

CALLUP Steering of Roaming

Product Description



CALLUP
ONE1 TELECOM DIVISION

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1. Overview

1.1. About CALLUP

CALLUP net is a subsidiary of the One1 Group, headquartered in Israel and traded in the Tel-Aviv Stock Exchange TASE (Symbol: ONE). Founded in 1999, CALLUP has been a leading reliable provider of Value Added Services and Mobile Device Management Solutions for the telecom industry for over a decade.

1.2. About Innovation LAB

CALLUP Innovation LAB is a dynamic centre blending creativity which contains innovative products, few are patent Pending. These innovative products allow MNO's to increase ARPU and profitability in dynamic changing Eco system of OTT Apps and flat tariffs.

1.3. About CALLUP Steering of Roaming

CALLUP Steering of Roaming, or SoR for short, is a solution designed to help mobile carriers control the distribution of their outbound roamers on the desired roaming partners.

Mobile carriers may have several roaming agreements in a certain country. Some, may offer more attractive prices for data, voice and messaging services than others. In that case, the mobile carrier may prefer to have his outbound roamers connect to this cheaper partner, instead of the more expensive others. With CALLUP's SoR the operator can do just that – meaning, the carrier can direct, or *steer*, the outbound roamer to the preferred network.

However, according to the example above, if all subscribers would have been directed to the cheapest partner, we would not have any outbound roamers on the other partners in this country. This could make them unhappy. For that reason, the system enables the control of the *statistical distribution* of outbound roamers. This means for example, the mobile carrier can say that 20% will go to the less favourable roaming partner, and 80% will go the preferred partner.



CALLUP SoR is a feature-rich, high-performance platform that offers premium service with zero compromises. Utilizing CALLUP's strong VAS infrastructure, CALLUP's SoR offers high capacity traffic with Telco-grade high availability. The modular design enables CallUp to offer an easily upgradeable, entry-level system so you can pay as you grow.

2. System Architecture

The following diagram describes the SoR architecture in high level:

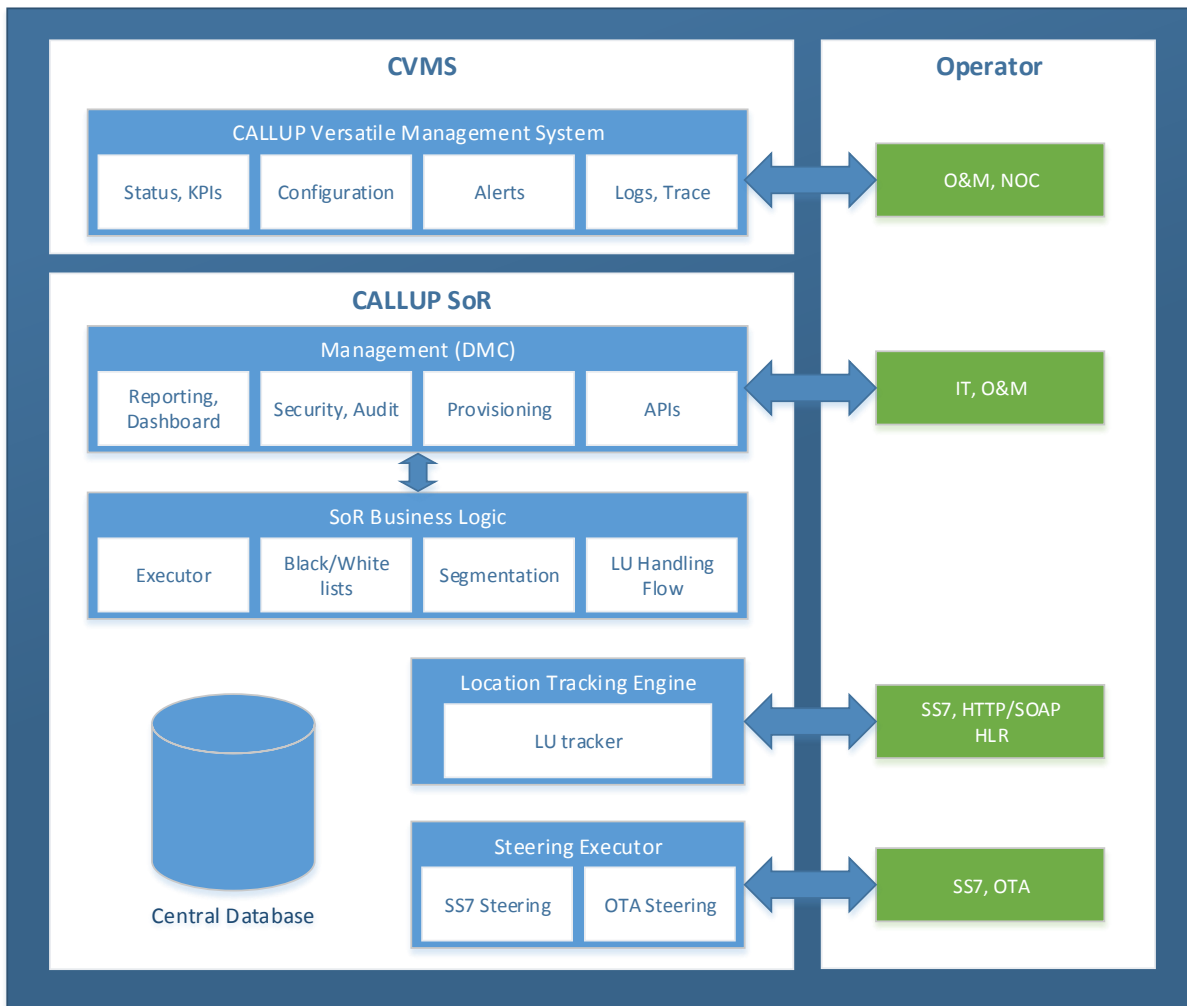


Figure 1 - CALLUP SoR Block Diagram

Module Overview:

- **Management module:**
 - UI for operations and maintenance
 - GUI provisioning of the settings and preferences
 - User permission, security and audit logs
 - Reports, statistics, BI and system dashboard
 - APIs (SOAP) for the operations and maintenance of the platform
- **Business logic module:**
 - Flow of handling location-update events coming from the Location Tracking engine
 - Takes decisions on the necessity of steering
 - Black/white listing
 - Operator and country groups management

- Dynamic PLMN/FPLMN generation
- Multi-IMSI considerations
- Subscriber segmentation (i.e. heavy users)
- Location Tracking Engine:
 - Handles the triggers for location updates
 - Connects to the relevant source, either as SS7 proxy/probe or provides API for external parties to call (i.e. HLR)
- Steering Executor:
 - Executes the actual task of steering
 - Receives commands from the SoR business logic modules
 - Uses either SS7 or OTA

3. High Level Feature List

Feature	Description
Hybrid Steering	Change roamer's network to the desired one, using a combination of SS7 and OTA techniques.
Friendly Provisioning	Rich and easy to use web UI for setting service preferences.
REFRESH applet	Smart refresh STK applet, for all card vendors, for reloading PLMN lists on the fly.
World Map Reports	Interactive world map, with drilldown statistics about each country.
Access Technologies	Support all access technologies (2G, 3G, 4G), fine control of roaming agreements and steering.
Dashboard	Control panel with status, application routing configuration, logs, user management etc.
API	Application programming interface to operate every aspect of system's provisioning, operations and reporting.
Welcome SMS	Welcome SMS when arriving abroad, and welcome back SMS when arriving home.
Tariff Confirmation	Allow roaming only after SMS confirmation from subscribers about their tariff!
Black List	Block ranges of IMSIs, MSISDNs from steering. Block particular countries or operators.
Multi-IMSI	Multi-IMSI supported, system supports the combination of direct agreement in parallel to multi-IMSI agreements.
CDR Generation	Detailed CDRs on every incoming and outgoing message/call which passes through the server.

Statistics and Reports	Detailed usage reports, usage statistics, available from the web management console and CVMS.
Detailed Logger	Detailed logger which enables troubleshooting and problem investigation easily.
SNMP Alarms	Alarms on various hardware and software events, sent to NOC over SNMP, and available from CVMS.

4. SoR Functionality

4.1. Hybrid Steering

The basic and most important feature is the system's ability to detect, and later direct (steer) outbound roamers to the preferred network, automatically.

Detection of a new roamer can be achieved in two ways:

1. SS7 proxy, before the HLR, to detect MAP UPDATE LOCATION messages
2. HLR feature, that sends location changes event to 3rd party applications

Both methods are easy to implement. With the first, all that's needed is to configure in STP to route all MAP UPDATE LOCATION messages to the CALLUP SoR SS7 module (Location Tracking Engine).

Note – a backup route direct to HLR is always defined in STP, to allow access to HLR in any event of SoR outage. With the second, a simple integration with the HLR's API achieves similar functionality.

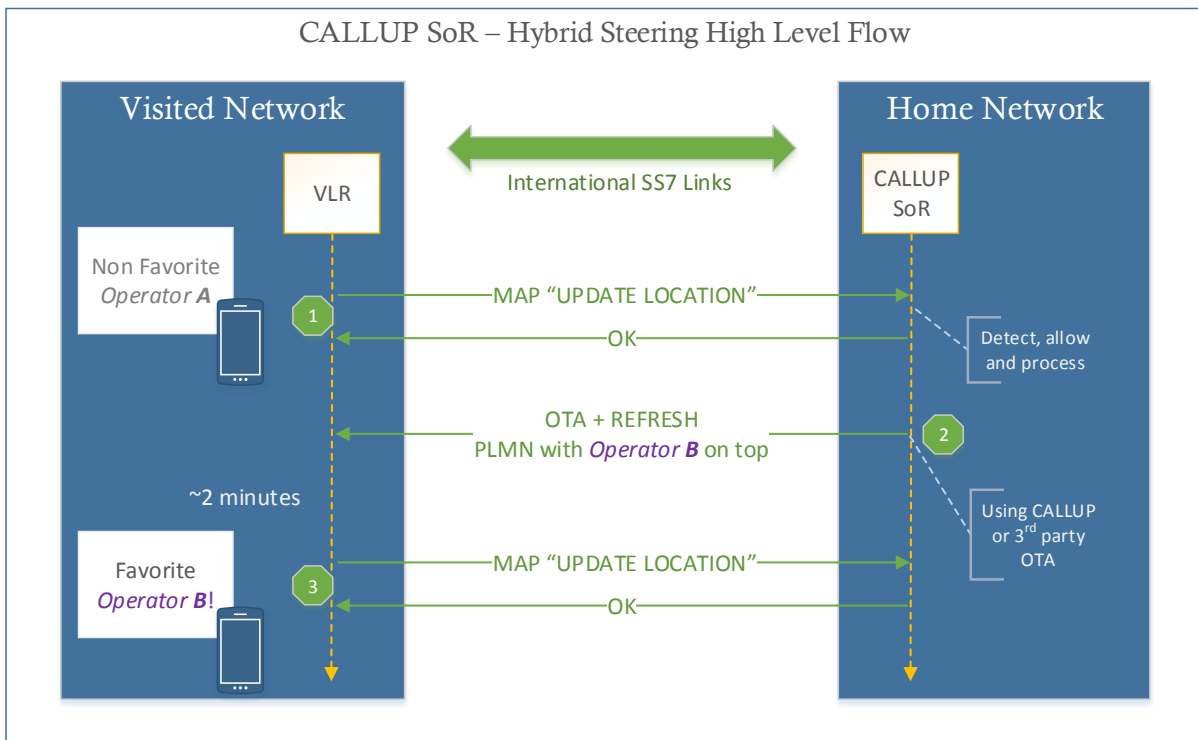


Figure 2 - Hybrid Steering Flow

The preferred network is calculated automatically by the SoR platform, based on the inputs provided in the SoR preferences GUI (see next chapter).

The settings are then sent to the handset, over the air, and the handset is instructed to REFRESH its data from the SIM, and reconnect to the network. As seen in the example shown in “Figure 2 - Hybrid Steering Flow”, Step 3, the end result was achieved, and the roamer is on the preferred network.

CALLUP’s SoR can work in SS7 steering mode. This means that for non-OTA supporting SIM cards (for example), the SS7 module can reject the “UPDATE LOCATION” MAP request from the roamer, if it is a non-preferred network. This method is not the recommended way, since:

1. Bad customer experience – subscribers might have to wait long minutes until they get service
2. Not compatible with some new devices
3. Susceptible to anti-steering

This is why CALLUP, although supports SS7 steering, recommends the hybrid approach, which provides the best success rates, and eventually best results from the steering solution.

4.2. Provisioning

The system’s administrator can define log in and configure its preferences using an easy to use web based GUI tools. The tool enables fine settings of the operator preferences. To list just a few examples:

- Define the operators with whom you have roaming agreements with.
- Define the VLR prefixes related to these operators.
- Define the preferred percentage per operator. The system will make sure outbound roamers will distribute according to these preferences.
- Support multiple MCC per country.
- Get the current image of outbound roamers, for each operator and total for this country. This includes the breakdown of distribution per IMSI type, if multi-IMSI is used by the operator.

Country	Country Name	MCC	CC	MCC 2	Total HM	Total VF	Total SFR	Total
Italy	Italy	222	39		90	2	0	92
Germany	Germany	262	49		10	58	0	68
France	France	208	33		57	7	0	64
United Kingdom	United Kingdom	234	44		0	41	0	41
Japan	Japan	440	81		0	39	0	39
Romania	Romania	226	40		1	34	0	35
Thailand	Thailand	520	66		33	2	0	35
Spain	Spain	214	34		0	32	0	32
Turkey	Turkey	286	90		30	0	0	30
Russian Federation	Russian Federation	250	7		4	23	0	27
China	China	460	86	461	0	25	0	25
Greece	Greece	202	30		4	21	0	25
Saudi Arabia	Saudi Arabia	420	966		0	24	0	24
Czech Republic	Czech Republic	230	420		1	21	0	22
USA	USA	310	1	311	0	22	0	22
Cyprus	Cyprus	280	357		0	20	0	20
Netherlands	Netherlands	204	31		5	9	0	14
Switzerland	Switzerland	228	41		13	1	0	14
Poland	Poland	260	48		7	7	0	14
Belgium	Belgium	206	32		9	1	0	10

Figure 3 - Steering Provisioning

4.3. Access Technology

The specific access technology of the roaming agreement can be set, and is taken into considerations, as part of the system's set of business rules and decisions. This means, you can control 2G, 3G and LTE agreements differently.

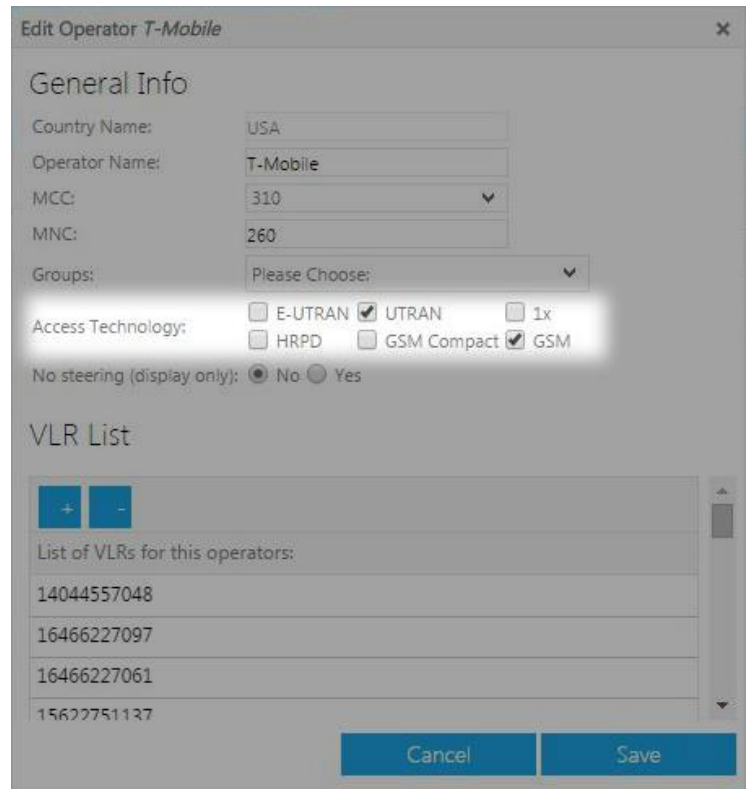


Figure 4 - Access Technology

4.4. Dynamic PLMN and FPLMN Generation

During the processing of a location update trigger, the decision if steering is required or not is taken. If the decision is yes, and OTA based steering is used, the system will:

- Build the list of the preferred networks, in the correct order as preferences direct
- Build a list of forbidden networks (FPLMN), if required
- Do the above for the various file systems on the card (i.e. 2G, 3G, 4G etc.)
- Deliver these lists to the card
- REFRESH the handset so that it reads these lists again, and reconnect to network, now with the correct order of PLMN, with the preferred network on top

The process of building the correct PLMN and FPLMN lists take into account several factors, including constant prefixes and suffixes, preferred networks in the country, other networks in the country, and other network in the surroundings or groups.

4.5. Export and Import

The complete list of preferences, as well as the current roamer count, status and distribution, can be exported to an excel file. This can be used as a report or to be saved for backup purposes. The list can also be imported, for bulk provisioning of the entire preferences from one file.

4.6. Black Lists

The SoR administrator can create and maintain various types of blacklists. The blacklists are lists of numbers, which can represent for example MSISDN range or IMSI range, for which steering of roaming operations are not allowed.

CALLUP SoR platform can blacklist:

1. IMSI numbers and ranges
2. MSISDN numbers and ranges
3. MCC numbers and ranges
4. MNC numbers and ranges

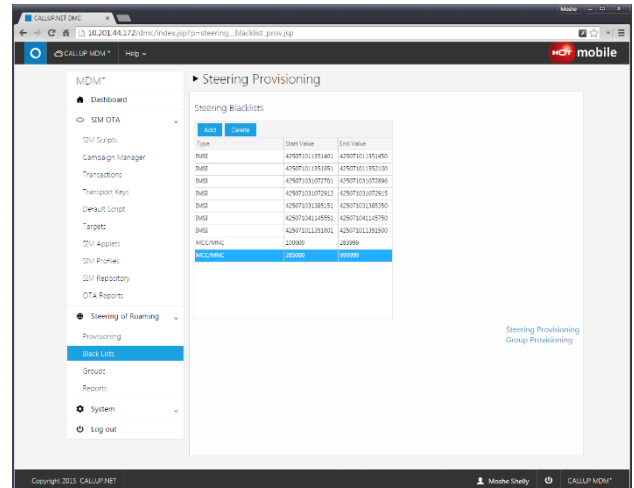


Figure 5 - SoR Blacklists

This provides great flexibility, and enables blocking segments of numbers, or certain countries or networks completely from steering of roaming operations.

4.7. Welcome SMS and Tariff Confirmation

For roamers landing at their destination country, as well as to roamers returning home (welcome back SMS).

If the charges/package information can be retrieved from the billing systems, CALLUP SoR can retrieve information about package/tariff and include this in the text sent to the subscriber abroad upon landing. This can even be used for confirmation – meaning, using a two-way SMS mechanism, ask for the user’s confirmation on the tariff before allowing mobile service abroad.

4.8. Customizable Business Logic

The handling of a location update trigger is the heart of the system. This event needs to be processed, in real time, and a decision about how to process this trigger needs to be taken.

So factors that are taken into consideration during this process:

1. Can we identify the subscriber/IMSI of the event?
2. Do we have the subscriber’s previous location?
3. Per-user history (Do Not Disturb timer) – did we successfully steer this subscriber, in this country, in the last X minutes?
4. Per-country timer – improve the user experience, by allowing some grace time to the subscribers to settle, before doing the steering. This greatly improves the user experience!
5. Is the subscriber/country/network blacklisted?

All this considerations and more are taken in the business logic, which is great out of the box but also fully customizable as per each customer’s needs.

4.9. CVMS Interconnection

The SoR platform, as all other products from CALLUP, interconnect to CALLUP’s CVMS – the CALLUP Versatile Management System.

CVMS is used to manage common O&M tasks for all of CALLUP’s products, and particular SoR events, KPIs, counter and alerts are available. The common tasks performed using CVMS include KPI inspection, start/stop of services and modules, health checks, alarms, viewing and inspecting log files and traces, changing module configuration and more.

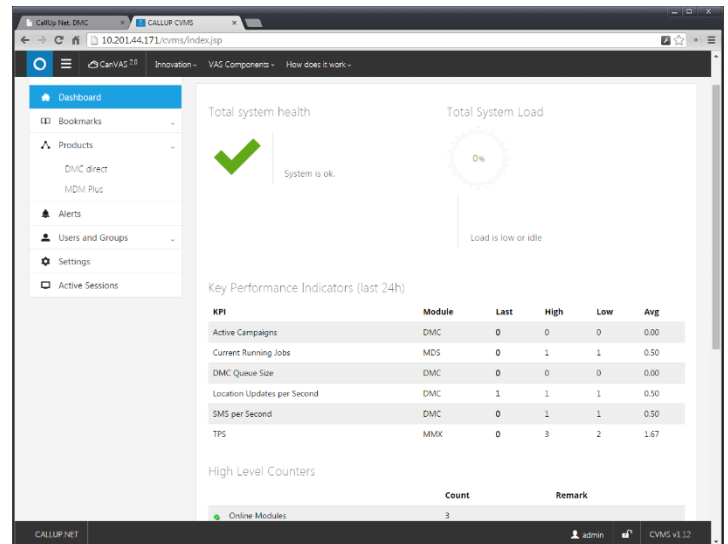


Figure 6 - CVMS KPIs

4.10. Multi-IMSI Support

A mobile carrier may choose to mix two approaches for roaming, which can live side by side – direct roaming agreements, and multi-IMSI service in which IMSI ranges are provided as a service from a big operator or broker (such services are provided by BICS or Vodafone for example).

CALLUP’s SoR platform fully supports this setup. It contains the logic and GUI to handle the mission of setting where do we want our subscribers to use the broker’s services, and where do we want them to use our direct roaming agreements. The reports and statistics that the platform provides include the distribution of there “IMSI” numbers, or basically how our subscribers connected, directly or via our roaming broker services.

4.11. Dashboard

The administrator of the CALLUP’s Steering of Roaming solution lands on a dashboard GUI after login, with some interesting information. This includes latest steering success rates, number of location update events in the past 24 hours or past week, numbers of steering operations and some interesting KPIs such as queue size and connectivity indicators.

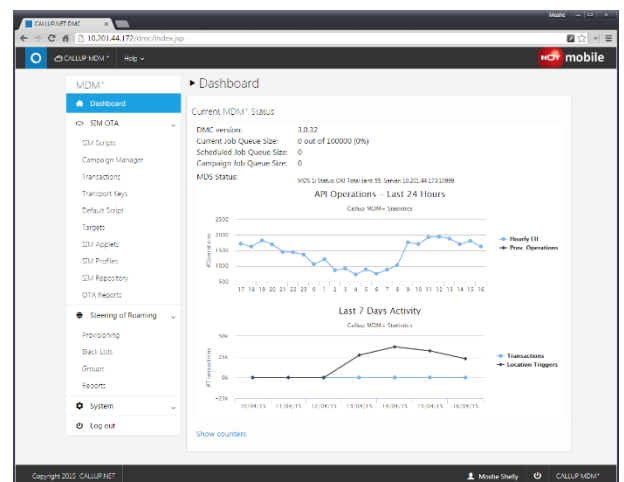


Figure 7 - SoR Dashboard

5. STK Applets

CALLUP provides complementary STK applets that complete and enrich the functionality of the SoR solution. This chapter will describe some of the relevant ones.

5.1. REFRESH STK Applet

The REFRESH applet provides the ability to make the device refresh, meaning reload the contents of the SIM card files, and reconnect back to the network again with this freshly read information.

The logic of CALLUP's STK applet includes several technics to improve the chances of success of the REFRESH operation, to support all devices, and all REFRESH types, including retries, remote configuration etc.

Some of the features of the REFRESH applet include:

1. Remote configuration
2. Enable/Disable
3. Static and dynamic SoR modes
4. Multiple REFRESH types
5. Textual message display to user in some cases
6. Retries and timers

The REFRESH applet allows the triggering of this REFRESH operation remotely, using SMS. The SMS is a special binary SMS, which is targeting the applet itself, and based on the strict security and encryption schemes required for communicating with SIM cards.

The REFRESH applet is not mandatory – should a REFRESH applet already exists on the operator's SIM cards, CALLUP can use the already existing one, and does not have to necessarily deploy CALLUP's applet on all cards.

5.2. Bill Shock Preventing STK Applet

The Bill Shock Preventing STK applet allows the operator to provide real time information about the costs to the subscriber. Especially for situations where there's no CAMEL agreement, or maybe other setups where real-time information cannot be achieved in another way, the Bill Shock Preventing STK applet can:

- Monitor any outgoing call
- Count the time
- Query the server using USSD, and display the cost in real time to subscriber
- Aggregation of costs, daily or one time when returning home

6. Connection with Billing System

The Steering of Roaming platform does not necessarily need to be connected to the operator's billing platform. The system provides the fact cost savings, but those are for the mobile carrier itself, on the interconnection charges.

However, there are few places where such a connection might be required:

1. Heavy-users determination. The SoR can collect information about individual subscribers, and give them a sort of "weight" factor. This factor can be used for steering calculation, to provide a better distribution, which is based on actual usage rather than number of roamers.
2. Welcome SMS Tariff – Should the operator choose to include the costs for this country, in the welcome SMS message (or to request confirmation via SMS back), a connection with the billing system should be established, such that this information will be provided to the SoR platform.

Interfaces to Pre-Paid, Post-paid or converged billing systems, via standard protocols such as Diameter or HTTP, are available. The integration to the billing system is done using a generic Callup component called BaP - which stands for Billing and Provisioning. This means that only the BaP interface is modified and adapted to the specific requirements of our customer, and the specific billing/OSS platform.

7. Reports

The SoR constantly collects and stores interesting information about the subscriber traffic, distribution over the globe and various operators, and about every event that passes through it.

This information is stored in the database, and several reports are available out of the box. These reports include for example:

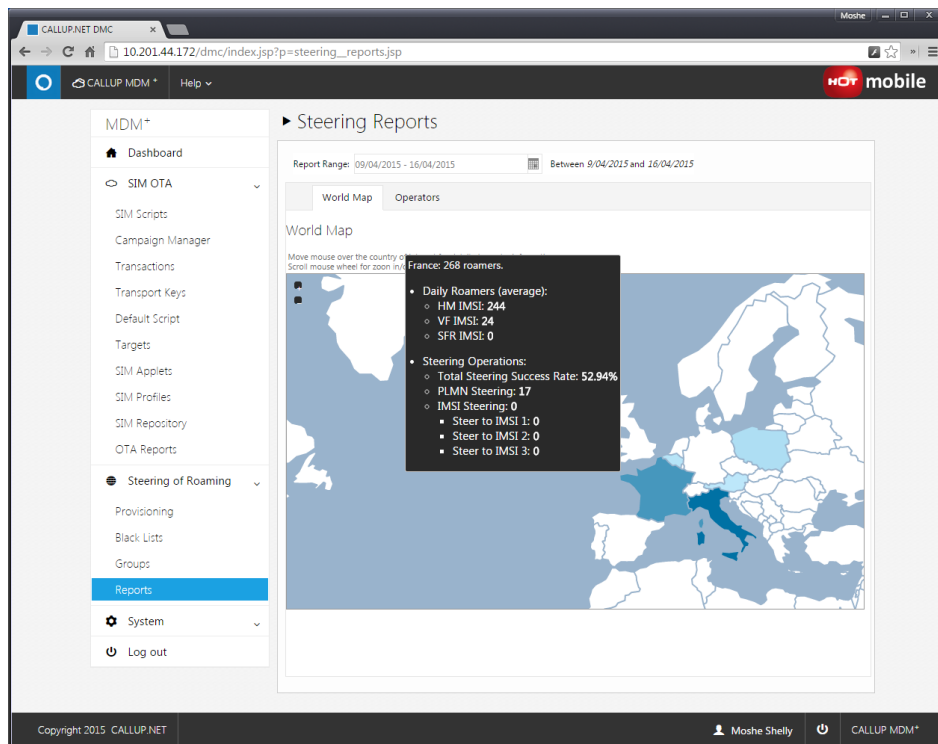


Figure 8 - SoR World Distribution Report

1. World distribution report:

Graphically shows the number of roamers in each country on the globe. Hovering over a country shows steering success rates, number of roamers per IMSI, and total number of roamers. All of the above can be shown per time period of choice.

2. Operator report:

Graph that shows, for the selected period of time, and for the selected countries and/or networks, the number of subscribers over time, the percentage required for each network, the actual percentage of actual subscribers, and the gap between the preferred and the actual percentages.

3. Preferences Report:

This the current number of roamers, for all the network and all the countries, along with our set of preferences for each network and country.

All of the SoR reports can be exported to excel or PDF format. In addition, a subscriber can choose to register to a report over email. The report can be sent to the email on a daily or weekly basis.

8. Deployment Options

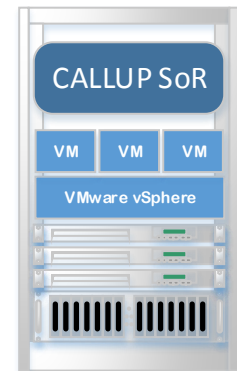
The system can be deployed in 3 ways – physical, virtual and cloud.

8.1. Physical Deployment on Site

This option means the system is provided as a turnkey solution. All HW, 3rd party SW and CALLUP SW is provided by CALLUP, as a complete end to end solution.

CALLUP is using standard hardware equipment, usually from HP. CALLUP provides OEM agreement from HP which can provide 5 year warranty on hardware with NBD (Next Business Day) part replacement.

On top of the hardware (usually servers, storage and switching functions) CALLUP runs VMWare software for virtualization, so the solution is always eventually installed on virtual machines.



Turnkey
HW and SW from CALLUP

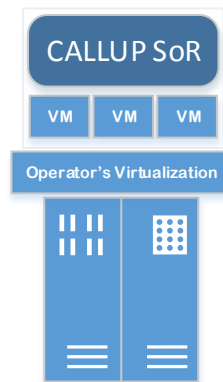
8.2. Virtual Deployment (Customer's Computing Resources)

With this option, the customer provides the computing resources.

CALLUP provides requirements, or SPECs, with the capacity required in terms of number of guests, number of CPUs, size of RAM, storage volume and IOPS etc.

This option is good for carriers who already invested in such virtualization infrastructure, and can take the load of computing and virtualization for the steering platform.

Note – this option may be partially available if SS7 is required, and the customer does not support SS7 over IP (SIGTRAN).



Virtual
VM images from CALLUP

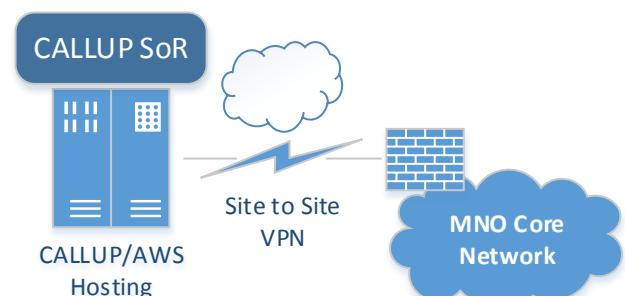
8.3. Cloud Deployment

With this option, the customer is not involved in the hardware/computing resources at all. CALLUP provides the computing services, either by hosting the services on CALLUP's server farms, or by using public/private cloud infrastructures (for example, AWS from Amazon). This method eliminates the hassle of working with physical hardware, taking care of hardware failures, support contracts and SLAs, power consumption etc.

Amongst other benefits of a cloud solution:

- Managed service
- Solution resources aren't dictated by peaks
- Gradual growth

Note – this option may be partially available if SS7 is required, and the customer does not support SS7 over IP (SIGTRAN).



9. Scalability and High Availability

The solution is designed to be saleable. This means, the system can be dimensioned to support small to extremely large amounts of traffic. An entry level system provides full steering capabilities with a throughput of 1-10 location updates per seconds. This system can be dimensioned to support hundreds and thousands of location updates per second.

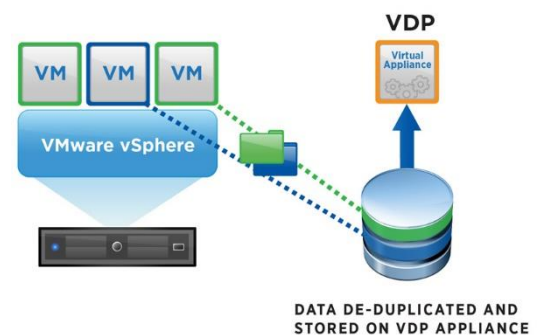
CALLUP SoR has an availability of %99.999. There is no single point of failure as the product is deployed in a cluster of N+1 servers while all critical message information is kept in a failsafe database cluster. All signalling links are duplicated and redundant.

10. Backup and Restore

CALLUP SoR solution is running on virtual machines. The virtualization platform of choice is from VMWare, the work leader of virtualization technologies.

The solution includes license for a backup and restore software package called **vSphere® Data Protection**, or VDP for short.

VDP is a backup and recovery solution designed for vSphere environments. Powered by **EMC Avamar**, it provides agent-less, image-level virtual machine backups to disk. vSphere Data Protection is fully integrated with vCenter Server and vSphere Web Client, and is easy to use and operate.



VDP offers efficient backup and recovery, including:

Figure 9 - VDP Backup and Restore

- **Variable-length deduplication:** Achieves very high deduplication rates and minimizes backup storage requirements by up to 75 percent compared to fixed-length deduplication technologies. Deduplication is performed across all virtual machines backed up by the same virtual appliance.
- **Integration with EMC Data Domain Systems:** Increase scalability by backing up data to a Data Domain system; increase backup efficiency using DD Boost software.
- **Automated Backup Verification:** Scheduled automated virtual machine restores provide the ability to test backup integrity.

10.1. Default Backup Policy

The default backup policy includes:

1. Complete daily backups of all virtual machines
2. 90 days back of images
3. Complete daily application backups (for file-level restore of application/configuration)
4. Complete daily database backups (for selected tables, for file-level restore of data from DB)

11. SoR Specifications and Standards

11.1. Software Specifications

- System alarms and management functions are over SNMP
- ITU-T Recommendation Q.701/Q.703 (07/96) Signalling system no 7 – MTP2&3
- ITU-T Recommendation Q.711 – Q.714. Blue Book (1988) Signalling system no 7 – Signalling Connection Control Part Procedures
- ITU-T Recommendation Q.771 – Q.774. Blue Book (1988) Signalling system no7 – Transaction Capabilities Procedures
- GSM 09.02 version 7.8.0 – Release 98 Digital cellular telecommunications system (Phase 2+); Mobile Application Part (MAP) specification
- SMTP RFC 821
- SMPP 3.4
- GSM 03.40
- 3GPP TS 24.341
- RedHat or Oracle Linux cluster or Microsoft Windows 2008 and up
- SQL database
- Interfaces to SMSC (SMPP) and billing systems (HTTP, Diameter)
- HTTP for Web interface
- Full SIGTRAN support

11.2. Hardware Specifications

- The SoR hardware is based on server, storage and networking solutions from HP.
- Virtualization and backup/restore provided by VMWare.
- Servers are connected to storage via fiber channel connections, usually via a fibre switch
- High availability Ethernet cluster is based on HP switches
- All servers have redundant power supplies, fans, Ethernet interfaces and RAID disks.
- AC (110-250V) or DC (-48V) power options are available
- Final BoM of HW is provided by CALLUP, after evaluating the scale and customer's needs