reply to check the bill
CSFB	Call service fall back, fall back from 4G to 3G and make call
VoiceQuality	Call from A-Side to B-Side and perform speech quality check

Testing menu parameters



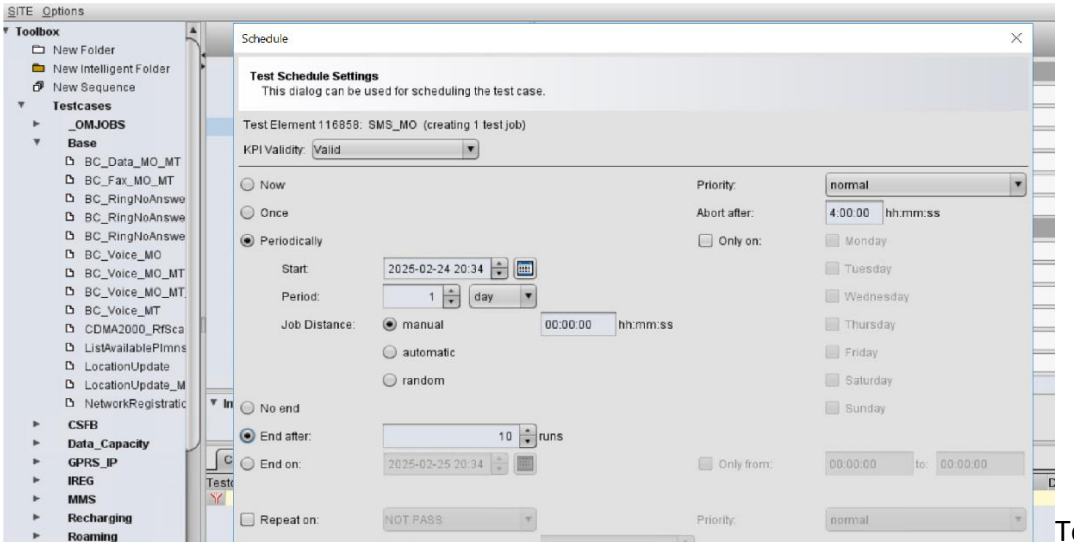
Outbound roaming



Inbound roaming

Scheduling Tests

A test execution is arranged by scheduling it. The user can schedule a folder, a test case call or a sequence call from the test definition tree. In case of a folder, the scheduler creates an execution job for each test case or sequence within this folder or any sub-folders.

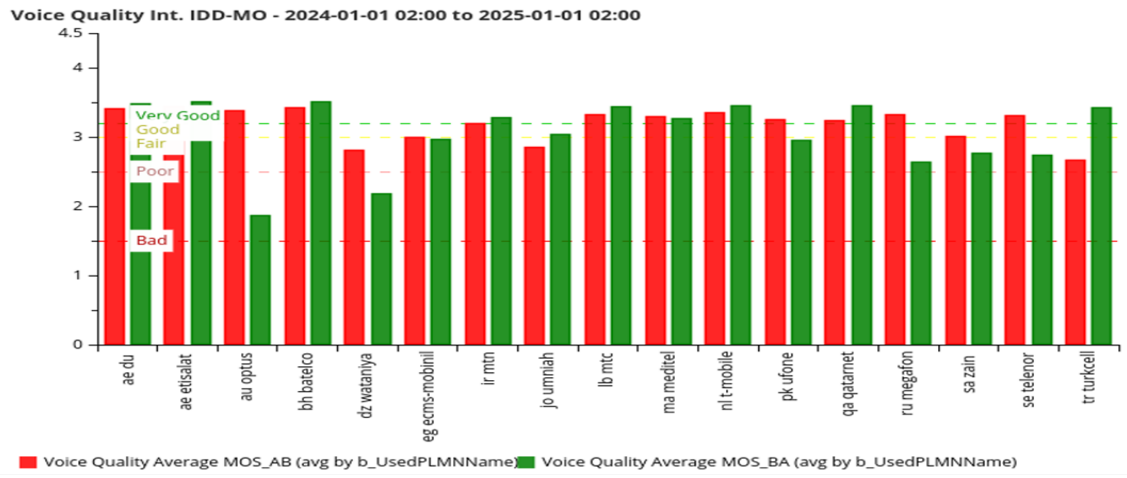


Test schedule setting

Reports

IDD (international direct dialing): it is a direct call from Asiacell number in Iraq to other countries, below is the report for scheduled Auto tests, quality of the voice will be measured as MOS (mean opinion score) which is global measurement from 1 to 4.5 .

Destinations (DU UAE, Etisalat UAE, Optus Australia, Batelco Bahrain, Wataniya Algeria, Mobinil Egypt, MTN Iran, Umniah Jordan, MTC Lebanon, Meditel Morocco, T-Mobile Netherland, Ufone Pakistan, Qatarnet Qatar, Megafone Russia, Zain Saudi, Telenor Sweden & TURKCELL Turkey)



IDD report

GRQ (Global roaming Quality): it is for outbound roaming quality, includes 4G (LTE) Speed test, attach, ping delay, packet loss….ect , below is a screenshot of the report showing us the quality under Ooredoo Group (Algeria, Indonesia, Kuwait, Maldives, Oman, Qatar and Tunisia)

sitecu Report

Report GRQ Summary LTE (ID 226626)
Definition /Periodic/Reports/Temporary/GRQ_2024/GRQ Summary LTE (ID 116008)
Creation 2025-02-24 23:00:27 UTC+03:00
URL http://siteui.site/webui/faces/pages_site/reports-new.xhtml?id=116008

Speed test - 2024-01-01 00:00 to 2025-01-01 00:00

KPI ↓	dz wataniya	id indosat	kw wataniya	om Nawras	qa qatarnet	tn tunisiana	avg
LTE Throughput DL [MBits/s]	9.89	5.66	16.37	11.12	12.07	12.48	11.96
LTE Throughput UL [MBits/s]	8.33	8.93	11.41	6.26	6.57	11.38	8.91

GRQ_matrix - 2024-01-01 00:00 to 2025-01-01 00:00

KPI ↓	dz wataniya	id indosat	kw wataniya	mv wmobile	om Nawras	qa qatarnet	tn tunisiana	avg
LTE_Attach_SuccessRatio_AV	100	100	100	100	100	100	100	100
LTE_Attach_Duration [Seconds]	9.25	16.56	7.03	7.3	6.64	8.38	7.19	8.61
LTE_PingRoundTripDelay_AV [Milliseconds]	243.28	366.59	263.62	420	415.1	344.88	227.01	307.7
LTE_PingPacketLossPercent_AV [Percentage]	0.46	0.96	0.87	0	0.66	0.08	0.63	0.59
LTE_Default_EPS_SuccessRatio_Activation_AV [Percentage]	100	100	100	100	100	99.8	100	99.96
LTE_Default_EPS_BearerActivation_Duration_AV [Milliseconds]	56.86	82.88	67.91	48	79.98	65.18	70.35	70.05
DNS_host_name_resolution_success_ratio [Percent]	100	100	100	100	100	100	100	100
DNS_host_name_resolution_time [Milliseconds]	108.11	538.7	459.9	379	1550.51	418.64	246.16	584.44
HTTP_session_success_ratio [Percentage]	100	100	100	100	100	100	100	100

GRQ

Upload/download in MB/S

Attach in Second

Ping in millisecond

Thank you