

Product Guide | Portfolio | Use Cases



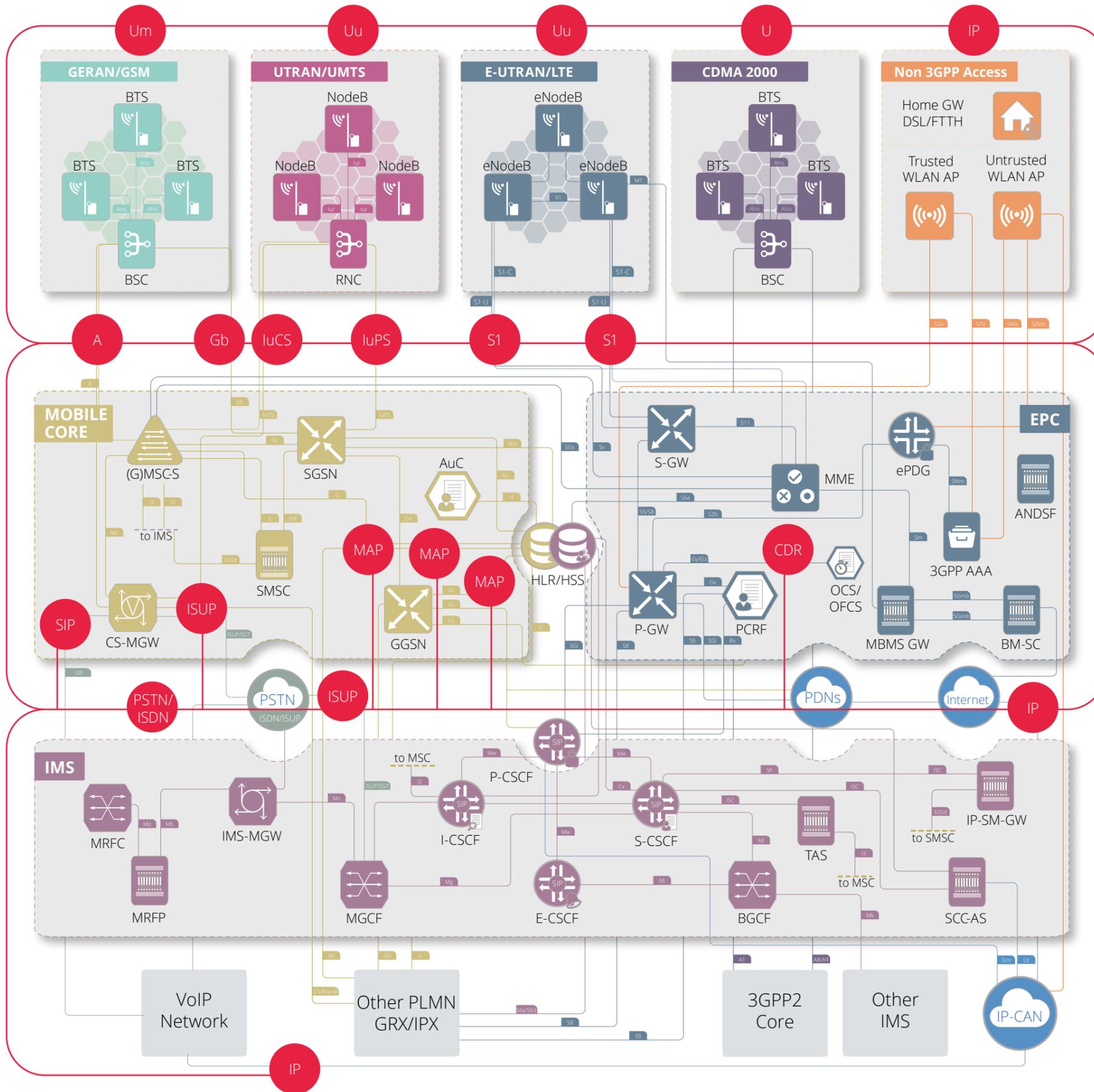
GlobalRoamer & Roaming Services

Professional Services Telecommunications

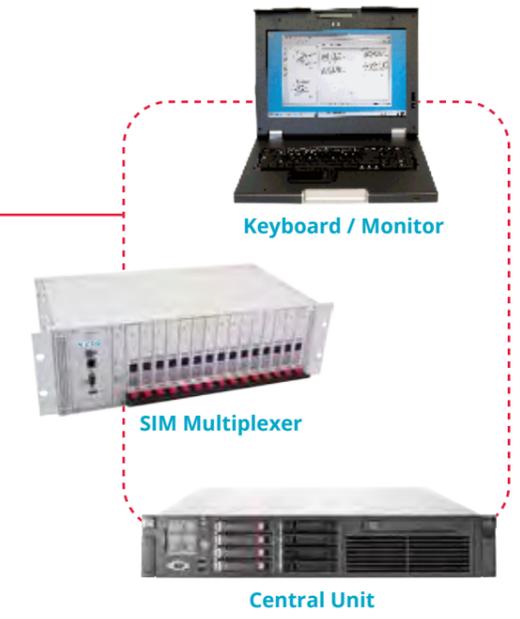
SITE for Quality of Service & Quality of Experience Testing

Revenue Assurance

Fraud & SIM Box Detection



SITE Central Components



Abbreviations

- XY SIGOS test interfaces for multiple technologies
- SITE Communication Network
- 3GPP** 3rd Generation Partnership Project
- 3GPP AAA** 3GPP Authentication Authorization and Selection Function
- ANDSF** Access Network Discovery and Selection Function
- AP** Access Point
- AuC** Authentication Center
- BGCF** Breakout Gateway Control Function
- BM-SC** Broadcast Multicast - Service Center
- BSC** Base Station Controller
- BTS** Base Transceiver Station
- CDMA** Code Division Multiple Access
- CDR** Call Detail Record
- CS-MGW** Circuit Switched - Media Gateway
- DSL** Digital Subscriber Line
- E-CSCF** Emergency - Call Session Control Function
- EPC** Evolved Packet Core
- ePDG** Evolved Packet Data Gateway
- E-UTRAN** Evolved UMTS Terrestrial Radio Access Network
- FTTH** Fiber To The Home
- GERAN** GSM EDGE Radio Access Network
- GGSN** Gateway GPRS Support Node
- (G)MSC-S** (Gateway) Mobile Switching Center - Server
- GRX/IPX** GPRS Roaming Exchange/IP Exchange
- GSM** Global System for Mobile Communications (2G)
- GW** Gateway
- HLR** Home Location Register
- HSS** Home Subscriber Server
- I-CSCF** Interrogating - Call Session Control Function
- IMS** IP Multimedia Subsystem
- IMS-MGW** IMS Media Gateway
- IP** Internet Protocol
- IP-CAN** IP - Connectivity Access Network
- IP-SM-GW** IP - Short Message Gateway
- ISDN** Integrated Service Digital Network
- ISUP** ISDN User Part
- LTE** Long Term Evolution (4G)
- MAP** Mobile Application Part
- MBMS GW** Multimedia Broadcast Multicast Services Gateway
- MGCF** Media Gateway Control Function
- MME** Mobility Management Entity
- MRFC** Multimedia Resource Function Controller
- MRF** Multimedia Resource Function Processor
- MSC** Mobile Switching Center
- OCS** Online Charging System
- OFCS** Offline Charging System
- PCRF** Policy and Charging Rules Function
- P-CSCF** Proxy - Call Session Control Function
- PDN** Packet Data Network
- P-GW** Packet - Data Network Gateway
- PLMN** Public Land Mobile Network
- PSTN** Public Switched Telephone Network
- RNC** Radio Network Controller
- SCC-AS** Service Centralization and Continuity - Application Server
- S-CSCF** Server - Call Session Control Function
- SGSN** Serving GPRS Node
- S-GW** Serving Gateway
- SIP** Session Initiation Protocol
- SITE** SIGOS Integrated Test Environment
- SMSC** Short Message Service Center
- TAS** Telephony Application Server
- UMTS** Universal Mobile Telecommunications System (3G)
- UTRAN** UMTS Terrestrial Access Network
- VoIP** Voice over IP
- WLAN** Wireless Local Area Network

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Another Kind of Prologue



In my career at SIGOS of more than 25 years I have visited our telecommunications business customers around almost half of the world and learned to recognise a 'developed' country. This is a country where people talk a lot about getting the right work-life balance. Obviously, quality of life is extremely important.

More and more, whilst crossing continents, I have also been faced in

executive meetings with another type of question about the right balance between investment and Quality of Service. This is always a good signal as it shows that SIGOS has become known as a synonym for quality.

Somehow, it seems that there is a link between each of these balances, getting quality both in life and in business.

Considering all the technological innovations in the last hundred years, we can say that the quality of human life has improved dramatically. Initially only in a few countries, innovations particularly in IT and communication technologies have helped to distribute this improved quality of life rapidly to all countries worldwide, even to the small villages of the world. This is another balance in an ongoing process which makes us happy.

It's not wrong to say that being 'connected' is now almost a human right when we see how people across the globe are becoming involved in the world economy, in education and in healthcare.

How is SIGOS connected with all these balances? Our core business is to help you ensure best Quality of Service and Quality of Experience for your end users of communication services, wherever in the world they are. We simply provide you with the right active testing tools and expertise for the optimisation of your business. We are not actively testing for you the quality of red wine from the Pauillac region of Bordeaux. No, we are helping you to manage innovation in the world of mobile and Internet technology – in a key area for humanity and for business.

How are we doing it? We support you in getting another perspective on your networks and a more balanced view with testing in a wide range of areas, from service quality to roaming testing, from Fraud Detection to billing verification for Revenue Assurance and from sophisticated core network testing up to app testing on smartphones.

Let us guide you in these following 92 pages. For more information about us you could simply ask any of our more than 410 existing customers, from mobile and fixed operators to multiple international carriers, regulators and service providers all around the world. Or you could just contact me directly.

Let me close with a few words about our company. Our HQ is in Germany but we act worldwide, in 150 countries. Our expert staff are international and intercultural, speaking more than 30 native languages. Together with our global consulting and partner network, we are committed to being your partner worldwide whilst being at your side locally, in your culture. We act internationally, delivering active testing that increases your revenue and helps you avoid fraud. We aim to do this in an environment that places the highest value on humanity – and we always work at the highest quality levels.

We are simply proud to do this.

Adil Kaya
CEO SIGOS
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Your worldwide partner in active testing of telecommunications

The Company

Founded in 1989, SIGOS is the worldwide leader in automated end-to-end active testing and Fraud Detection of telecommunication networks and services.

Our scalable and entirely customisable solutions enable network operators, over-the-top (OTT) content and solution providers, carriers and regulators to fully understand Quality of Service and Quality of Experience from an end-user perspective, Fraud Detection, Revenue Assurance and Consulting Services based on the same architecture complete the portfolio.

We have over 410 customers in the telecommunications industry, including most of the top 100 operators, which benefit from our comprehensive range of active testing, tracing and reporting solutions across all technologies (2G, 3G and LTE).

Our key competences lie in the following areas:

- // Quality of Service Testing
- // Quality of Experience Testing
- // Network Testing (Radio, Fixed, IP, Core)
- // Roaming Services and Roaming Testing
- // Fraud Detection and Grey Route Detection
- // Revenue Assurance with Billing Verification
- // Boundary Free Testing
- // Managed Services

The company headquarter is in Nuremberg, Germany, where our products are developed. With the acquisition of Meucci Solutions in 2014 SIGOS added the market-leading fraud solutions to its portfolio.

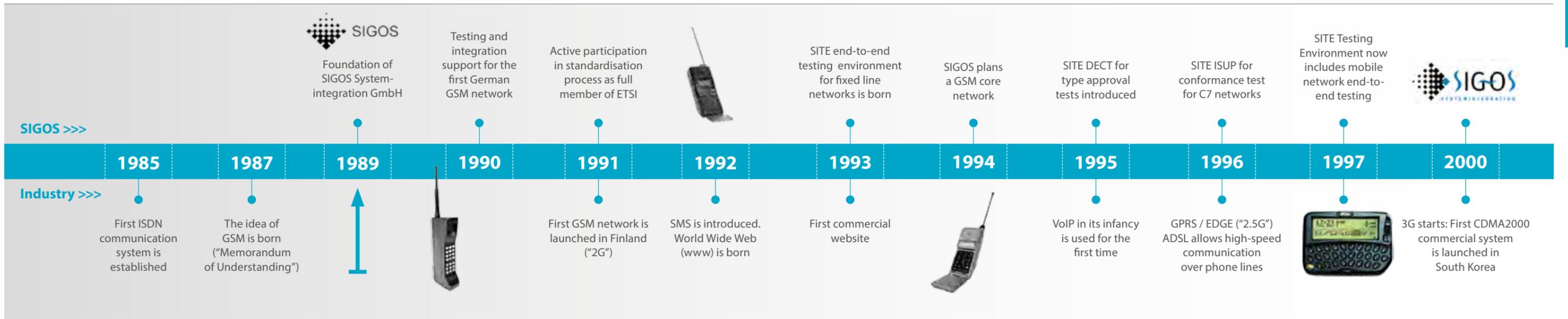
Our international expert staff of more than 240 employees speak over 30 languages and are passionate about communications. The network of SIGOS authorised partner companies and representatives in over 50 locations across the globe completes our worldwide presence.



Benefits at a glance

- Unparalleled customer service
- One solution – numerous test applications
- True reflection of customer experiences
- Expert staff with global market knowledge and a rich language skill set
- Authorised worldwide partner network
- Large global customer base
- German engineering
- More than two decades of experience in telecommunications

- SIGOS sales and technical representative
- SIGOS authorised business partner



GlobalRoamer & Roaming Services

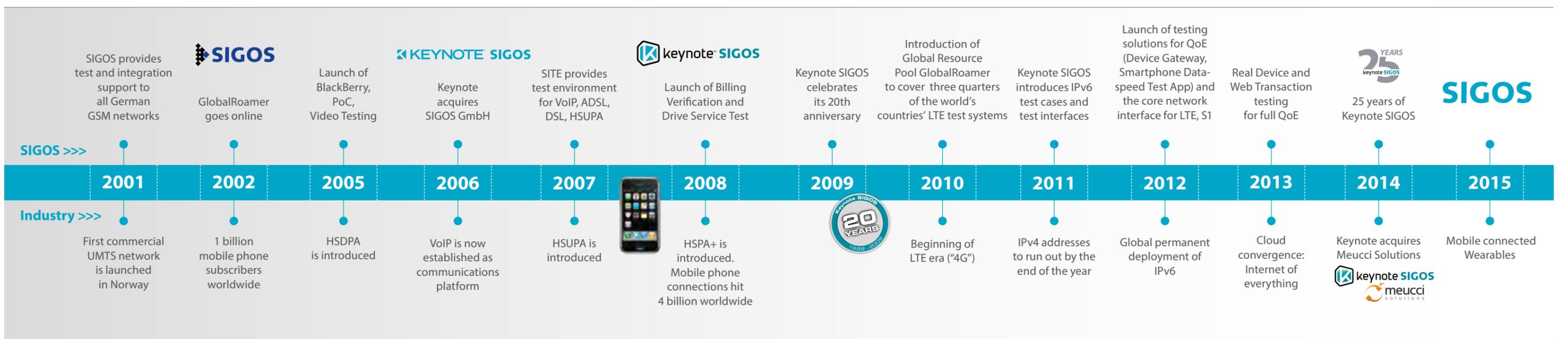
Professional Services Telecommunications

SITE for Quality of Service & Quality of Experience Testing

Revenue Assurance

Fraud & SIM Box Detection

over 25 years
of broad experience
in telecommunications



About SIGOS

SIGOS provides you with a complete portfolio for an active testing approach, including the key elements for successful network management as well as fraud and billing control.

We support you with the optimisation of your network performance from an end-user perspective and help you to find the right balance between revenue assurance and service quality.

GlobalRoamer & Roaming Services

Professional Services Telecommunications

SITE for Quality of Service & Quality of Experience Testing

Revenue Assurance

Fraud & SIM Box Detection

At the core is:

SITE®

as your own test system

GlobalRoamer® & Roaming Services

the worldwide test system hosted by SIGOS

Fraud & SIM Box Detection

SIGOS' BAPT certified service that helps to detect interconnect bypass losses quickly and efficiently

Revenue Assurance

enabling you to get a comprehensive testing perspective for any services

Professional Services Telecommunications

providing tailored assistance by our expert staff

Portfolio

SITE®

Your own active testing infrastructure for all technologies

SITE, the SIGOS Integrated Test Environment, is the most advanced active end-to-end test system available on the market. It enables network operators all around the world to host and work with their own testing facilities whilst easily integrating into any existing network infrastructures.

With its sophisticated hardware and software components, SITE's unique scalability, versatility and flexibility guarantee high investment security for your complete end-to-end testing requirements.

GLOBALROAMER® & ROAMING SERVICES

The worldwide reference test system hosted by SIGOS

Based on the intelligence and technology of SITE, we offer the largest and worldwide leading reference system for automated outbound roaming testing: **GlobalRoamer**. Hosted by SIGOS, GlobalRoamer and Roaming Services customers can

verify the availability and functionality of their roaming services via a network of test probes, located in more than 200 countries, providing access to over 770 networks, all without having to maintain their own system infrastructure.

FRAUD & SIM BOX DETECTION

The most advanced and leading Fraud Detection Solution

The industry's most efficient, most advanced and largest **SIM Box Detection** solutions, to secure your revenue and protect your network against fraud. The SIGOS **Fraud Detection** and Interconnect Verification Services are fully BAPT certified.

The portfolio will support you to detect interconnect bypass losses quickly and efficiently, based on innovative call and SMS methods using the largest number of routes and delivering results with absolute accuracy.

REVENUE ASSURANCE

Unparalleled accuracy and flexibility to secure your revenue

SIGOS' **Revenue Assurance** with active testing and CDR reconciliation is the most powerful and forensic approach to make sure that all provided services are being charged correctly. Even a very small error in the complete billing chain can lead to a revenue leakage of millions.

Don't take the risk of launching new tariffs before you're sure that the billing is absolutely accurate. Also ensure, that the main revenue driving tariffs are being analysed and tested in the finest detail, so that even the smallest billing error will be detected and fixed and the revenue leaks can be closed.

PROFESSIONAL SERVICES TELECOMMUNICATIONS

Your customised managed services by our senior experts

SIGOS **Professional Services Telecommunications** provides fully managed service packages for all important tasks in SITE and GlobalRoamer testing solutions and campaigns. This includes project planning and implementation, operation, maintenance, training as well as solution consulting.

Let the Professional Services Telecommunication Expert Team look after your headaches so you can fully concentrate on your core business of providing the best QoS and QoE to your subscribers!

SITE

Benefits

- Modular design architecture guarantees maximum flexibility and can easily be integrated into existing test environments
- Get the full picture on your end-users' experience through active end-to-end testing
- Identify and localise service or network outages before they impact users and translate to revenue losses
- Reduce operational costs and increase efficiency with automated testing, monitoring and reporting
- React in the shortest time possible, thanks to real-time reporting and alarming
- Receive software updates and expert support quickly and reliably

SITE Use Cases

Network Testing

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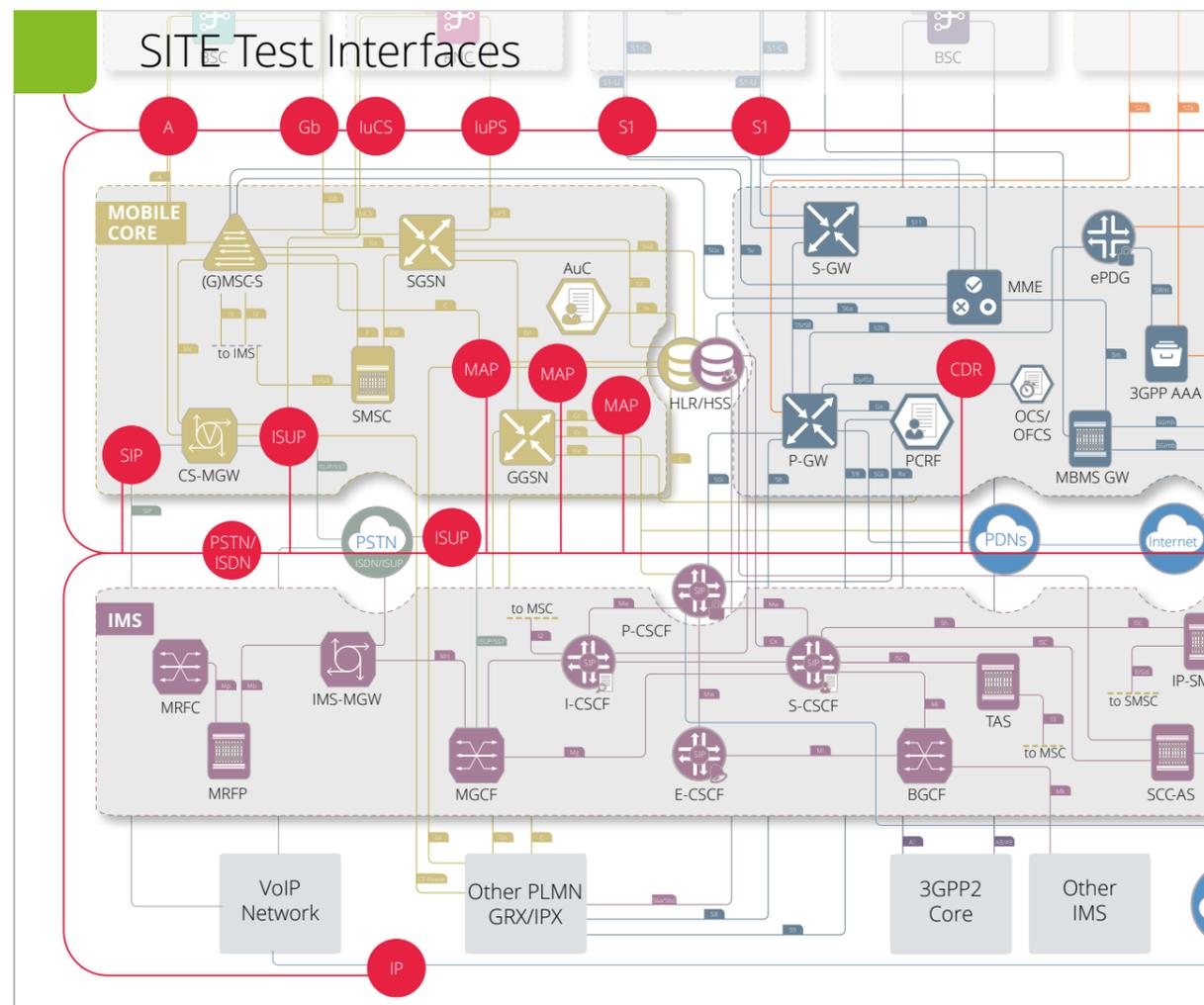
SITE

One platform for all your end-to-end test requirements

Challenge

Today network operators are confronted with an extremely dynamic market. To remain competitive, they need to constantly maintain customer satisfaction, keep up with the latest technology and guarantee Service Level Agreements (SLAs), while at the same time remain cost efficient.

Finding the right balance between all these aspects is a challenge and can become a lengthy, complex and costly process. In order to meet this challenge, network operators need to find a cost-efficient solution, which enables them to permanently monitor Quality of Service (QoS) & Quality of Experience (QoE) in their networks.



Solution

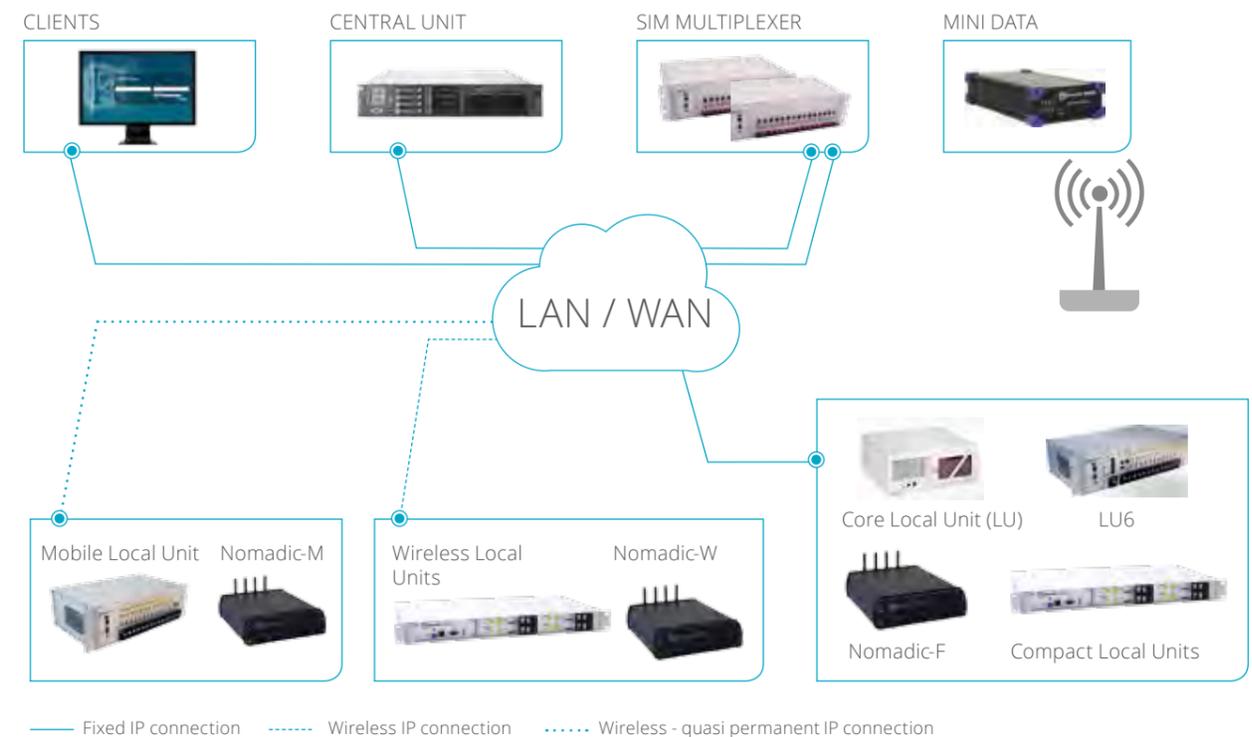
SIGOS offers comprehensive active end-to-end QoS and QoE testing solutions. Active testing, considered the most efficient testing approach in the telecommunications industry, complements passive monitoring solutions. While passive monitoring solutions look at actual traffic, active testing provides controlled, repeatable, 24/7 monitoring. This approach detects problems before real users are affected and can provide testing for specific use cases.

SIGOS has developed the most advanced automated active end-to-end test system available on the market that complements any passive monitoring system. SITE offers network operators all around the world, the opportunity to deploy their own and operate their own testing system, that can be seamlessly integrated into any network or testing environment.

The modular structure of SITE allows the system to be tailored so it matches your exact requirements. With SITE's flexibility and scalability, deployments can range from small local installations to a large-scale distributed testing solutions. But no matter how big or small the system might be – all locations covered by the SITE system can be used for flexible end-to-end testing.

SITE combines radio, fixed-line, IP and core network testing – all in ONE test system. It enables both single technology testing as well as cross-technology testing, so that all possible combinations can be verified: Radio, fixed-line, IP & core-based technologies (using 2G, 2.5G, 3G, 3.5G and LTE networks).

SITE Architecture



How Does it Work?

The SITE test system is made up of five main components:

- 1.) System users, which communicate with the SITE test system via a graphical user interface
- 2.) Central Unit, which comprises all central processes and which is used for the control and coordination of the complete system
- 3.) Databases, which contain all system configurations like test and measurement definitions
- 4.) SIM Multiplexer, which handles a large number of vSIM and USIM cards
- 5.) Local Units, distributed in different locations, which contain the test probes for test execution

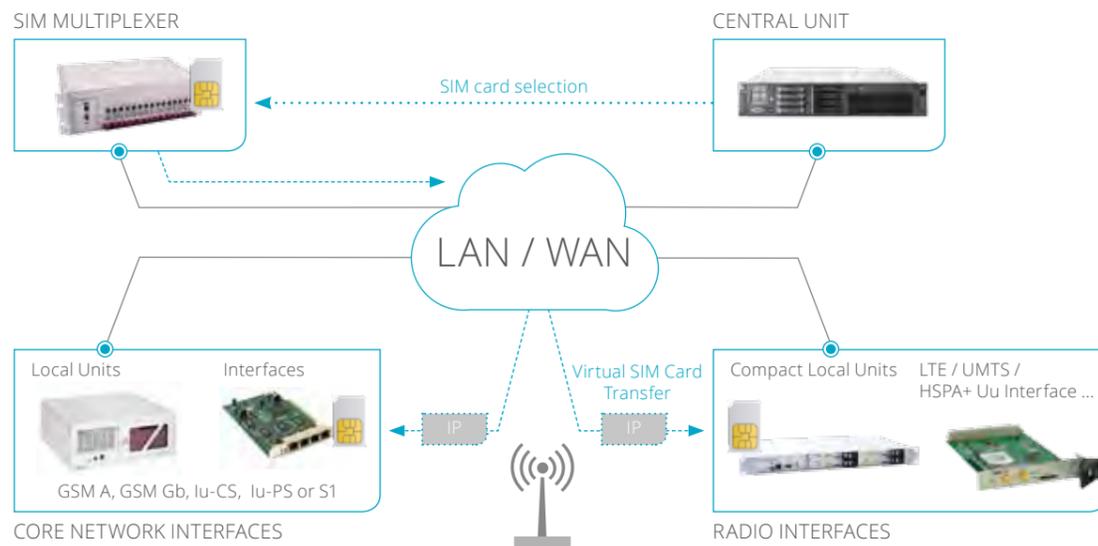
The user-friendly and intuitive graphical user interface (GUI) can be accessed via a web interface. The user logs on to the GUI and is in control of the whole process from testing, reporting and analysis.

SIM cards are centrally hosted and virtually transmitted to any of the systems remote test stations where the actual test is performed. Subscriber information from a SIM card is read out by the system and transmitted via LAN/WAN to any test location required. The SIM authentication procedure is handled virtually between the wireless interface in any location and the real SIM is stored in the central SIM Multiplexer.

The test cases, also controlled by the user from the Central Unit, are then executed using the specific test location. This can be automated by flexible test scheduling possibilities according to customers' needs.

An extensive set of tools is available for problem diagnosis, reporting and real-time alarming to adapt SITE exactly to individual demands. Various administrative views provide the right level of information and tools in relation to individual users' permissions.

Central SIM Multiplexing



Ensuring High Performance, Security and Stability

- // SITE runs on a robust, Linux-based server solution offering the highest standards of redundancy and security
- // To ensure maximum performance and flexibility, the SITE system uses an open SQL database
- // All configuration information, test results, measurements and KPIs are stored logically, to provide clear measurement and reporting capabilities

- // Using powerful filter functionality, any database listing can be easily modified and a multi-format export function allows the sharing of data with other network support tools
- // To avoid any resource conflict, an intelligent resource management system controls access to interfaces and SIM cards, ensuring smooth operation and maximum test parallelism
- // The self-management checks system components regularly and generates an alarm in the event of any failure

Benefits

- All Technologies
- All Services
- Unlimited Scalability
- All Use Cases
- High ROI
- Stable and robust

SITE Solution for Testing All

Network Services			Network Interfaces			
Speech	DATA	Messaging	Fixed	Radio	IP	Core
Voice	IP Service Testing	SMS	ISDN S ₀	LTE U _u	WLAN	LTE S1
Voice Quality	Web/WAP Browsing	MMS	ISDN PRI S _{2m}	HSPA	DSL	I _u cs/I _u ps
VoLTE	WLAN	Mobile IM	PSTN a/b	UMTS U _u	Ethernet	GSM G _b
VoWiFi	E-mail	iPhone		GSM U _m	MM7	GSM A
VoIP	Streaming	BlackBerry		EDGE	SMPP, UCP, CIMP	ISUP
Suppl. Services	Video Telephony			CDMA 2000	SMTP/IMAP	SS7
IVR	Video Quality			GSM-R		IN/CAMEL
Push-to-Talk						MAP (HLR/VLR)
Echo						

Synergies
VAS (Value Added Services), IREG Scenarios, Digital Rights Management

SITE HARDWARE COMPONENTS AND INTERFACES

SITE Central Unit / SIM Multiplexer

The Central Unit is the heart of the SIGOS test system, comprising all central processes. The role of the Central Unit is to control and coordinate all system components.

At any point in time, add-ons can easily be connected to the existing infrastructure, supporting any future growth of your system.

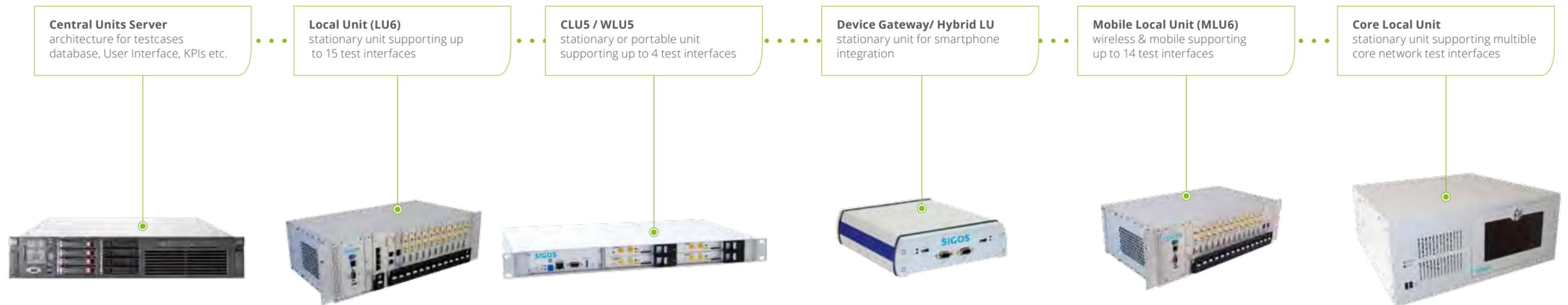
The SIM Multiplexer has the capacity to host up to 225 SIM cards at a time and is used to virtually transmit the SIM/USIM/ISIM information to any of the systems remote test stations.

There is no limit to the number of SIM Multiplexers that can be connected to the SITE system, resulting in the ability to test and manage an unlimited number of SIM cards.



SITE Hardware Components

UNIT	DESCRIPTION	ADD ON
Central Unit DB Server	Central part of the architecture containing configuration database and test data	
Central Unit UI Server	Central User Interface Server coordinating system and user interaction processes	
Central Unit KPI Server	Contains Key Performance Indicator and measurements database from all test case runs	✓
Central Unit Extension (CUX)	Provides the possibility to increase the number of parallel running test cases	✓
Uninterruptible Power Supply	Ensures an uninterruptible power supply for more stability	✓
Keyboard/Monitor	System hardware administrator interface to control the system (rack-mounted)	
KVM Switch	Switches the keyboard and monitor between the different servers	
DB Backup Server	Configures and stores all database backup files	✓
MAP Server	Stores all maps that are used in the SITE Graphical User Interface (GUI)	✓
VPN Server	Front-end access to Local Units via Virtual Private Network (VPN)	
SSM Proxy Server	Controls proxy connection between units (Example: SITE to GlobalRoamer via Global Resource Pool)	
SIM Multiplexer	SIM card library for tests and storage for all SIM cards and USIMs	
Load Balancer	Balances user distribution over all UI servers	✓



SITE Remote Components

The remote components, also called Local Units, are distributed in different geographic locations and are used for test execution. SIM cards are centrally hosted in the SIM Multiplexer and virtually transmitted to any of the systems remote test stations where the actual test is performed.

SIGOS offers various remote components to accommodate all your testing needs, ranging from stationary (to be used in a static location) to portable (can be moved from one location to another) and mobile (can be used in motion).

UNIT	CONNECTION	LOCATION	APPLICABLE INTERFACES
Local Unit	fixed	stationary	Radio, Fixed Line, IP
Core Local Unit	fixed	stationary	Core, Fixed Line
Compact Local Unit	fixed	stationary	Radio, Fixed Line, IP
Wireless Local Unit	wireless	portable	Radio, Fixed Line, IP
Mobile Local Unit	wireless	mobile	Radio
Hybrid Local Unit	fixed	stationary	Smartphone, Radio, IP, USB Stick
Nomadic-F	fixed	stationary	Radio
Nomadic-W	wireless	portable	Radio
Nomadic-M	wireless	mobile	Radio
Mini Data Probe	wireless or fixed	portable	Radio, IP (if connected fix)
Mini VoIP Probe	fixed	stationary	IP

SITE Test Interfaces

SIGOS offers interfaces supporting the full range of today's telecommunication technologies and frequencies.

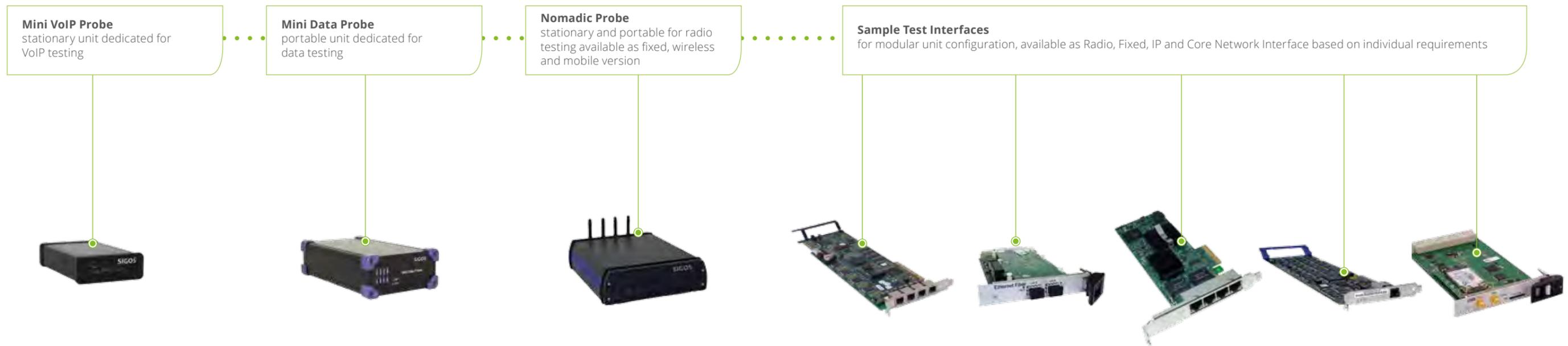
Tests can be executed in 2G, 2.5G, 3G, 3.5G and LTE networks via radio, fixed-line, IP and core-based interfaces.

The interfaces are inserted into the remote components, which can then be used for stationary, portable or mobile deployment.

The wide range of interfaces allows you to decide what to test and where to test it – according to your requirements.

RADIO / AIR INTERFACES	FIXED LINE INTERFACES	IP INTERFACES	CORE NETWORK INTERFACES
GSM / GPRS / EDGE U _m	PSTN a/b	LAN Ethernet IP over 4 ports	2G Core (GSM Gb over E1/T1/IP, GSM A over E1/T1/IP)
UMTS/HSDPA/HSUPA U _u (HSPA+)	ISDN S ₀	LAN Ethernet IP over 1 port/Fiber IP	3G Core (IuCS over IP, IuPS over IP)
UMTS U _u (AWS Band)	ISDN S _{2/m}	WiFi / WLAN IP	LTE Core (S1 over IP)
LTE/UMTS/HSPA+ U _u			Fixed Line Core (ISUP over E1/T1)
CDMA 2000 1x EV-DO			

All test interfaces are developed by SIGOS and made in Germany.



Quality of Service - SITE in Cloud

Challenge

Operators tend to increase their OPEX (Operational Expenditures) investment versus CAPEX (Capital Expenditures). In the near future this trend will increase even more. Especially with the introduction of software-defined networking and network functions virtualisation, where network-building is defined on another level and will be fuelled via OPEX investments and not the traditional CAPEX model.

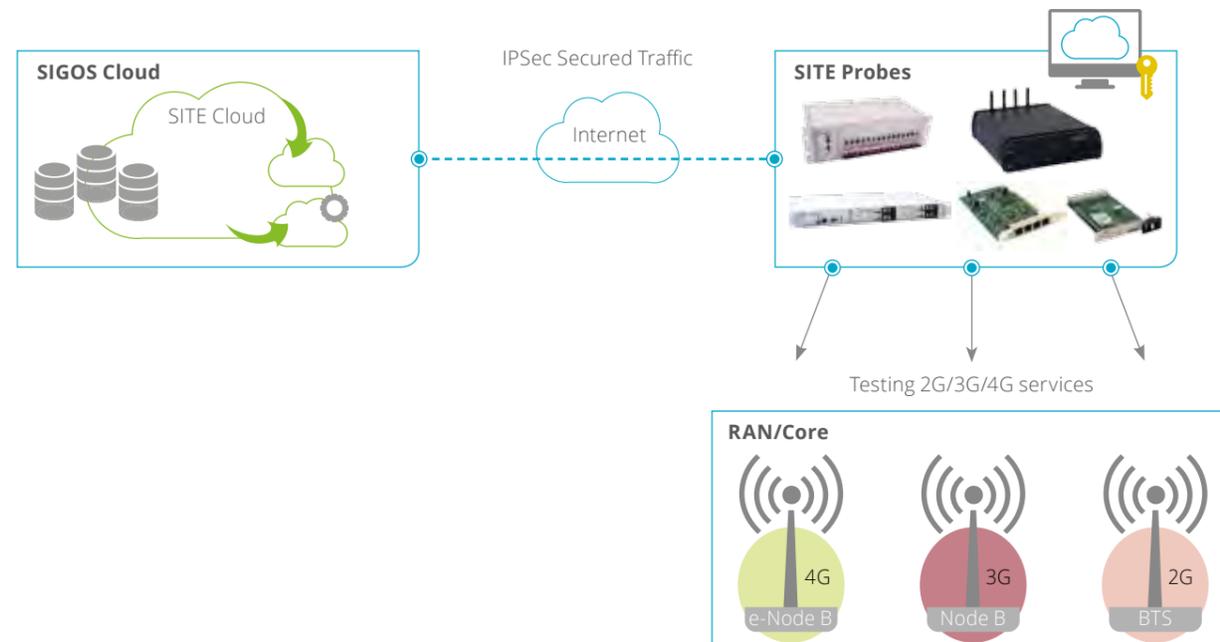
Solution

SIGOS' SITE in Cloud is an efficient and flexible active end-to-end service quality testing platform that lets you start controlling the QoE and QoS for your services. The platform is fully supported via the SIGOS Cloud, it is easily integrated into existing network structure and test environ-

ments, which minimises the involvement of your IT team. Still, operators will need to rely on proven and efficient E2E testing for QoS and QoE in established and emerging technologies, in order to maintain customer satisfaction, permanent monitoring of SLAs as well as reducing downtime and potential revenue losses.

Still, operators will need to rely on proven and efficient E2E testing for QoS and QoE in established and emerging technologies, in order to maintain customer satisfaction, permanent monitoring of SLAs as well as reducing downtime and potential revenue losses.

SITE Cloud can be activated in a very short time. It gives you a comprehensive overview on the QoE and QoS on your fixed or mobile network services.



Global Resource Pool (GRP)

Often SITE solutions are deployed for testing networks within national boundaries. Some existing SITE installations also cover international testing by deploying SITE Local Units in neighbouring countries for the purposes of outbound roaming testing and fraud detection. However, international testing on a large scale usually comes up short. The unique feature 'Global Resource Pool' enables users to expand the capability of their SITE system by connecting it

to the worldwide network of GlobalRoamer test probes, covering over 200 countries with access to 2G, 3G and LTE test interfaces. GlobalRoamer is a scalable pre-deployed infrastructure of worldwide testing probes owned and managed by SIGOS. This frees operators from the cumbersome manual implementation, operation and maintenance of remote test interfaces in neighbouring countries and gives access to over 770 networks in more than 310 additional locations worldwide.



Benefits

- Global testing using your SITE system
- No capex investments
- Covering 98% of the world's networks
- All technologies
- Instant connection to 3500 probes
- KPIs and data on your SITE system
- LTE, CSFB, HSPA, UMTS, GSM

Benefits

- Always up-to-date SITE software
- Access to the latest test cases
- Reduced installation and deployment time
- Reduced maintenance overhead
- High availability, including geo-redundancy
- Virtual, powered by 100% green energy

GlobalRoamer & Roaming Services

Benefits

- Get the full picture on the service quality your customers are experiencing worldwide with automated active end-to-end testing
- Real-time reporting, alarming and analysis
- Largest footprint of over 3500 test probes across the globe with access to networks in more than 98% of the worlds countries
- Cost-effective solution: simply start using GlobalRoamer – no hardware and software investment, no maintenance, no capex, no setup or exit fees for GlobalRoamer use
- Flexible packages available ('prepaid' for ad hoc testing / 'flat-rate' for periodic testing)
- Pay-as-you-use concept (with full functionality)
- Easy web access allows 24/7 availability, irrespective of time zone
- Independence and convenience through prescheduled automated test execution
- Save valuable time thanks to comprehensive libraries of test cases and report templates
- Fast enabling of new roaming partners
- Largest LTE, CSFB test infrastructure available

GlobalRoamer Use Cases

Network Testing

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Quality of Service Testing (QoS)

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Quality of Experience Testing (QoE)

Testing Services on Real Devices	(p. 72)
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Roaming Testing

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International Carrier Quality Testing (ICQT)

Periodic QoS Testing	(p. 81)
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Fraud & SIM Box Detection

SIM Box Detection	(p. 84)
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Revenue Assurance

CDR Comparison and Testing	(p. 89)
Billing Verification	(p. 90)
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Boundary Free Testing

QoS Testing on the Move	(p. 93)
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GLOBALROAMER & ROAMING SERVICES

The leading reference system for worldwide testing and fast Roaming Rollout

Challenge

Customers roaming in mobile networks abroad often complain about not getting the services as expected.

Violated roaming agreements, network disruption and grey routes are just some of the issues network operators have to

deal with in addition to the lack of operational visibility of the roaming partners' networks. This is why a permanent observation of all roaming services is a key task for network operators in order to protect their revenues and increase customer satisfaction.

Solution

Based on the intelligence and technology of SITE, SIGOS' fully hosted GlobalRoamer offers the most extensive platform for automated end-to-end roaming testing and troubleshooting. With access to 770+ networks worldwide, GlobalRoamer allows operators to verify that all services are fully available for roaming customers without having to invest in their own testing infrastructure and the efforts of running their own SITE system.

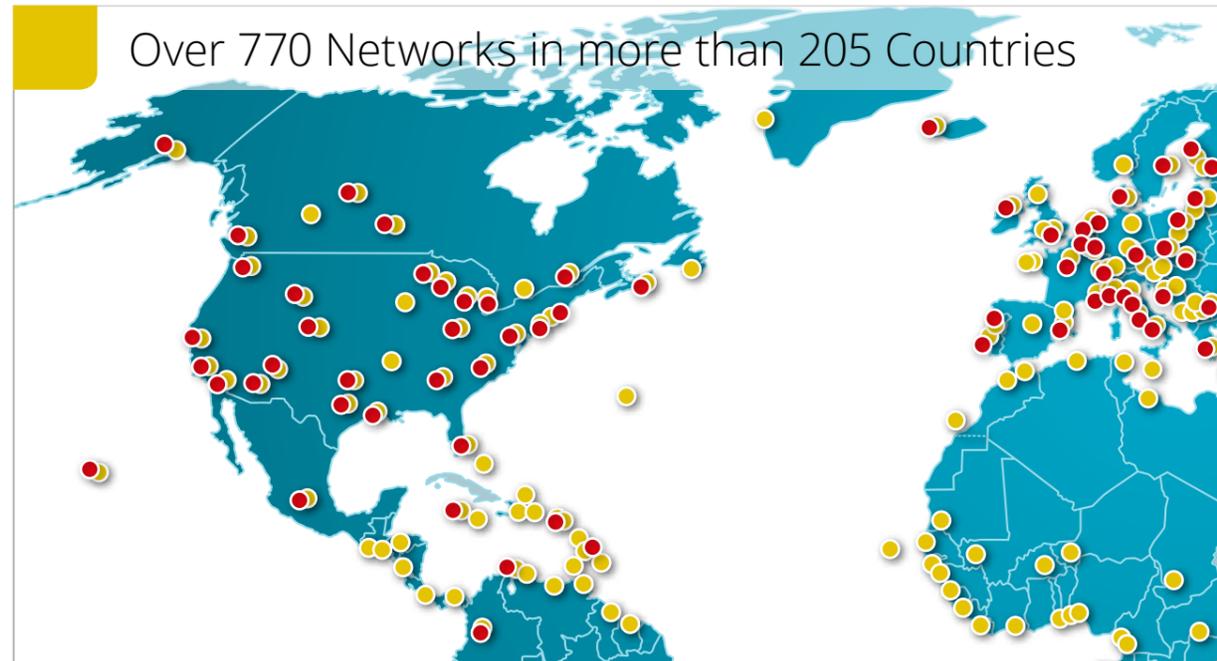
Enjoy the convenience of predefined tests and reports by accessing our comprehensive library of templates, while the

option of customer-specific test scenarios provides you with full flexibility and experience-based alternatives!

Roaming Rollout

In addition, SIGOS offers Roaming Rollout Services as well as Roaming Audit.

The highly experienced team cuts rollout time and costs significantly on IMP targets such as quality, technology (LTE) and more.



How Does it Work?

The largest and most comprehensive network of testing facilities already covers more than 98% of the world's countries, and keeps on expanding.

GlobalRoamer customers can use this sophisticated testing infrastructure through an easy-to-navigate web-based graphical user interface. Simply log on with your account and set up your test schedules.

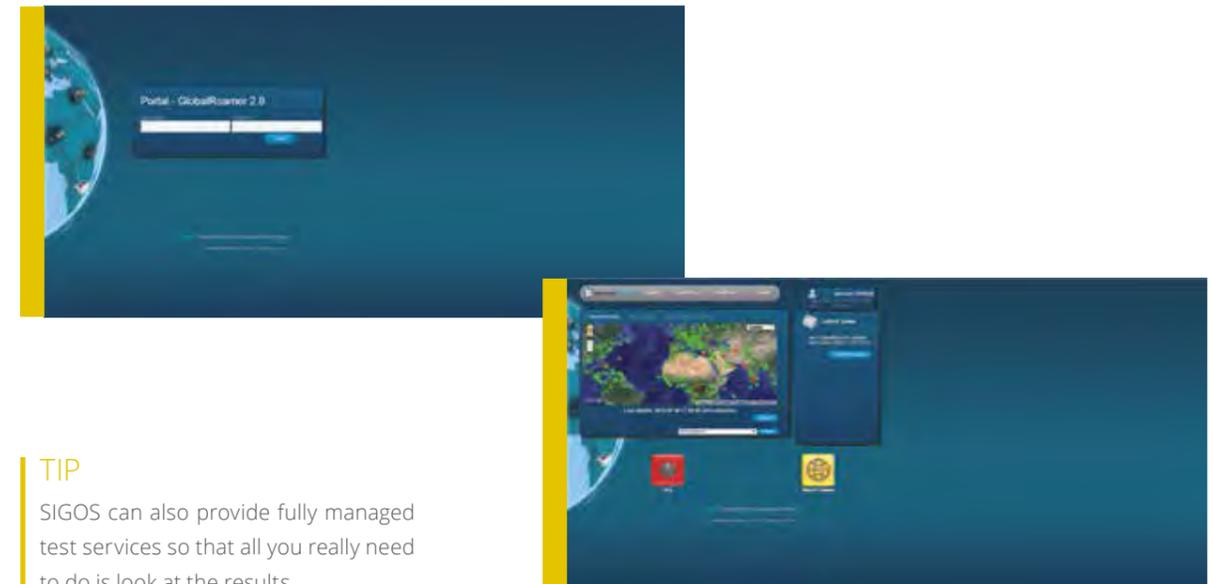
Via our unique SIM Multiplexing technology, your SIMs can be virtually transmitted to any of GlobalRoamer's more than 3500 test probes worldwide for 2G, 3G, LTE, CDMA and fixed probes, where tests simulating end-customer experience are performed.

Extensive alarming, performance notifications and reports provide real-time network visibility for rapid fault resolution, essential to ensure high QoS to your end customers.

All You Need to Do

- // Get your account at SIGOS
- // For testing in mobile networks: Send your test SIM cards to SIGOS
- // Access the worldwide test network via the web GUI
- // Define your tests and set them running
- // Collect the results and analyse the findings

How to access GlobalRoamer



Roaming Managed Services

SIGOS hosts and maintains a variety of GlobalRoamer Managed Service packages for different requirements.

Roaming Implementation Services

Operators face big challenges when it comes to roaming: It goes without saying that the roaming rollout is crucial and needs to be fast and effective, especially for new technologies like LTE. It requires the right skills to run through the phases of negotiation, coordination and testing before the actual launch.

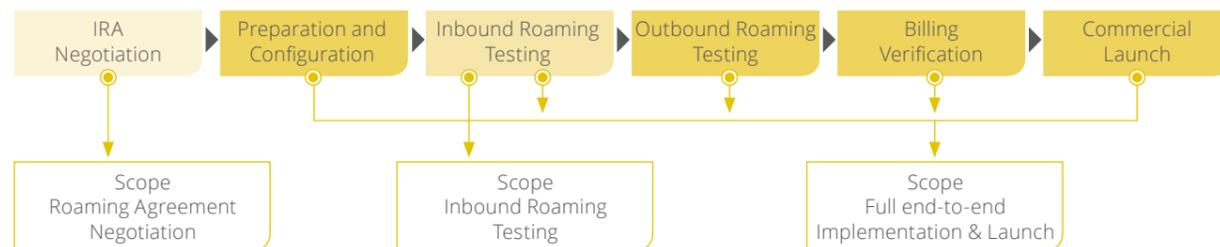
Setting up new roaming agreements and testing different technologies with roaming partners can be very challenging as many different departments within the organisation are involved, each with their own priorities and often many other tasks.

We can help you to quickly expand your roaming footprint while you can focus on your core business. Our experienced

and professional team coordinates all the different steps in the roaming rollout process involving all concerned departments. We have our expert team of roaming engineers, coordinators and billing experts focused to follow exactly your expansion strategy, to enable roaming agreements and to test new services at best quality, fast and efficiently. We will always tailor the service to your needs and take your internal processes into account.

We can count on the best cooperation from all mobile operators around the world thanks to our excellent name in the roaming business.

Roaming Rollout process - where can we help?



International Carrier Quality Tests

By constantly monitoring the transmission quality of all connected carriers, traffic can be routed intelligently. Observe your SLAs with your carriers and find the right balance between revenue and traffic volume.

Work with SIGOS to understand and monitor the traffic quality to more than 410 operator networks worldwide and avoid poor quality transmission.

Roaming Audit

Mobile operators are usually only monitoring a limited number of roaming partners and services. A lot of roaming relations have never been retested after launch, sometimes many years ago. Chances of service deterioration are high as mobile networks constantly undergo configurations and software updates which may affect the connectivity to your roaming partner networks.

The service could be down for a long time without getting noticed, leading to customer dissatisfaction and missed revenues. By performing regular audits you can test the availability of the service, reduce operational costs and identify issues prior to customer complaints.

Perform a Roaming Audit now and get a full picture of the quality of your roaming footprint!

GRQ Tests

The outbound roaming revenue is not based on general experience of the roaming market, approximately 80% of your outbound roaming revenue comes from the top 20 roaming partners. For this reason the GSM Association recommends close monitoring of service quality during outbound roaming

with these top roaming partners. Just send us your SIMs and we will regularly measure, monitor, report and receive alarms on all aspects of the service quality among your roaming partner networks.

Needless to say, SIGOS is fully compliant with the GRQ framework defined by the GSMA.



Managing Worldwide Roaming made Easy

Billing Testing for Roaming

Operators need to implement effective solutions to manage and control revenue assurance for their roaming agreements, including all the aspects of accurate billing. SITE offers a precise and reliable tool for rating verification and CDR comparison in

outbound roaming services. Take advantage of SIGOS Managed Services to ensure correct billing for you and your customers- globally!

Testing Campaigns for Special Events

Mega events like the Olympics, the World Cup, religious festivals and others attract huge numbers of international roaming subscribers, increasing the pressure on network operators to provide superior service quality. The expectations for uninterrupted and seamless network services are high while the window of opportunity to retain roaming subscribers is small.

With SIGOS' multistage and tailored testing campaigns to measure and monitor your QoS, you are best prepared to successfully facilitate as well as optimise your earnings for the full duration of any special event and avoid churn.

Roaming Steering and Anti-Steering Tests

Test the functionality of any steering activities! A number of location update tests are performed and examined by SIGOS experts to analyse country- and network-specific steering.

By distributing a large number of tests over all networks in a country, it is determined whether the planned steering ratios between the networks are fulfilled.



The World at your Fingertips!

Enter the most extensive global network test system from your desk and gain access to:

206 Countries
309 Locations
774 Networks

412 Pool SIM Cards from
368 Different Operators



- GlobalRoamer Country
- GlobalRoamer Location
- LTE / CSFB Location

as of April 2015

*Map includes GlobalRoamer Q2 rollout plan

Visit [page 98](#) for the full GlobalRoamer Footprint



Test Tools on SITE and GlobalRoamer

Benefits

- Widest range of test cases on the market
- 450 standard test cases measuring over 5300 KPIs
- Use flexible charts, diagrams and other visualisation features for your detailed reports
- Easy and intuitive way of creating and sharing reports, alarms or dashboards

Test Tools on SITE and GlobalRoamer

With SITE and GlobalRoamer reporting, users can create, display and forward multiple reports generated from measurements collected in the KPI database. SIGOS standard KPIs, customised measurements and KPIs according to ETSI specifications can be selected to form the basis of these reports. While report creation is done by an easy drag-and-drop arrangement, users can visualise test results with

several graphic reporting tools, including flexible charts, diagrams and other enhanced visualisation functionalities.

With the users defining individual threshold settings and severity points, real-time alarms can easily be configured to automatically send SMS, e-mail, SNMP notifications etc. to predefined recipients.

TEST TOOLS		DESCRIPTION	BENEFITS
Reporting and Alarming	Dashboard	The graphical Dashboard provides a simple yet intelligent interface to SITE and GlobalRoamer Reporting. Multiple reports can be displayed, filtered, updated and individually configured.	Simple to use, fast and easy drill down to individual trace level. Saves time compared to multiple reports, while individual configuration to additional data analysis is possible.
	GIS	The Geographic Information System (GIS) is integrated into SITE and displays a large set of KPIs and received GPS information created during drive tests. All data is processed and displayed on the operators' individual geographic maps or alternatively on Google Maps.	Map-based, near real-time view of captured and analysed KPIs generated from service testing "on the move".
	SSI	The most important KPIs for each service are the building blocks of a new KPI called Single Service Indicator (SSI). Get a quick start to SSI Reporting, using SITE predefined SSI templates for Voice, SMS and Data. The SSI reporting is flexible and you can add new KPIs, add your own alarm thresholds and add or remove services in order to automate and shape your service score cards.	An overall perspective of Service Quality using SSI gives you a quick and high level overview on where problems are arising per service. The Single Service Indicator is perfect for NOC/SOC Monitoring. Display and navigate your SITE reports together with SAM views on smart devices, everywhere and anywhere.
Test Creation Tools	Test Case Editor	The Test Case Editor provides the possibility to create individual and customised test cases. Via a user-friendly drag-and-drop function, complex test case scenarios can be assembled ad-hoc and individually.	Customised and complex test case scenarios can be quickly built to match individual needs for network testing and tests for new network services.
	SITE Recorder	This tool allows intuitive automated recording of browsing actions taking handset characteristics into account. It retrieves mobile and provider-specific web and WAP pages from the network and shows traces to get real information on download behavior and latency. Recorded browsing sessions can be edited and adapted with the Test Case Editor at any time.	SITE Recorder gives instant remote control access to specific handset characteristics and browsers in a remote location without the need to travel anywhere to use it.
Diagnosis Tools	Service Alarm Map	SAM is a powerful tool for visualising the status of mobile network services by logically mapping service alarms generated by the SITE systems to network elements or geographical locations. The SAM World Map allows users to assign alarms to specific countries, regions within a country or cities and logically correlate them with the location of their test probes. Color Coding illustrates network service levels, depending on the reported alarms.	The service view provides an easy high-level overview of the status of the whole network. Upon services performing below specific thresholds the responsible network elements are highlighted for further drill-down.
	Layer 3 Tracing and Trace Inspector	SITE records traces of the Layer 3 Non Access Stratum signaling messages sent and received by the mobile. (Available for 2G, 3G and LTE) Optionally, the NAS traces are supplemented with traces of Radio Resource Control (RRC), signaling messages exchanged between mobile and the radio access network. (Available for 3G and LTE only) Additional information derived by the trace inspector provides insights into the causes of failing test cases, e.g. Protocol Discriminator, Message, Cause Text, Cause Value.	Detailed insight into message flow and protocol data exchange between mobile station and network for quality monitoring and communication troubleshooting.

SIGOS offers the widest range of test cases to verify Quality of Service in your network. You can access a huge library of more than 450 standard test cases measuring over 5300 KPIs.

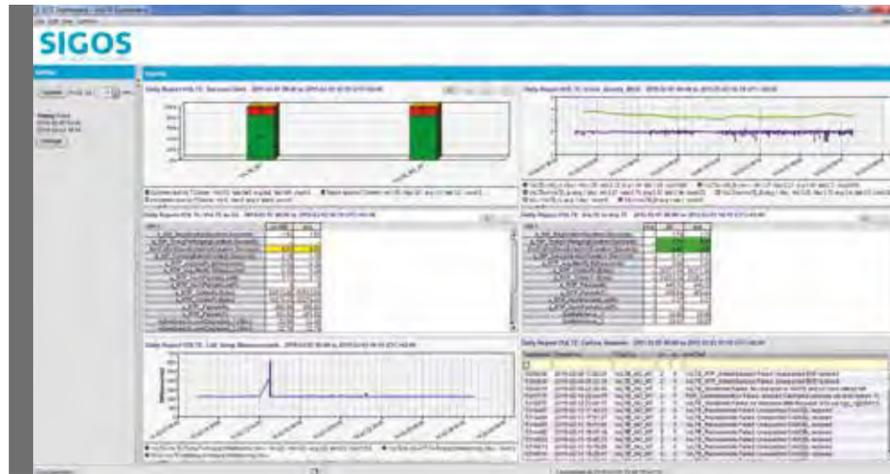
An additional 550 Drive Service Testing KPIs as well as over 1000 customer-specific measurements and tests conclude the scalability and flexibility of SITE and GlobalRoamer.

TEST APPLICATIONS	SAMPLE FEATURES / TEST CASES
Network Registration CDMA/2G/3G/LTE	Network Registration Circuit Switched / Packed Switched
Voice Services Mobile CDMA/2G/3G/LTE (CSFB/VoLTE), Fixed PSTN/ISDN, VoIP	Service Accessibility (Call Establishment, CLI Transparency)
	Interactive Voice Response (Voice Mailbox, Voice Prompts, Service Availability, Recognition Rate)
	Supplementary Services (Call Forwarding, Call Barring, Call Waiting, Call Hold, Multi-Party Call) HD Voice, AMR-Wideband (G.722.2) support for Iu-CS and smartphone, wideband support (G.722) for VoIP Voice Quality With narrow band and wide band CODEC support. HD Voice/AMR-Wideband (G.722.2) testing over Iu-CS, S1, LTE Uu and smartphone. Implemented voice quality algorithms: ECHO, 3SQM, PESQ and POLQA.
Messaging 2G/3G/LTE (SMSoSG/SMSoIP)	SMS, MMS, Mobile IM (Service Functionality, Transmission Time, Storage Limitations)
Data CDMA EV-DO/2G/2.5G/3G/LTE	Data IP (Upload/Download speed using single or multiple TCP sessions, data capacity testing, Web Browsing, speedtest.net test case, E-mail, WAP etc.)
Video 3G/LTE	Video Telephony, Video Quality (referenced video quality algorithm according to PEVQ), Streaming (YouTube, Flash, RTSP)
Value Added Services 2G/3G/LTE	Media Download (ring tone, video, logo etc.) Ring back tone, Digital Rights Management, other VAS
Handset Simulation 2G/3G/LTE	End-to-end content testing of various handsets; database of more than 1000 mobile device profiles and their relevant parameters
Testing on Real Devices	Device Gateway, USB Stick / Smartphone Integration, Smartphone-based speed testing Various services and OTT APPs can be tested, such as HD VoiceQuality for 3G/4G voice calls, SMS, CSFB, VoLTE, HTTP/FTP, YouTube Streaming Video Quality, Skype Voice Quality, Speedtest.net, Joyn

GlobalRoamer & Roaming Services

SITE for Quality of Service & Quality of Experience Testing

Test Tools on SITE and GlobalRoamer



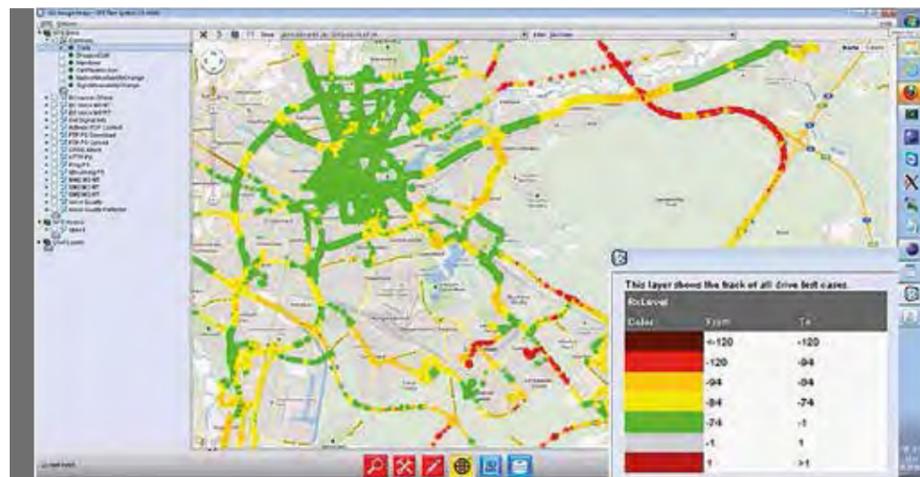
Dashboard
Sophisticated
Dashboards provide
multiple overviews

SITE Recorder
Easy recording
of web browsing
interaction



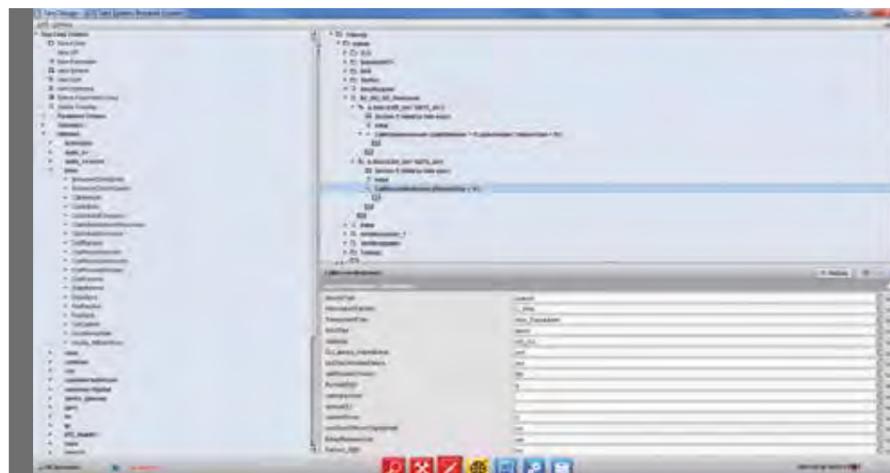
Drive Service
Testing GIS

Displaying the test
results in geographical
maps



Service Alarm Map

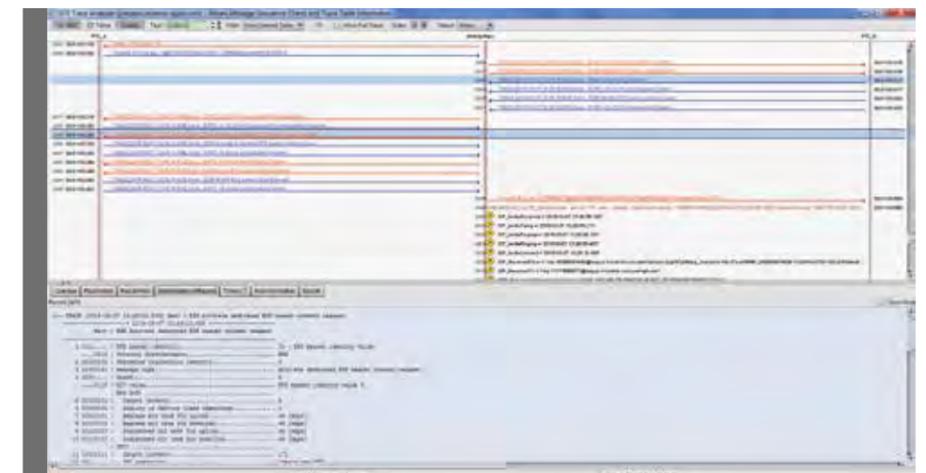
For a fast network status
based on your
RAN/Core architecture
or geographical
distribution

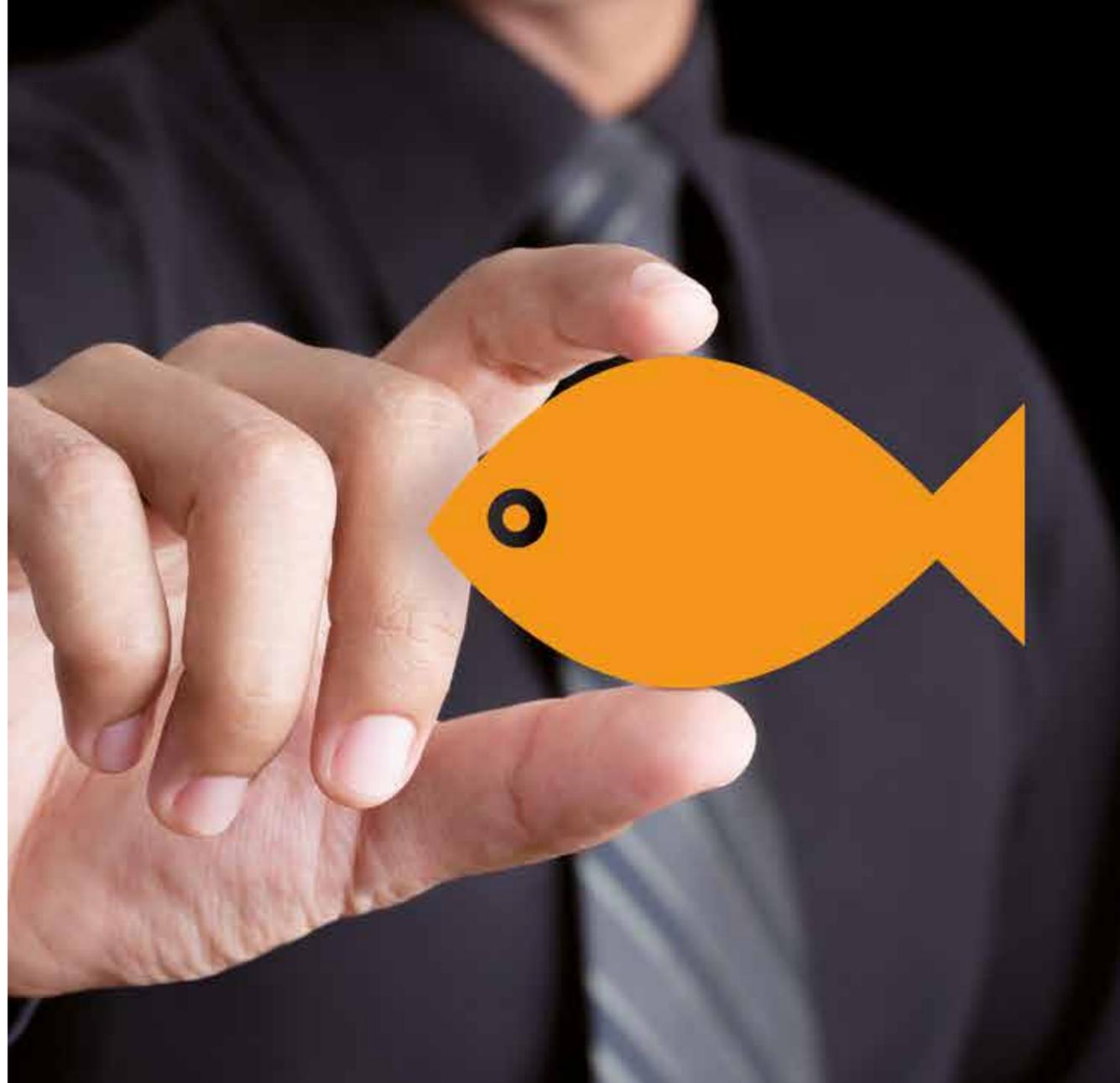


Test Case
Editor
Arrange your own
test scenarios in
a drag-and-drop GUI!

Trace Inspector and
Layer 3 Tracing

Deep Trace drilldown
for your intelligent root
cause analysis





Fraud & SIM Box Detection

Benefits

- Global fraud customer base
- Industry-leading detection solution
- Reaching beyond SIM Box Detection
- Patented and innovative approach and roadmap
- Seamless service
- Fraud expert team
- Tailored to your individual demands
- Multilingual operations and expert team
- 24/7 365 Fraud Detection
- Robust and certified technology

Fraud & SIM Box Detection

Use Cases

Network Testing

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Quality of Service Testing (QoS)

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Boundary Free Testing

QoS Testing on the Move	(p. 93)
Nomadic and Venue Testing	(p. 94)

FRAUD DETECTION AND INTERCONNECT VERIFICATION

The most advanced and leading Fraud Detection solution on the market

Challenge

Are you losing wholesale revenue because of bypassed International Voice or SMS traffic?

We help you to identify the problem and stop the revenue leakage! SIGOS' BAPT (British Approvals Board for Telecommunications) certified services help you to detect interconnect

bypass losses quickly and efficiently. Our solution is based on innovative call and SMS methods using a limitless number of routes and delivers results with absolute accuracy. Providing the most advanced solution on the market to more than 150 telecom operators, SIGOS is the unchallenged market leader.

Solution

With us, you will have a partner who you can rely on to

- // Control the SIM Box situation in your network
- // Safeguard your SMS business from fraudulent activity
- // Identify threats on OTT service
- // Verify and help monetise your International Voice and SMS traffic

The results of our campaigns are automatically sent to you and easy to interpret, allowing you and your team to take the necessary actions immediately.

Our approach within a full service model reduces the workload on your teams and maximises the impact on your interconnect revenue.



SIM Box Detection

Challenge

Saturated telecom markets force operators to launch cheaper subscriptions and promotions. SIM Box operators become more and more sophisticated using high-tech equipment incorporating the latest new features to hide their activities. And the mobile operators? They lose revenue...

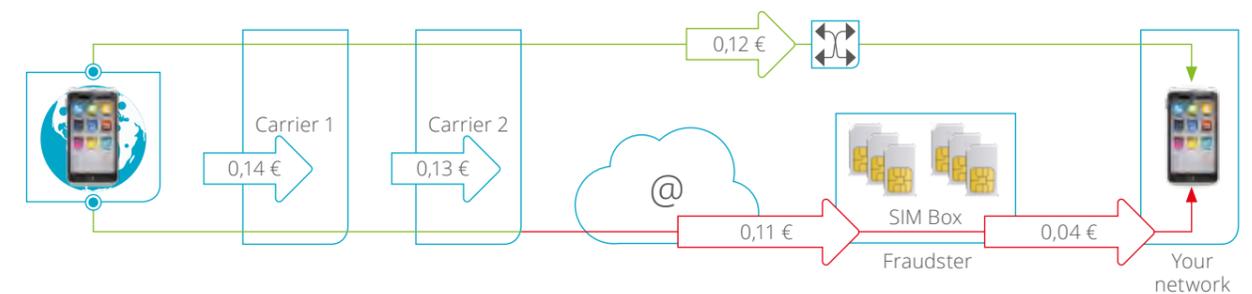
SIM Boxes (also known as GSM Gateways) generate important interconnect revenue losses for mobile operators by bypassing official interconnections and causing the operators to lose millions of wholesale minutes. SIM Boxes also have a negative impact on the call quality perceived by end customers like unavailable CLI and background noise.

Solution Based On Active Testing

SIGOS' SIM Box Detection service detects interconnect bypass losses quickly and efficiently. Our continuous improvements on the system in order to stay ahead of the ever-evolving fraudsters ensure SIM Boxes continue to be discovered with absolute accuracy and avoid counter-detection by advanced SIM Box operators.

SIGOS is working within a full service model. Each customer is allocated a dedicated Interconnect and Fraud Consultant who

follows up the trends in the results on a continuous basis and adapts and optimises the test schedules accordingly. Detailed analyses are made and a continuous follow-up guarantees the maximum results. With SIGOS' detection methodology, you are 100% sure that the detected numbers are used in SIM Boxes. We rapidly identify these so you can deactivate the relevant SIM cards automatically before they become profitable.



The mobile operator suffers a direct revenue loss of 0,08€/minute

Benefits

Stop your interconnect revenue losses!

- Ensure first-class end-user experience through quick SIM Box elimination
- Detect grey routes and get real-time alerts of SIMs that are used in SIM Box equipment
- Real-time reporting with drill-down function to full call data and timestamp
- BAPT certified
- Unchallenged market leader with more than 150 MNO up and running
- Superior technology and service

SIM Box Terminator

Leading Innovation: Active Testing and CDR Profiling

SIM Box Terminator Solution based on Active Testing and CDR Profiling

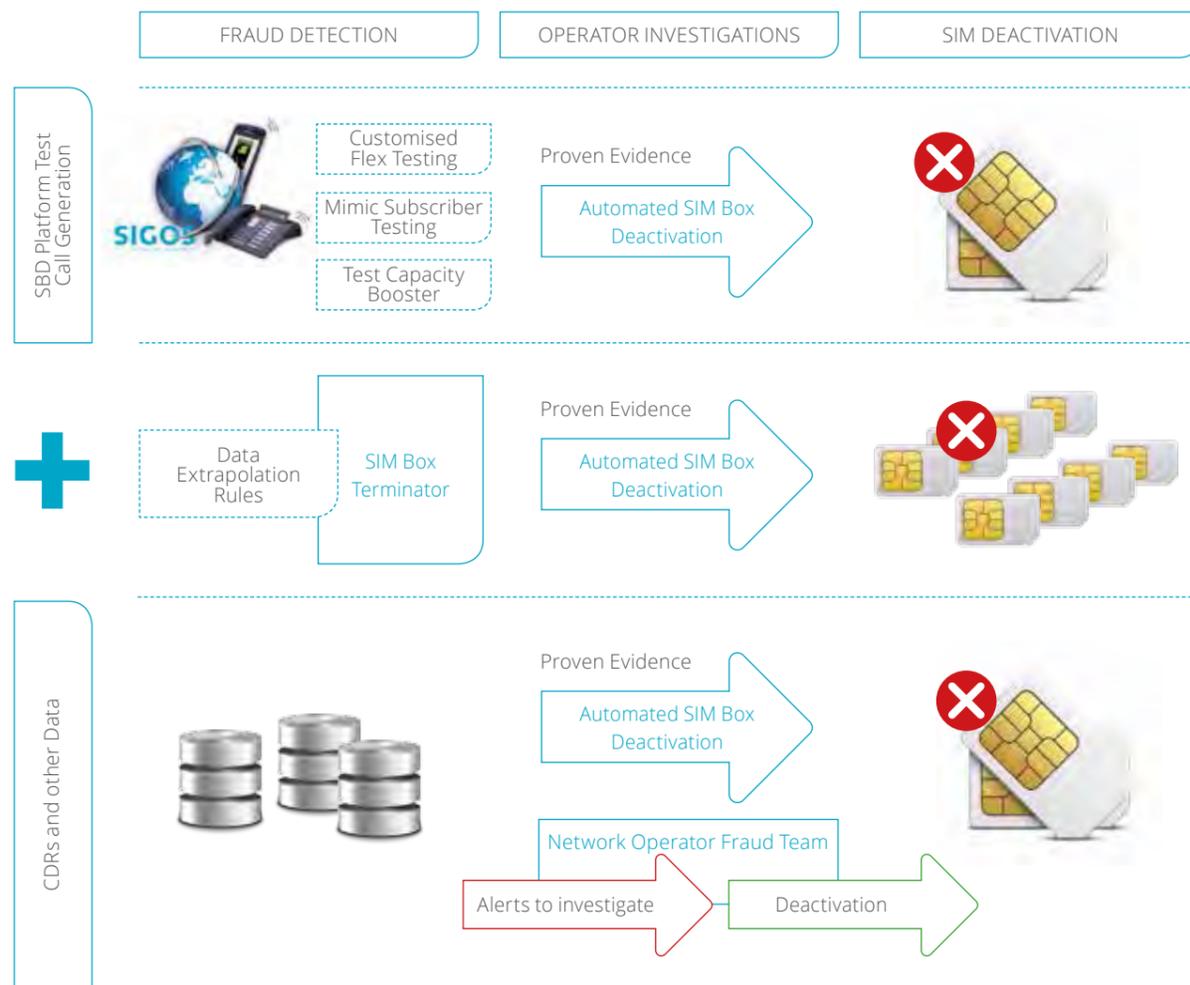
We believe that 1+1=3. In order to cope with the ever-evolving market and its demands, we have developed a combined solution based on active testing and CDR profiling.

Combining the speed and effectiveness of active testing with extrapolation through CDR profiling and fingerprinting leads to intelligent and proactive identification of SIM Boxes. More SIM Boxes will be caught faster.

Benefits

Stop your interconnect revenue losses!

- Full service model
- Guaranteed stop of revenue losses
- Quick detection of interconnect bypass losses



Voice Fraud Detection

Challenge

The interconnect path is made up of many steps, and each of these steps could hold a security breach causing revenue losses for you.

Verifying the entire interconnect path and monitoring all events are crucial. Ghost trunks, refiling, missing CDRs, arbitrage, ... can have a significant impact on your business.

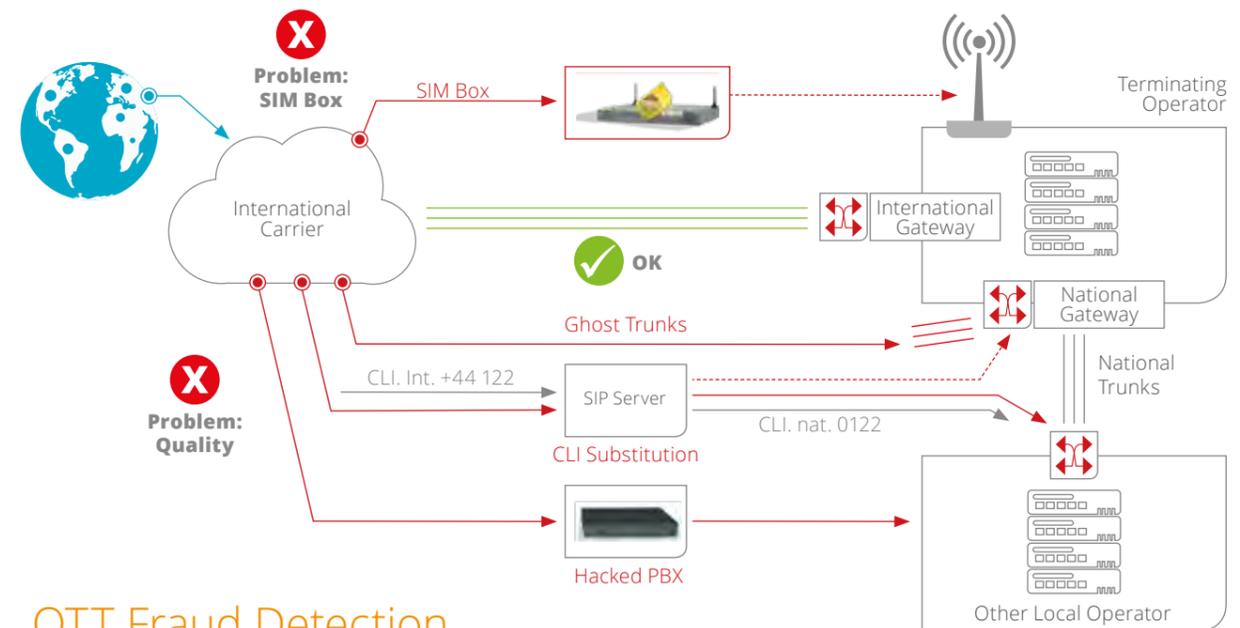
Solution Based On Active Testing

SIGOS is able to set up international test calls towards your network and perform a detailed CDR matching.

Benefits

Stop your interconnect revenue losses!

- Automatic end-to-end measurements
- 24/7 365 days a year
- Guaranteed stop of revenue losses



OTT Fraud Detection

Challenge

Now, the next step in this market change has been taken: some OTT players are actively terminating international traffic. The loss of wholesale minutes for the mobile operators can run into millions.

OTT players have the capability to attract international traffic and terminate it through their applications. While you should receive the International Termination Rate for every internationally incoming call, there is no Termination Fee for traffic entering via these applications.

Solution

SIGOS' end-to-end active testing helps you identify these interconnect bypass losses efficiently.

Benefits

Stop your interconnect revenue losses!

- 100% reliability
- Guaranteed stop of revenue losses
- Fully managed service

Interconnect Fraud Detection

SIM Box Detection – Location Finding Service

Challenge

The Location Finding Service is designed to accurately locate SIM Boxes, which are typically engaged in fraudulent activity. The use of SIM Boxes leads to a loss in revenue for operators and international carriers.

Additionally, the SIM Boxes can also be used to mask criminal activity by bypassing the monitored network and hiding the true identity of the caller. Locating and confiscating the SIM Box equipment allows the operator to reduce revenue leakage, increase income and terminate security risks.

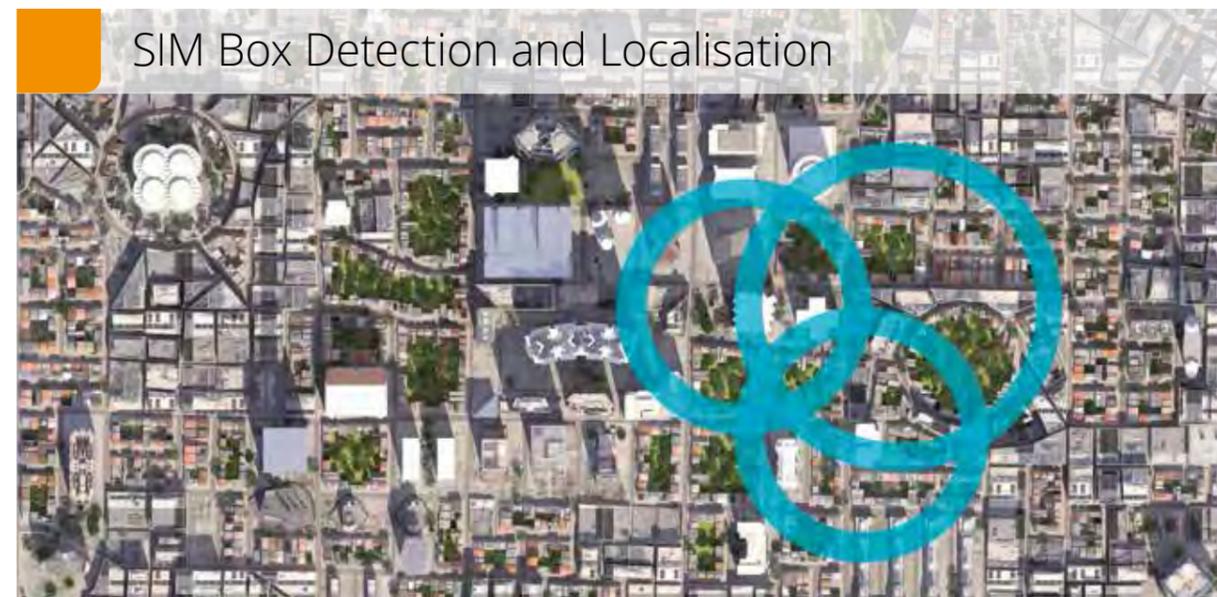
Solution

SIGOS offers a fully managed service, including a possible combination with Active SIM Box Detection through Test Call Generation and Passive SIM Box Detection through CDR Profiling (Terminator).

SIGOS' Field Application engineers perform active Location Finding using an IMSI catcher on site. The SIM Box equipment will be located through our "Knock on the door"-principle, allowing Law Enforcement to confiscate the SIM Box including the fraudulently used SIMs and arrest the fraudsters.

The Location Finding process can be summarised as follows:

- 1) IMSI of SIM Boxes are identified through Active Testing or CDR Profiling
- 2) Based on that information the operator identifies the Cell-IDs of the selected IMSIs
- 3) SIGOS' Field Application engineers perform active location finding using an IMSI catcher on site
- 4) The SIM Box equipment will be located accurately, allowing Law Enforcement to confiscate the gateway and SIMs and arrest the fraudsters



SIM Box Detection and Localisation

Benefits

- Identifying IMSIs used for fraudulent activities
- Positioning of SIM Box equipment through "Knock on the door"-principle
- Enabling confiscation of SIM Box equipment
- Supporting 2G/3G/4G bands

SMS Fraud Detection

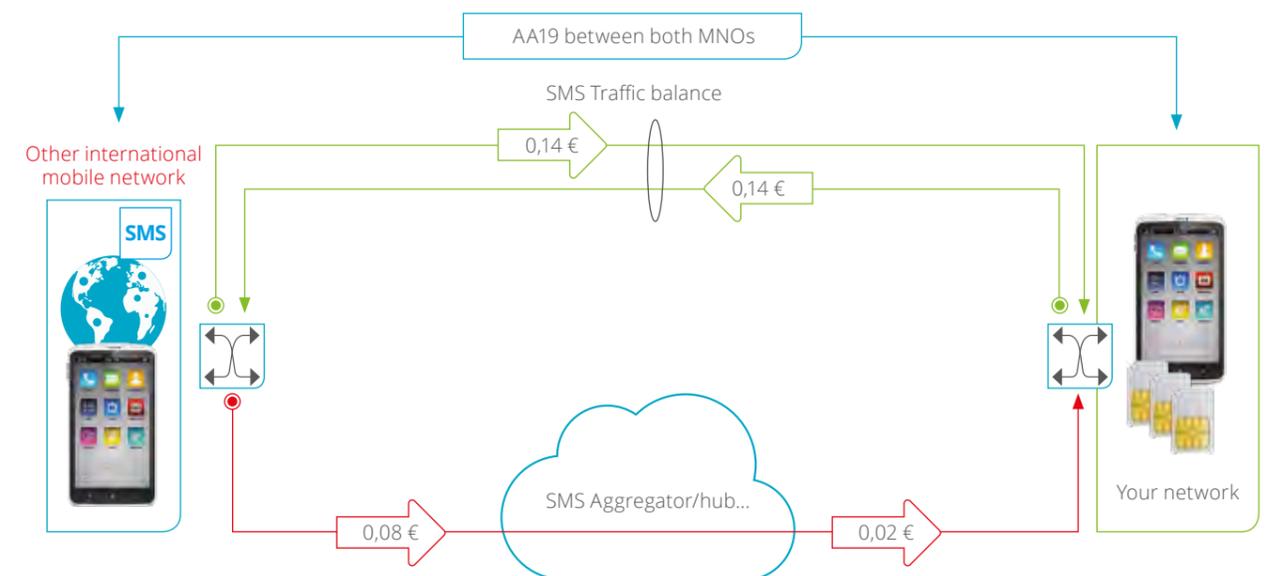
Challenge

SMS revenues remain high. More and more there is a growing discrepancy between the amount of incoming and outgoing SMS caused by enterprise generated SMS traffic (A2P) fueling the potential of monetising the SMS traffic further. Safety measures to ensure correct termination of this traffic are paramount. With OTT trying to get their share of this billion dollar business, other players with easy access to SS7 and fraudsters happily hacking into the systems, SMS termination needs to be carefully monitored.

SMS traffic, as any other interconnect traffic, is subject to revenue leakages on different levels. Arbitrage, SIM Boxes or relay operations, third-party routing, abuse of open SMSC and spoofing are big contributors to your daily losses. You need to verify these if you plan on monetising your incoming SMS traffic.

Solution

SIGOS' services help you to identify the actual SMS flow. The solution sends multiple SMSs from SIMs as well as generates web-based SMS traffic in a fully managed service.



Benefits

Stop your interconnect revenue losses!

- Automatic end-to-end measurements
- 24/7 365 days a year
- Irregularities are reported automatically
- Limited internal effort from your staff
- Fully managed service

Revenue Assurance

Benefits

- Integrated part of SITE architecture
- Highest flexibility: Tariffs, bundles, promotions
- Multiple CDR comparison
- Prelaunch testing
- ROI within shortest time
- All services, all technologies, national and roaming

Revenue Assurance Use Cases

Network Testing

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Quality of Experience Testing (QoE)

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REVENUE ASSURANCE

Unparalleled accuracy and flexibility to secure your revenue

Challenge

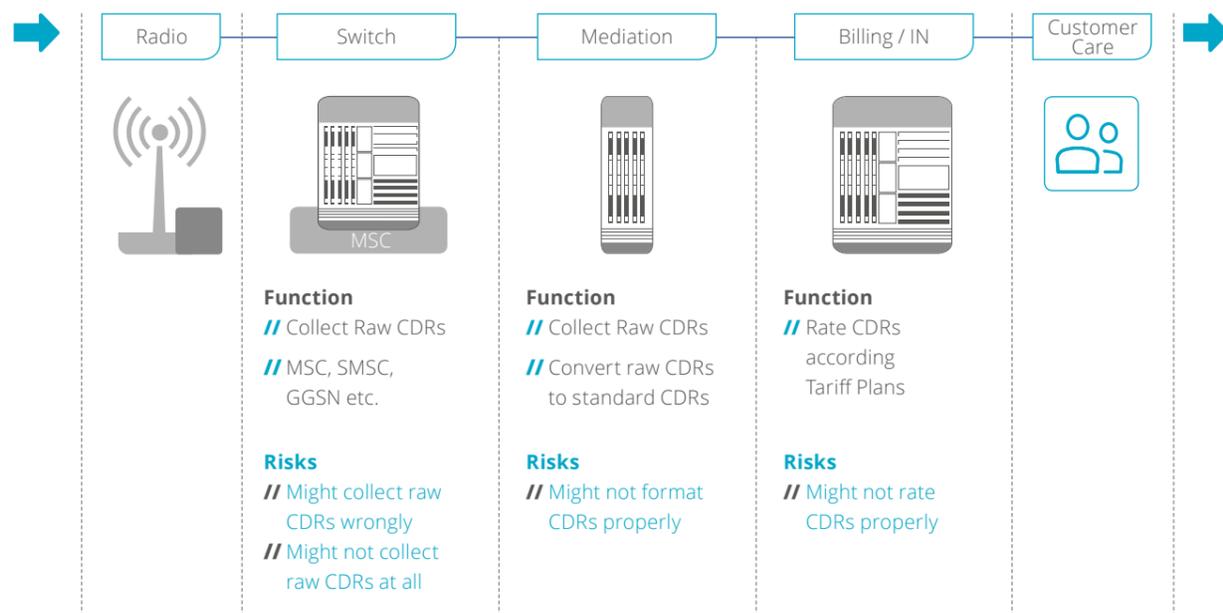
Are you charging the right amount of money for the services you are delivering?

The business model for telecommunication companies is to invest money in order to provide different services to its customers. Then the customers are charged for these services, generating a profit for the operator.

The revenue chain is a mixture of complex technologies from

different manufacturers (such as switches, multiple servers for mediation, rating and billing, invoicing, IN platforms etc.) and every small error can be very expensive. Reducing the revenue leakage by only 1–2% can be worth millions.

Passive Revenue Assurance solutions can only identify a subset of common billing and rating errors seen in billing systems by pure CDR reconciliation.



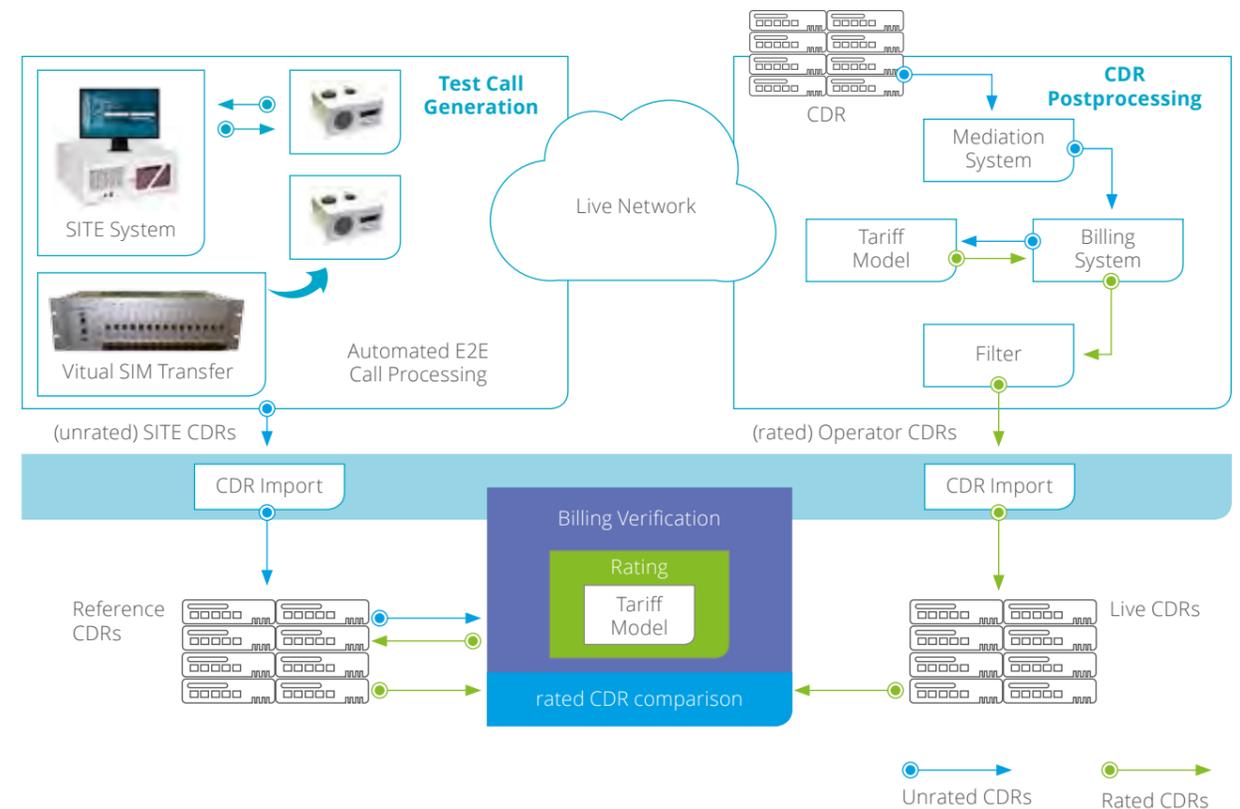
- ### Benefits
- Identify issues before customers complain
 - Decrease revenue losses
 - Assure future revenues through product prelaunch testing
 - Certified solutions
 - Used across the globe
 - Highest tariff flexibility

Solution

In order to overcome the limitations of passive Revenue Assurance solutions, independent CDRs are generated by active tests (such as voice, data, SMS, MMS), because only then can the correct number of CDRs, the correct timestamps and the correct content be verified.

Furthermore, passive Revenue Assurance solutions rely on live data, which means a detected rating error already affects millions of subscribers and a tremendous amount of money has already been lost. Verify the correct tariff implementation and complete billing chain before the tariff is officially launched in order to prevent these losses.

Once the prerequisites are configured and implemented (short and effortless HW/SW deployment for the mobile or fixed operator), the Revenue Assurance solution is automatically testing and verifying the complete billing chain, from the creation of the event (e.g. voice call, SMS, data session, national and roaming) up to CDR comparison (live CDRs against reference CDRs) and rerating of each individual CDR. Billing Error Rates (BER) can then be detected in near real time and the revenue leakage can be minimised or stopped.



- ### Benefits
- Decrease revenue losses
 - Used across the globe
 - Certified solutions
 - Highest tariff flexibility
 - Assure future revenues through product prelaunch testing
 - Identify issues before customers complain

Roaming Revenue Assurance Outbound Roaming

Challenge

Roaming revenue generates a higher profit margin than domestic revenue but presents a far higher risk to network operators. The risk is higher because of the large number of processes and connections a billing event needs to successfully navigate on roaming partners' networks, your own network and the clearing houses in between.

Solution

The solution is simple and inexpensive. For the cost of a small fraction of the losses at risk, a network can use the SIGOS global infrastructure of over 700 event generators in over 210 countries to generate controlled independent events. If a network sent us SIMs today, we could be generating independent events from its major roaming partners tomorrow. SIGOS' ingenious SIM Multiplexing technology allows us to use these SIMs in any of our global event generators even though the SIMs never leave our Nuremberg head office. This removes the time-consuming and expensive requirement for a network to install and maintain test equipment in other countries.

Crucially, networks have zero visibility of the accuracy of the billing data received from other networks. Without independent, external, accredited validation of the data received from other networks, one is simply 'hoping for the best'. Auditors, shareholders, regulators and, most importantly, customers would hope for more.

The SIGOS SITE Test Call Generator (TCG) system creates an independent reference CDR for each of these independent, controlled events. The CDRs contain independent timing and metering data and independent rating data created from an independent billing system. These areas of independence allow SIGOS testing to identify billing issues which a passive system, counting live CDR streams, will never be able to detect. The independent reference CDRs are compared to the corresponding TAP data from roaming partners plus live CDRs from a network's own systems by a sophisticated, automated comparison tool. Errors are identified, categorised and reported on a daily basis allowing losses to be minimised.

Inbound Roaming

The same approach can be applied for the most important inbound roaming partner SIMs. After analysing which roaming partners generate most of the inbound roaming revenue, independent events (voice, data, SMS, since these are the most often used services while roaming) will be generated in your network, using the roaming partner SIMs.

The reference CDRs will then be automatically compared to your live CDRs in terms of metering accuracy and rating (IOTs). Make sure your billing system is working properly before you forward the details to the Data Clearing House, and ask for the right amount of money from your roaming partner.

Benefits

- A simple and inexpensive solution
- Use SIGOS infrastructure in over 210 countries worldwide
- No maintaining and installation of an expensive network
- Creates independent reference CDR for each controlled events
- Fast identification and reporting of errors

Domestic Revenue Assurance

Challenge

Networks often report very impressive revenue in their quarterly figures. After operational, sales acquisition, network investment and spectrum costs are taken out, the resulting free cash flow figures are a small percentage of the initial revenue. In times of new spectrum, technology or infrastructure rollout, free cash flow can disappear altogether. Anything which has a positive impact on overall revenue, no matter how small, can have a significant impact on improving essential free cash flow for mobile networks. A single per cent added to the revenue figure can increase the free cash flow figure by 20% or more.

Many tier 1 networks in developed markets suffer revenue leakage greater than 1%. Emerging markets can see leakage of 3% or even higher than 5% where there is low maturity of the Revenue Assurance function. A frequent error observed in networks is their sole reliance on passive business analysis Revenue Assurance systems to count the live CDRs through the billing chain to ensure that none are lost. While these systems are essential to the financial security and risk management of a network's billing chain, it is also essential to understand their limitations and the risks these expose a network to. The biggest risk is complacency. An example may be that a network has leakage of less than 0.001% because

they are able to verify the number of CDRs which successfully pass along the whole length of the billing chain. The revenue assurance risks the network is still exposed to include:

- // CDRs not created at all
- // Subscribers able to access services when they should not be able to access them
- // Lost revenue when subscribers are not able to access services they should be able to access (opportunity loss)
- // Lost revenue due to no signal
- // Lost revenue due to the network terminating a call or a data session before the subscriber intended
- // Incorrectly metered events which can only be detected by using an external time source
- // Incorrectly measured data sessions which can only be detected by using an external known data source
- // Incorrectly rated events which can only be detected by using an independently created external billing engine
- // Website update inaccuracies which form the legal contract with the subscriber

Independent, external active testing of tariff time and quantity boundaries in accordance with network business rules is the only way to identify these potential issues and assure the network against these risks.

Solution

The SIGOS SITE system generates voice, data, SMS, MMS, VAS, subscription and recharge events across a network. It creates an independent reference CDR for each of these independent, controlled events. The CDRs contain independent timing and metering data and independent rating data created from an independent billing system. These areas of independence allow SIGOS testing to identify billing issues which a passive system, counting live CDR streams, will never be able to detect. The independent reference CDRs are compared to

the corresponding live CDRs from the operators network system by a sophisticated, automated comparison tool. Errors are identified, categorised and reported on a daily basis allowing losses to be minimised.

In addition to testing hardware and software, the third element is expertise. SIGOS will train network staff on how to use the system or if the network wants to minimise headcount and maximise the return on investment, SIGOS will provide a fully managed service.

Benefits

- CDRs containing independent timing and metering data
- Identify billing issues which a passive system will never be able to detect
- Benefit from SIGOS experts training your network staff
- Fully managed service
- Minimise headcount
- Maximise return on investment

Professional Services Telecommunications

Benefits

- Portfolio of telco experts – from core, LTE, IMS to Roaming, Fraud and Revenue Assurance
- Flexible to your demands
- Worldwide expertise, multinational and multilingual
- On-site and remote
- High know-how transfer
- Initial setup for SITE and GlobalRoamer
- Expert SITE operation service
- Quality of Service management
- Quality of Experience management
- Portfolio administration service

Professional Services Telecommunications Use Cases

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PROFESSIONAL SERVICES TELECOMMUNICATIONS

Challenge

You are expecting to utilise the benefits of the most comprehensive active end-to-end test system for either long-term network performance or for specific projects.

But you do not want to look after the administration and operation of the infrastructure?

Solution

SIGOS provides different levels of fully managed service packages encompassing SITE system hosting, maintenance, administration and operations. This allows you to concentrate on running your business. You choose to outsource the management of the complete SITE system or smaller specific testing projects. These individual services can be realised on your own SITE platform (on-site and/or remotely), or SIGOS hosts the SITE system for you.

We also carry out a variety of tailored GlobalRoamer and Roaming testing campaigns for special projects and events. Likewise, within these customisable managed service packages, our experienced and specially trained staff will also support you in each phase of your individual testing requirements.



A Pool of Experts at Your Hand

Benefits

Your access to a dedicated team of telecommunication experts!

- With low or no resources required, you can take upfront capex out of the budget and reduce opex in the long run
- Make use of the know-how of the most experienced engineers in the testing area to tackle dedicated projects
- Consulting services from single day, ad hoc projects to managed services 365 days/year

SITE Project and Consulting Services

Your dedicated single point of contact will manage all accruing tasks together with a pool of experts at hand. While all these functions can be carried out remotely or on-site, a mixture of

both is usually recommended. All tailored to your individual requirements, you can choose among various levels of SITE Managed Services.

SITE Project Management

Experienced in successful execution of SITE projects worldwide, SIGOS Project Managers support your project team in setting up and establishing your SITE system into your network testing infrastructure.

Typical tasks include:

- // Project planning, coordination and realisation
- // Management of SITE system rollout
- // Management of SITE system integration into your testing environment
- // SITE system acceptances

SITE Administration Services

With the Administration Services package SIGOS supports you in putting your own SITE system into operation. Your system will be prepared for realisation of your testing scenarios. Looking back on 20 years of experience, all the relevant administration tasks, including the rollout of new hardware, are carried out by the SIGOS Professional Services Telecommunications Team.

Typical tasks include:

- // Support of hardware rollout
- // User account management
- // Probe management
- // SIM card management
- // Cooperation with SIGOS support department
- // Ticket management
- // SITE system health reporting
- // Regression tests after SITE software releases

SITE Operational Services

As part of the Operational Services Package our consultant realises your test concept in close cooperation with you and your test requesters.

The package includes the configuration of test scenarios, KPI reports, network performance alarms and dashboard functions, all invaluable for benchmarking, roaming, revenue assurance, QoS and other important network performance indicators.

Typical tasks include:

- // Technical assessment and capacity analysis to coordinate test requirements within different departments
- // Configuration and management of tests, technical reports and alarms
- // Trend reports and dashboards for QoS monitoring
- // Know-how transfer to all involved engineers on-site
- // Customised report and alarm distribution among different departments
- // Preparation of management reports

SITE QoS / QoE Master Expert Services

This elite package is designed to speed up your 'Time back to Service'!

The SITE system automatically monitors all crucial services and alerts the relevant teams as soon as there is a negative impact on your service quality. SIGOS experts will then analyse and address the problem by using the vast array of SITE on-board analysis tools. While all tasks can be executed on-site or remotely, this managed package takes quality management into perspective.

Typical tasks include:

- // Root cause analysis of detected service problems with SITE
- // Distribution of all relevant log data (traces, PCAP files, result files) between the relevant departments and teams
- // Definition of process improvements
- // Support in solving the network problems and corresponding regression tests
- // Workshops for each involved department in order to present and explain the findings and processes
- // Know-how transfer to all involved teams

Revenue Assurance with Billing Testing

SIGOS' Revenue Assurance solution provides a powerful and flexible way to detect inaccurate billing in complex and fast changing tariffs. Make use of our Managed Services comprising the full revenue assurance chain. SIGOS will define the test call scenarios based on the output of the business analysis and risk mapping steps per tariff and will rerate each

single live CDR according to the specific tariff properties with its independent and flexible rating engine. As a result, you can benefit from regular reports summarising mismatches and billing errors with all the details required for effective troubleshooting.

SITE Managed Services Overview



International Carrier Quality Tests

By constantly monitoring the transmission quality of all connected carriers, traffic can be routed intelligently. Observe your SLAs with your carriers and find the right balance between revenue and traffic volume.

Work with SIGOS to understand and monitor the traffic quality to more than 410 operator networks worldwide and avoid poor quality transmission.

Roaming Managed Services

SIGOS hosts and maintains a variety of GlobalRoamer Managed Services packages for different requirements.

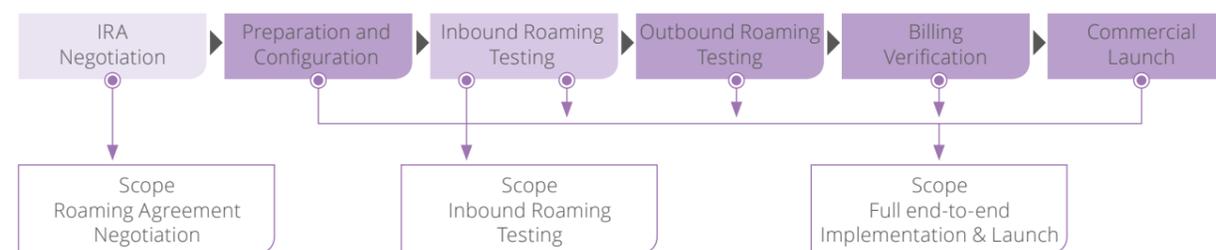
Roaming Implementation Services

Operators face big challenges when it comes to roaming: It goes without saying that the roaming rollout is crucial and needs to be fast and effective, especially for new technologies like LTE. It requires the right skills to run through the phases of negotiation, coordination and testing before the actual launch. Setting up new roaming agreements and testing different technologies with roaming partners can be very challenging as many different departments within the organisation are involved, each with their own priorities and often many other tasks.

We can help you to quickly expand your roaming footprint while you can focus on your core business. Our experienced

and professional team coordinates all the different steps in the roaming rollout process involving all concerned departments. We have our expert team of roaming engineers, coordinators and billing experts focused to follow exactly your expansion strategy, to enable roaming agreements and to test new services at best quality, fast and efficiently. We will always tailor the service to your needs and take your internal processes into account.

We can count on the best cooperation from all mobile operators around the world thanks to our excellent name in the roaming business.



Roaming Audit

Mobile operators are usually only monitoring a limited number of roaming partners and services. A lot of roaming relations have never been retested after launch, sometimes years ago. Chances of service deterioration are high as mobile networks constantly undergo configurations and software updates which may affect the connectivity to your roaming partner networks.

The service could be down for a long time without getting noticed, leading to customer dissatisfaction and missed revenues. By performing regular audits you can test the availability of the service, reduce operational costs and identify issues prior to customer complaints.

Perform a Roaming Audit now and get a full picture of the quality of your roaming footprint!

GRQ Tests

The outbound roaming revenue is not based on general experience of the roaming market, approximately 80% of your outbound roaming revenue comes from the top 20 roaming partners. For this reason the GSM Association recommends close monitoring of service quality during outbound roaming

with these top roaming partners. Just send us your SIMs and we will regularly measure, monitor, report and receive alarms on all aspects of the service quality among your roaming partner networks.

Needless to say, SIGOS is fully compliant with the GRQ framework defined by the GSMA

Billing Testing for Roaming

Operators need to implement effective solutions to manage and control revenue assurance for their roaming agreements, including all the aspects of accurate billing. SITE offers a precise and reliable tool for rating verification and CDR comparison in

outbound roaming services. Take advantage of SIGOS Managed Services to ensure correct billing for you and your customers-globally!

Testing Campaigns for Special Events

Mega events like the Olympics, the World Cup, religious festivals and others attract huge numbers of international roaming subscribers, increasing the pressure on network operators to provide superior service quality. The expectations for uninterrupted and seamless network services are high while the window of opportunity to retain roaming subscribers is small.

With SIGOS' multistage and tailored testing campaigns to measure and monitor your QoS, you are best prepared to successfully facilitate as well as optimise your earnings for the full duration of any special event and avoid churn.

Roaming Steering and Anti-Steering Tests

Test the functionality of any steering activities! A number of location update tests are performed and examined by SIGOS experts to analyse country- and network-specific steering.

By distributing a large number of tests over all networks in a country, it is determined whether the planned steering ratios between the networks are fulfilled.



Training

SIGOS offers a broad range of training to users of SITE and GlobalRoamer.

Training can be scheduled on demand either at your own premises or at the SIGOS training centre in Nuremberg, Germany.

With seats limited for each training session, maximum efficiencies are achieved.

Training is targeted at specific user groups according to the following scheme.

	Reporting & Diagnosis – Advanced		
	User Training – Advanced		
Reporting & Diagnosis – Base		Administrator Training	Test Case Editor Training
User Training – Base			
Users	Strategic Users	Administrator	Test Case Developer
Scheduling tests (ad hoc)	Scheduling tests Scheduling reports Defining alarms	Administrator of infrastructure, access rights management	Developer of test cases



Base and Advanced Trainings for efficient Know-How transfer

Use Cases



Use Cases

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// Network Testing

Radio, Fixed & IP Network Testing

Challenge

Are you experiencing network problems or service quality degradation?

Even though fixed networks continue to maintain their relevance, radio networks have evolved to be today's leading form of communication. In addition to that, IP-based voice and video services are on the rise and growing more and more in

importance. But no matter the technology – subscribers are expecting the same quality from all these services.

So, how can you stay up to date and ensure Quality of Service and Quality of Experience across all technologies?

Solution

SIGOS offers automated end-to-end test solutions for all types of technologies.

With the SITE test system, Quality of Service and Quality of Experience can be tested in various test scenarios, either

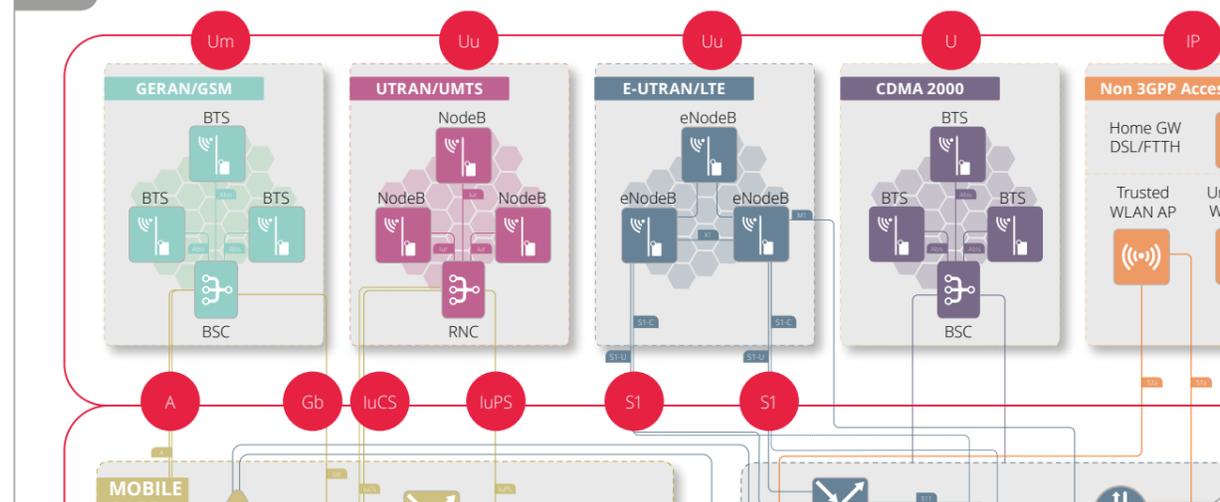
within one technology or across technologies. Tests can be executed in 2G, 2.5G, 3G, 3.5G, CDMA and LTE networks via radio, fixed-line, IP and core-based interfaces.

Benefits

ONE platform for testing multiple technologies

- Best reflection of end-user experience because of end-to-end quality testing
- Reduce operating costs by automated monitoring, testing and reporting
- Periodic and ad hoc quality testing
- Real-time reporting and alarming

SITE Radio Test Interfaces



// Network Testing

Core Network Testing

Challenge

Are you unable to localise the source of your network problem and need to check the service independently of the radio-specific issues?

Do you need to perform regression testing quickly to verify service degradations?

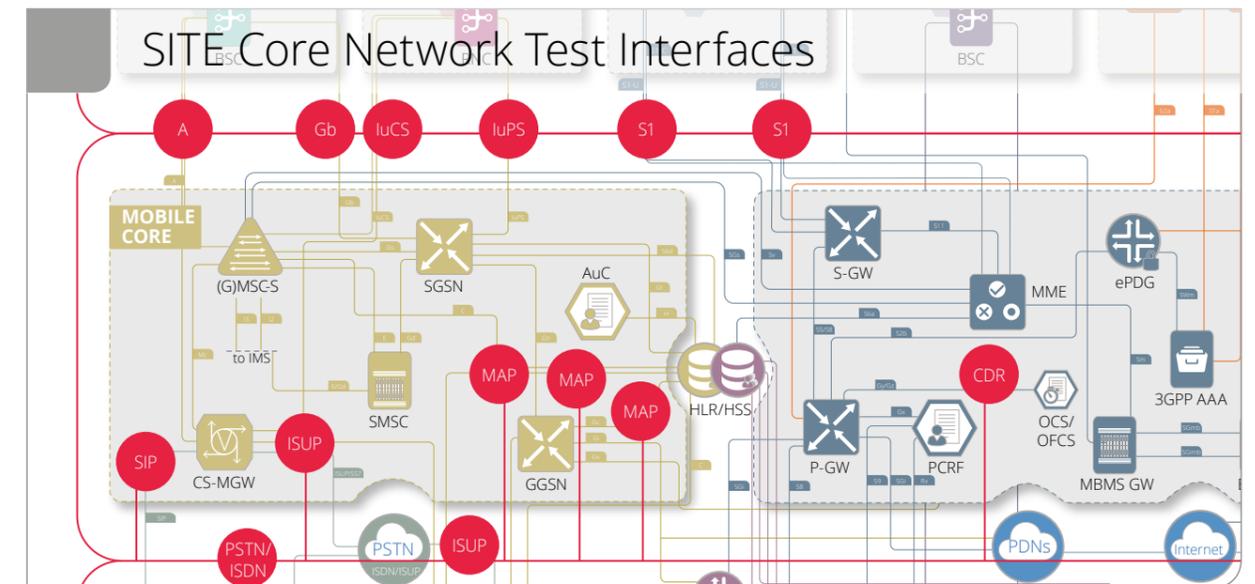
Solution

Test the Quality of Service by emulating the radio access part and connecting directly to the core components via A, Gb, IuCS, IuPS and S1 interfaces. By doing this you can completely eliminate radio-specific problems and concentrate on the preferred test cases, getting results faster by activating mass testing. It also offers reliable and quick regression testing of the core network functionality.

Sometimes the connection to the core network can also be

beneficial, because radio cells get congested in crowded locations and network operators do not want to occupy radio resources with additional testing. Core network testing lets you execute tests in a very short time frame or in high volumes without using air interfaces. Typical cases would be the update of a network component, the launch of venue service or the influence of a high number of concurrently connected subscribers.

SITE Core Network Test Interfaces



see page 2

Benefits

Elimination of radio-specific problems!

- No concerns about radio coverage or cell congestion
- Cost reduction, increased speed and volume testing
- Increased testing efficiency
- Active simulation of up to 30 subscribers per core network interface in parallel
- Detailed trace analyses
- Full support of all SITE test applications

// Quality of Service (QoS) & Quality of Experience (QoE) Testing Periodic Testing

Challenge

Are you having difficulties ensuring continuous QoS and QoE in your network?

Slow setup times, service outages and unsuccessful data downloads can be experienced in every network. Since customers usually have multiple options at hand, poor quality – even if it's only occasional – can have severe short-term

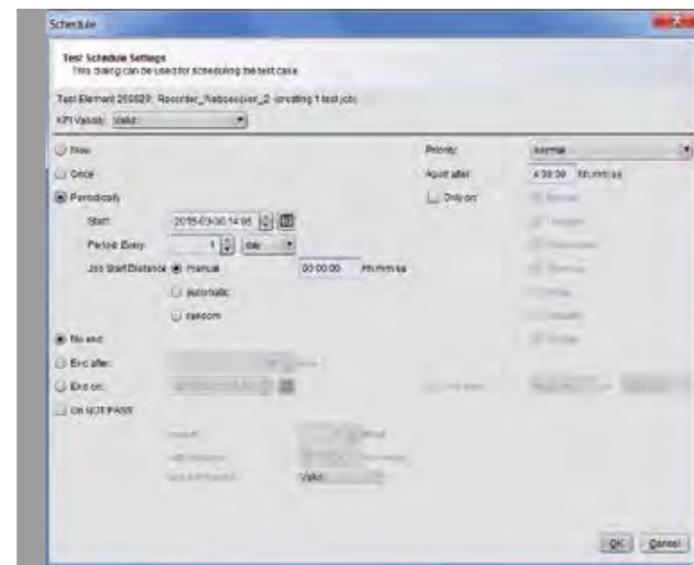
consequences, especially now that mobile number portability is common and switching between operators has never been easier.

In a highly competitive market, providing and maintaining the highest quality for end customers is the key to a sustainable competitive advantage.

Solution

SIGOS offers automated end-to-end testing solutions for QoS and QoE. Around the clock, measurements are taken at the communication endpoint (rather than in network nodes), giving the operator in-depth insights into network perception from the eye of an end-user.

Active test calls can be generated 24/7 without the cost of 24/7 staff. In combination with a centralised alarming system based on measured KPIs, the system provides excellent real-time feedback on the service levels of the network.



Test Scheduler
automatic testing 24/7 365

Benefits

Automatic end-to-end measurements 24/7 365 days a year

- Extended testing time because of continuous heartbeat tests
- Best reflection of end-user experience
- Fast identification and localisation of service and network issues, before actual service degradation
- Reduced operating costs because of automated monitoring, testing and reporting
- Full control of the testing scope

// Quality of Service (QoS) & Quality of Experience (QoE) Testing On Demand Testing

Challenge

Are you receiving customer complaints and requiring instant access to test your network services?

As Quality of Service is easily influenced by many factors, any undiscovered weak points and service outages carry the risk of potential revenue and image loss.

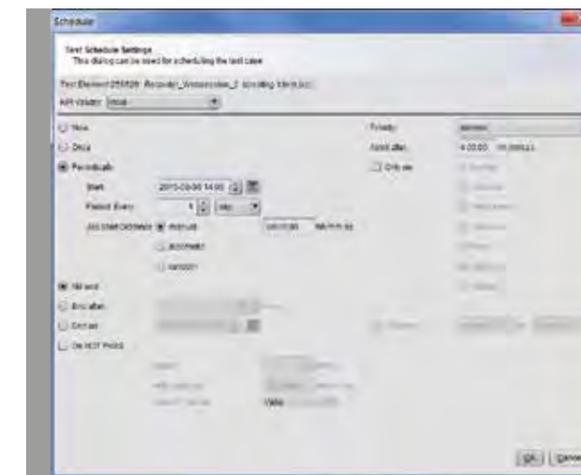
This is why quick action needs to be taken as soon as any complaints such as 'BlackBerry e-mail service not reliable', 'no Internet', 'basic voice calls not possible' or 'low speed' are received. It is crucial to understand the problem, receive trace analysis for troubleshooting and fix the service failures instantly to guarantee a speedy recovery to first-class service.

Solution

The SITE system provides the opportunity of 24/7 ad hoc end-to-end testing of services and components for rapid and focused troubleshooting of service problems. Ad hoc tests can be generated to and from all locations covered by a private test system for easy and quick localisation of root causes: via drill-down to identify particular service problems, through individual test result views or even with detailed test trace information. In combination with a centralised alarming system based

on measured KPIs, the system provides excellent real-time reports on the service levels of the network.

If a broader approach is needed, SIGOS GlobalRoamer also allows the worldwide testing of services in a roaming scenario with access to probes currently covering more than 98% of the world's countries and reporting capabilities to view reports by service, roaming partner or country as an example.



Ad hoc Testing
with priority levels to define
within existing schedule

Benefits

Reproducible ad hoc testing – anytime, anywhere

- Circumvent unnecessary testing delays and place control back in your hands
- Benchmark your service quality and performance against historical values or against those of the competitors
- Receive trace analysis for troubleshooting in order to guarantee a speedy time back to first-class service
- Perform reproducible ad hoc tests to check whether service has been re-established
- Enable multiple test cases simultaneously

// Quality of Service (QoS) Testing Network Diagnosis

Challenge

Something is wrong, but you cannot track down what and where exactly it is.

Service outages are easily detected through the results of

active testing, but if the cause of the fault lies within the network infrastructure, it is not as easy to determine it precisely.

Solution

SITE detects bottlenecks and service problems in the network infrastructure via its unique Service Alarm Map (SAM).

Individual network elements and systems are correlated with relevant end-customer services to anticipate, analyse and visually display service network problems. The drill-down

function supports the technical service teams with crucial information like error IDs, trace details and measurement values to improve reaction times during traffic congestion and network element failures.

Alarms can be mapped to countries, regions and cities.



Test Analytics
Service Alarm Map
and drill-down
for detailed investigations

Benefits

Find the root cause of service outages faster!

- Technical service teams are supported with detailed 'drill-down' information
- Identify the root cause of a problem via NAS, RRC and PCAP traces
- Get real-time alerts and reports of incidents
- Fix network problems before subscribers lodge a complaint
- Short back-to-service time
- Minimise revenue leakage

// Quality of Service (QoS) & Quality of Experience (QoE) Testing Content Testing / Handset Simulation

Challenge

Is my delivered content consistent across devices?

The huge variety of available data services like web and WAP browsing, video streaming, MMS and video telephony has to

be consistent across the great variety of available handsets on the market. Delivered content that is not displayed in the expected formats causes negative impacts on your subscribers' QoE.

Solution

The answer lies in automated testing while taking handset specifics into account. Our powerful handset simulation tool, integrated into the SITE test system, draws on a library of more than 1000 virtual handsets to imitate handset behaviour without the efforts and costs of labour-intensive manual testing.

New customer- or country-specific handsets can also easily be integrated, and an extensive number of SIM cards can be managed with our central SIM Multiplexer.



Handset Simulation of over 1000 Virtual Devices

Benefits

Test and verify the content display on various devices!

- Real end-to-end mobile content testing of multiple handsets
- Automated testing of services like web and WAP browsing, MMS, streaming, video telephony, content download
- Save the time and costs of manual testing
- Increase customers' QoE as well as your potential revenue

// Quality of Service (QoS) & Quality of Experience (QoE) Testing Benchmarking

Challenge

Do you want to identify gaps, opportunities and your true potential for improvements?

How does your network perform compared to your competition?

Who is the best performer, nationally and internationally? Do you want to quantify measures of your performance and the gap between your business and best practices?

Solution

National Approach: Start off with a national performance investigation of your network and service quality after national rollout has been completed. The SITE test system lets you benchmark your network services against the competition on the basis of internationally approved and recognised KPIs in a fast, flexible and easy way.

International Approach: Benchmarking of international carriers is an important step to ensuring highest quality of service and ultimately affecting your revenue. In order to get a comprehensive overview of multinational or group-wide benchmarks, GlobalRoamer's extensive footprint of more than 3500 testing probes worldwide enables you to perform comparisons on a global scale.

Static Test Approach: Static benchmarking tests are generally performed at airports, city centres, mega events and other hot spots where masses of people congregate. Using an active end-to-end test scenario, this network benchmark assessment provides a valuable observation of your network from a subscriber's point of view.

On The Move Test Approach: Drive QoS Tests cover different geographical areas of locally competing networks rather than focusing on static locations. This simulation of subscriber behaviour moving from one cell to another provides a comprehensive performance overview of the complete network.



Benchmark QoS / QoE National and International

Benefits

Compare your network performance to the competition!

- Enhance your own network performance by comparing it to successful operations of competitors
- Initiate an action plan for implementation and increase revenues in the long run
- Benchmark across all services and technologies
- 1:1 standardised QoS/QoE benchmark
- Investigate down to Layer 3 Testing
- Include roaming via GRP

// Quality of Service (QoS) Testing LTE and IMS Testing

Challenge

Is the availability and quality of your LTE and IMS services fully in place?

Using CSFB or VoLTE to place phone calls with mobile devices over the mobile network is an upcoming trend with many challenges as LTE users are expecting similar experiences

when using the same technology for data, voice and other multimedia services.

Preparing for the unparalleled growth of VoLTE subscribers, can you ensure that each element of your IP network is optimised for the delivery of voice services with a constant superior level of quality?

Solution

SITE, the SIGOS Integrated Test Environment, offers a range of LTE testing interfaces such as robust wireless modules, core network interfaces, mobile broadband USB sticks and smartphones.

With the SITE system you can test the following LTE and IMS services:

LTE data – Internet browsing and speed, CSFB Voice, SMSoSG, VoLTE, SMSoIP and RCS-e-based services.

VoLTE Testing

Testing VoLTE (IR.92) as a service from an end-to-end perspective is crucial in order to monitor, ensure and validate the configuration for all of the nodes in the LTE/EPC/IMS network.

SMS over IP

Test and continuously monitor the SMSoIP service end-to-end using the SITE system. The tests are performed between LTE and UMTS/GSM interfaces/subscribers and vice versa. They can be executed on both air and core interfaces.

LTE Data Testing

Monitor and ensure subscriber experience of LTE speed, Internet browsing and video streaming in a live LTE network via real smartphones, via robust air modules and via S1 core network interface.

Circuit Switched Fallback (CSFB)

Assuring the quality of the CSFB-based services such as SMSoSG and Voice is essential for your LTE subscribers.

Test cases support various scenarios of CSFB Voice MO/MT, SMSoSG MO/MT, as well as emulating a subscriber behaviour of originating or terminating a call while the user was in an active downloading session on LTE.

Benefits

One multi-testing platform to verify your LTE and IMS Services!

- Real subscriber experience
- Robust and reproducible results
- Extendible and flexible solution
- Detailed tracing for troubleshooting and root cause analysis via LTE NAS, LTE RRC and PCAP
- Maximise return on investment
- Benchmarking-capable
- Radio KPIs, Network Accessibility KPIs, service quality KPIs
- ETSI standardised KPIs
- SIM Multiplexing is supported

// Quality of Service (QoS) Testing M2M Service Assurance

Challenge

Can you ensure that your M2M service performs well across the globe?

M2M services are moving into more and more industries like automotive, chemical, healthcare and pharma, transport and logistics, security, wholesale and retail, energy and the public sector and can evolve to a new, significant source of revenue for mobile operators.

Furthermore, some M2M services are of vital importance and can even save lives, such as 'eCall' in the automotive industry (an alert system for cars involved in accidents), which is why a continuous and all-embracing monitoring of the M2M service is essential.

Solution

SIGOS helps you to provide seamless performance and 24/7 quality testing of local and global embedded M2M services based on real scenario testing.

The SITE system and the GlobalRoamer platform with its extensive global reach can perform active end-to-end service tests periodically and ad hoc, helping to ensure a peak quality of M2M service in both home and roaming networks. In addition, the automated alarming feature supports you with fast detection and correction of service outages before larger

service deterioration would dramatically impact the service delivered.

SITE M2M tests are based on standard customer access to the operator's M2M platform in order to test the whole M2M scenario, end to end. As your new customers are onboarded to your platform, SITE supports you in prelaunch and future operations, including national and international availability, anti-fraud testing of SIM cards, continuous performance monitoring and KPI observation.



M2M Performance Testing Worldwide

Benefits

Ensure correct function of your M2M services!

- Long-standing experience in testing of large global operators' M2M services
- Best reflection of end-user experience because of end-to-end quality tests
- Fast identification and localisation of service and network issues, before actual service degradation
- Reduced operating costs because of automated monitoring, testing and reporting

// Quality of Service (QoS) Testing SITE in Cloud

Challenge

Operators tend to increase their OPEX (Operational Expenditures) investment versus CAPEX (Capital Expenditures). In the near future this trend will increase even more. Especially with the introduction of software-defined networking and network functions virtualisation, where network-building is defined on another level and will be fuelled via OPEX investments and not the traditional CAPEX model.

Still, operators will need to rely on proven and efficient E2E testing for QoS and QoE in established and emerging technologies, in order to maintain customer satisfaction, permanent monitoring of SLAs as well as reducing downtime and potential revenue losses.

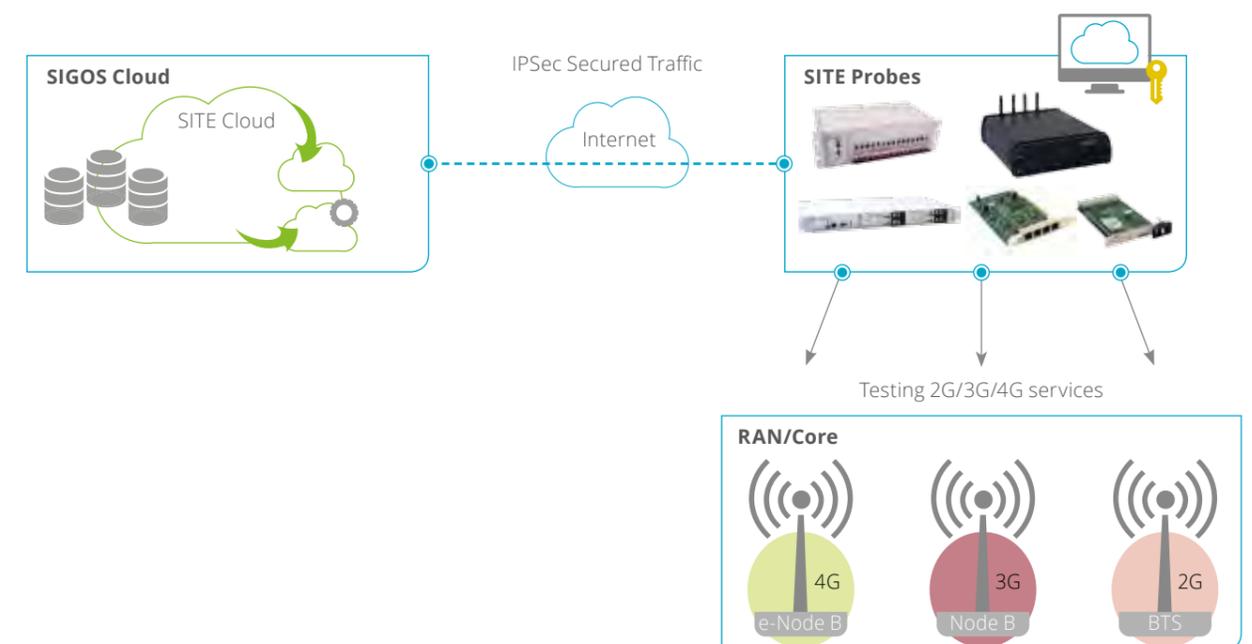
Solution

SIGOS' SITE in Cloud is an efficient and flexible active end-to-end service quality testing platform that lets you start controlling the QoE and QoS for your services.

The platform is fully supported via the SIGOS Cloud, it is easily integrated into existing network structure and test environ-

ments, which minimises the involvement of your IT team.

SITE Cloud can be activated in a very short time. It gives you a comprehensive overview on the QoE and QoS on your fixed or mobile network services.



Benefits

- The used software is up-to-date to the latest release
- Receive access to features from the latest SITE release
- Minimise costs due to the ability to pay for time based licenses for different QoS and QoE scenarios/packages
- Go to market for customised or new features is much faster
- Power consumption reduction, because of cloud infrastructure
- Geo redundancy ensures high availability for the service even if disaster happens
- Maintenance and technical support is included in the service
- Improved business resiliency through better uptime
- OPEX model for the hardware and software of the central components
- No need for a specialised personnel to maintain the central components and the remote probes

// Quality of Experience (QoS) Testing Testing Services on Real Devices

Challenge

Are you analysing your subscribers' experiences with newly launched devices?

More and more network providers offer custom-configured devices and smartphones to their customers, making it difficult to know exactly how the end-user is experiencing the provided network services.

As devices interact differently with networks and influence your subscribers' Quality of Experience, it is crucial to test using real devices in order to get the full picture before your customers can raise any complaints.

Solution

As a complement to the broad end-to-end Quality of Service testing possibilities, which rely on the simulation/emulation of devices, SIGOS offers Quality of Experience testing which uses tangible devices such as data sticks and smartphones. SIGOS' Device Gateway is a terminal solution to connect these external devices with the SITE system. Easily controlled from the Central System, it allows for a whole new way of testing commercial devices which are actually used by the subscriber!

The QoE monitoring in SITE is enabled with a Device Gateway. Real smartphones and mobile broadband USB dongles can be connected to the DG, and become testing interfaces. Various services and OTT apps can be tested, such as HD voice quality for 3G voice calls, SMS, CSFB, VoLTE, HTTP/FTP, YouTube streaming video quality, Skype voice quality, Speed-test.net, join etc.



Benefits

Not just a new probe – a new test concept!

- Real user experience through connection of tangible/commercial devices
- Extension to an existing SITE system for real QoE testing
- The direct approach for operators to test native services such as CSFB, VoLTE, LTE, data speed, SMS etc. in an ad hoc and periodic testing environment
- Get regular security patch updates as a fully managed service by SIGOS
- Benchmark multiple operators with the support of SIM Multiplexing on the smartphone
- OTT apps testing

// Quality of Experience (QoS) Testing Smartphone Dataspeed Test App

Challenge

Do you want to measure crucial KPIs straight from your mobile device?

Wouldn't it be ideal if your staff and selected customers would accurately report on your network's data speed everywhere and all the time, even using their own handsets?

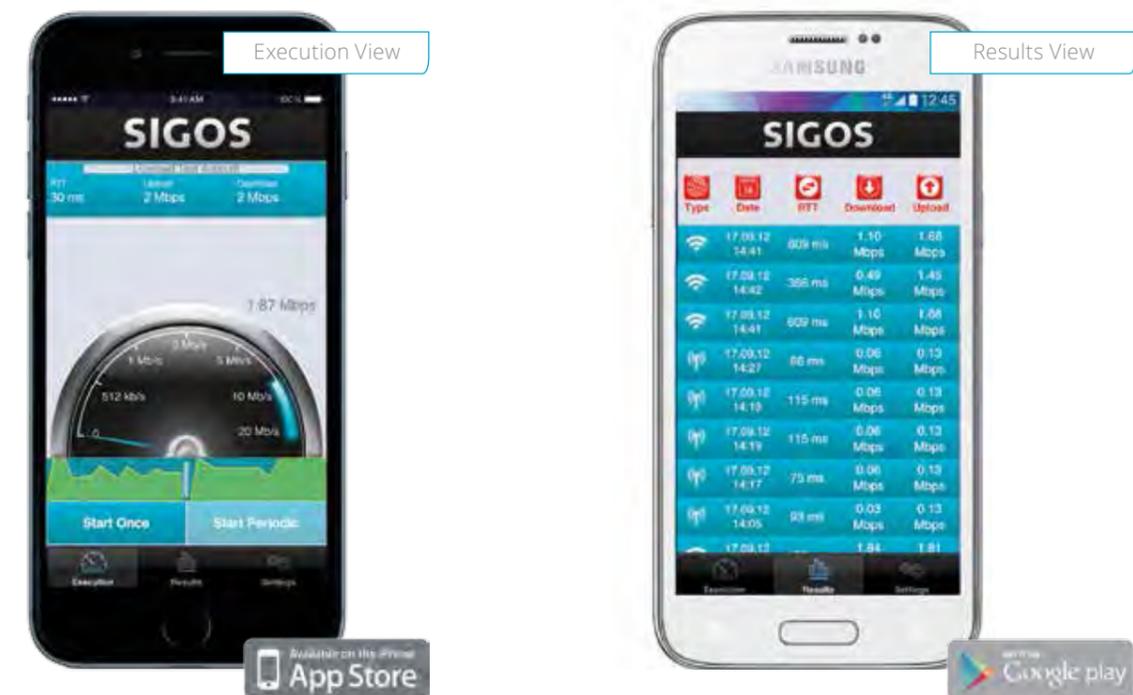
A solution combining standardised KPIs and reports centrally would be needed for reliable measurements ad hoc and in very short time frames.

Solution

The SITE Smartphone Dataspeed Test App measures your connection speed straightaway from your mobile device, directly from where you are. Complementary to SIGOS QoE solutions, the Handset Agent delivers KPIs measured from any location.

While all results can be viewed directly on the mobile device, they are also pushed to SITE/GlobalRoamer for further analysis and comparisons to other data collected in the database.

The app is also suitable for mass deployment. Why not provide Smartphone Dataspeed Test App to all your customers and let them build your coverage map?



Benefits

Measurements right from your mobile device!

- Ad hoc measurements at any location
- Quick rollout and easy data collection for temporary events (sports stadium, race circuit etc.)
- Easy deployment and KPI collection in points of interest (shops, offices etc.)
- Available for your private SITE system as well as on GlobalRoamer
- Available for iOS and Android

// Quality of Experience (QoS) Testing Web Transaction Testing

Challenge

Can you ensure full functionality of your web services with superior user experience?

Customers expect websites and web applications to run error-free, always and anywhere in the world. With web transactions being comprised of complex sequences of user clicks and actions across several pages, differences in Internet

backbones, geography, browsers and connection speeds heavily impact web transactions, site performance and ultimately end-user experiences.

Poor performance can lead to loss of sales, reduced productivity and customer dissatisfaction. Can you ensure that your site behaves fully functionally when customers interact with it?

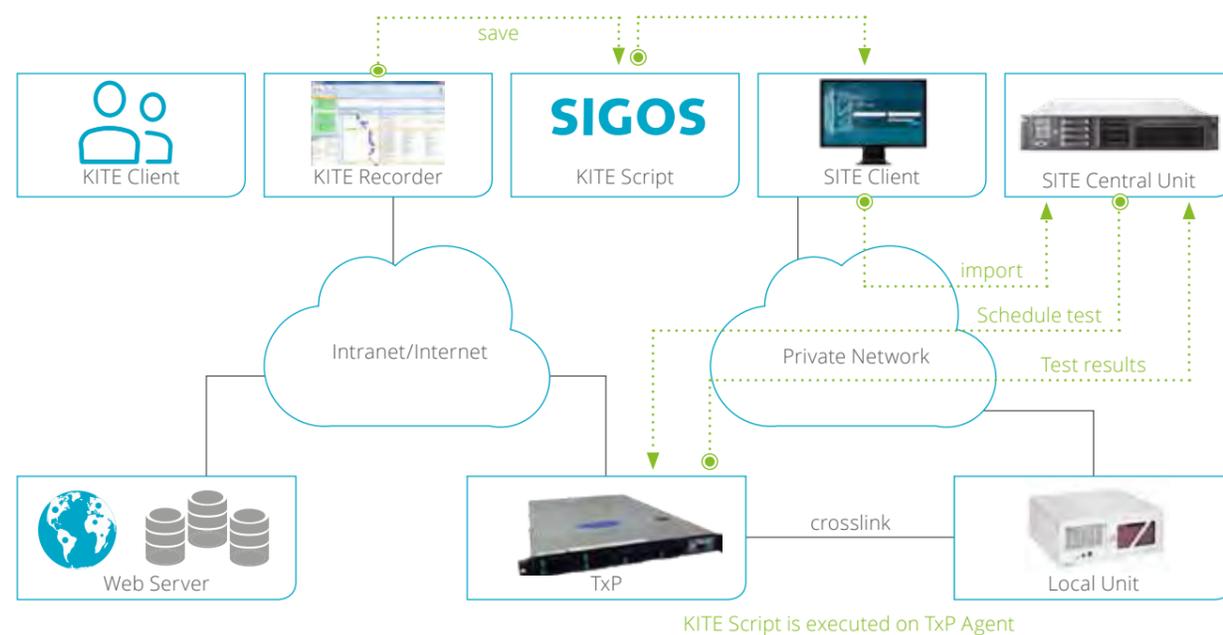
Solution

Using real Internet Explorer and Firefox browsers to generate and measure web transactions, SIGOS offers unparalleled accuracy and insights into websites and applications from an end-user perspective.

Key are the Transaction Perspective (TxP) Agents which are connected to SITE and continuously monitor and detect application errors, collect crucial performance metrics and identify exactly where problems within the transactions occur.

Recorded and stored in scripted files via KITE (Keynote Internet Testing Environment), the web transaction scenarios are imported into the SITE system including its test cases for real-time testing, diagnosing and troubleshooting of web performance issues.

Cutting-edge dashboards, smart alerts and analytics deliver all the important insights that web operation teams need to improve performance, especially before it impacts your customers' experience.



Benefits

Around-the-clock web performance monitoring with accurate levels!

- True representation of how users experience your web services
- Optimise interactive elements and highly critical web transactions
- Manage internal and agreed-upon partner service level commitments
- Benchmark web application performance and availability against your competitors

// Roaming Testing Inbound Roaming Testing

Challenge

Do you want to improve your revenues by providing better Quality of Service and Quality of Experience to your network visitors?

The battle for customers inside and outside the home network is fierce. Not only tourists but also international business

customers are roaming in your network and greatly contribute to your revenue.

Also, testing international roaming agreements according to GSMA International Roaming standards remains time-consuming and exhaustive if done manually.

Solution

Use SITE to perform international-roaming-specific tests in much less time, with less effort and easily reproducible test macros and reports.

Use SITE to perform automated periodic tests with the most important roaming partners by using the extensive library of test cases and KPIs available. The respective SIM cards required are implemented into SITEs' SIM Multiplexer, which can

be expanded to a capacity of more than 10,000 SIM cards. Ready-to-use test cases for international-roaming-specific test sets like IR 24, 26, 27, 29, 32, 35, 38, 50 and 60 are available and can be repeated at any time. The test results are then automatically processed into GSMA-conformant reports, ready for evaluation and exchange.



Benefits

Provide best service to visitors to your network!

- Save costs, increase operational efficiencies and revenues
- Flexible test creation via different interfaces
- Detailed KPI reports according to GSMA standards
- Air interface testing to measure real end-to-end subscriber experience and behaviour
- Core network testing for fast execution of many international roaming tests

// Roaming Testing

Outbound Roaming Testing

Challenge

Do you feel overwhelmed by the complexity of outbound roaming quality control?

Your customers are complaining about the availability and operation of their outbound roaming services. Relying on roaming partners to regularly collaborate on required network

performance tests is resource-consuming and can be inefficient from an operational perspective.

Why take the chance of losing customers and revenue when you can simply test the performance of your roaming partners all over the world 24/7?

Solution

Use GlobalRoamer for your automated active end-to-end testing, periodic monitoring of outbound roaming revenue networks, preventive testing in high seasons and on-demand testing everywhere across the globe.

worldwide, irrespective of time zones and completely independently of your roaming partners.

Do you want to create your own tests measuring different criteria via several interfaces according to GSMA standards? With GlobalRoamer it's all available at your fingertips.

Access GlobalRoamer from anywhere at any time via an easy-to-navigate web interface and perform tests in networks



Benefits

The largest outbound roaming platform for automated active testing

- Test standard and complex services without having to rely on cooperation of roaming partners (Steering of Roaming, SIM Box Detection etc.)
- IR81 LTE test according to GSMA standards
- Flexible and reproducible at any time with specific parameters and over several technologies
- Ready for 2G, 3G, 4G and CDMA

// Roaming Testing

Global Roaming Quality Testing

Challenge

How can you gain a global perspective on roaming quality with consistent, reliable, standardised and internationally recognised measurements?

Cost-driven threats to quality of roaming services, least cost routing, customer reaction to poor roaming experience,

decreased usage, churn, differences in service levels, troubleshooting and market focus all prevail as quality challenges. But what is quality? How important is quality? And who defines roaming Quality of Service?

Solution

In collaboration with selected partners, including SIGOS, the GSMA has developed the Global Roaming Quality Standards (IR.81), which provide a comprehensive framework for proactive testing, reactive monitoring and verification of end-to-end roaming services quality.

With SITE and GlobalRoamer you can have access to unique solutions to monitor your SLAs with numerous roaming

partners through a shared set of QoS KPIs within the categories of Network Accessibility, Service Accessibility, Connection Establishment, Connection Sustainability and Connection Quality.

By reducing roaming quality issues, quality levels and customer satisfaction can not only improve, but the costs associated with customer complaints and fault resolution can also be cut.

#	GRQ Parameter name	Category	Description	Major target	Minor target	KPI alarm	Trend report
1	CS LU SR	Voice	Circuit Switched Location Update Success Rate	95%	98%	yes	x
2	CS LU Delay	Voice	Circuit Switched Location Update Delay	50s	10s		
10	CLI	Voice	CLI Transparency	95%	98%		x
11	SpQ	Voice	Speech Quality	2.5	3		x
12	SA-MO	SMS	Service Accessibility SMS MO	95%	98%	yes	x
13	SA-MT	SMS	Service Accessibility SMS MT	95%	98%	yes	x
14	AD-MO	SMS	Access Delay SMS MO	10s	4s		
15	AD-MT	SMS	Access Delay SMS MT	10s	4s		
24	Throughput	Data	Throughput (kbit/s)				x
25	Goodput	Data	Goodput (kbit/s)				x
26	Roundtrip Time	Data	Roundtrip Time				
27	Packet Loss	Data	Packet Loss	2%	1%		

Benefits

Consistent and internationally recognised roaming QoS testing

- Cost-efficient cooperation with roaming partners through a shared set of QoS KPIs
- Increased roaming revenue and customer satisfaction through fast resolution of home and visited networks' SLA violations
- Periodic testing and real-time reporting everywhere in the world

// Roaming Testing

Roaming Hubbing Testing

Challenge

Is my roaming Hub ensuring the best QoS available and how does it compare with the market?

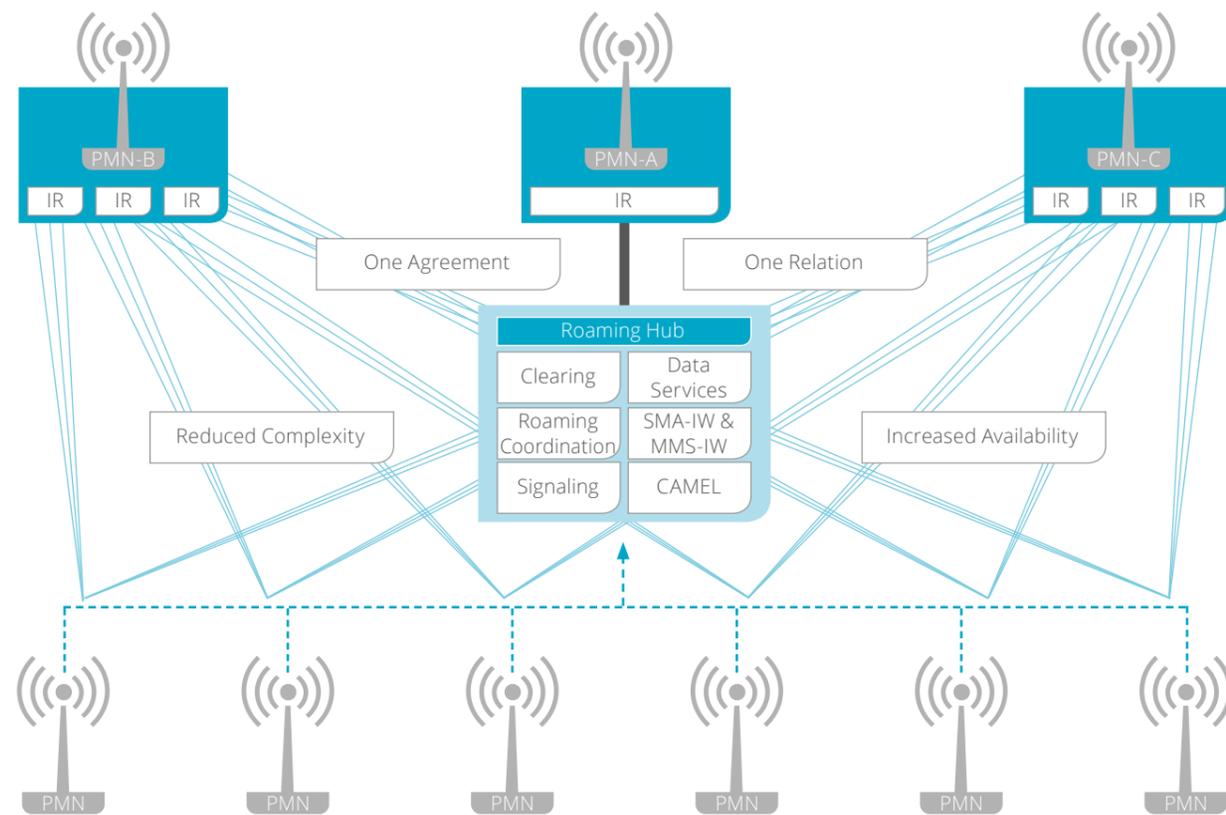
Open Connectivity enables multilateral roaming and inter-working relationships between operators in an operationally

Solution

SIGOS' on-demand test platform GlobalRoamer empowers operators to monitor SLAs. In addition to that, roaming Hubs can perform tests for outbound roaming services, inbound roaming testing, QoS monitoring and GRQ monitoring via its automated test approach and real-time reporting features.

efficient hub-based approach. But how can you be sure that your roaming Hub provides the best quality for voice, data and SMS services to their and ultimately your customers?

By activating and testing roaming Hub customers' SIMs, GlobalRoamer can therefore improve operational and cost efficiencies of worldwide Hubs.



Benefits

Connecting the world with a single roaming relationship!

- Operators can monitor the SLA they have in place with a Hub
- Provides Hubs more options to monitor the quality they offer to their customers
- Added value for Hubs to provide clear visibility to all Hub customers

// Roaming Testing

Steering of Roaming (SoR) Testing

Challenge

Are you experiencing margin losses due to subscribers roaming in non-preferred networks?

While Steering of Roaming (SoR) has been rolled out by operators in order to direct their roamers to preferred VPMNs in the roaming destinations, often a home network has very little control over the selection of networks for outbound

roamers. Either many subscribers continue to register on visited networks which are not preferred by the HPMN, or anti-steering practices are in place where the non-preferred network operators attempt to override the target Steering of Roaming.

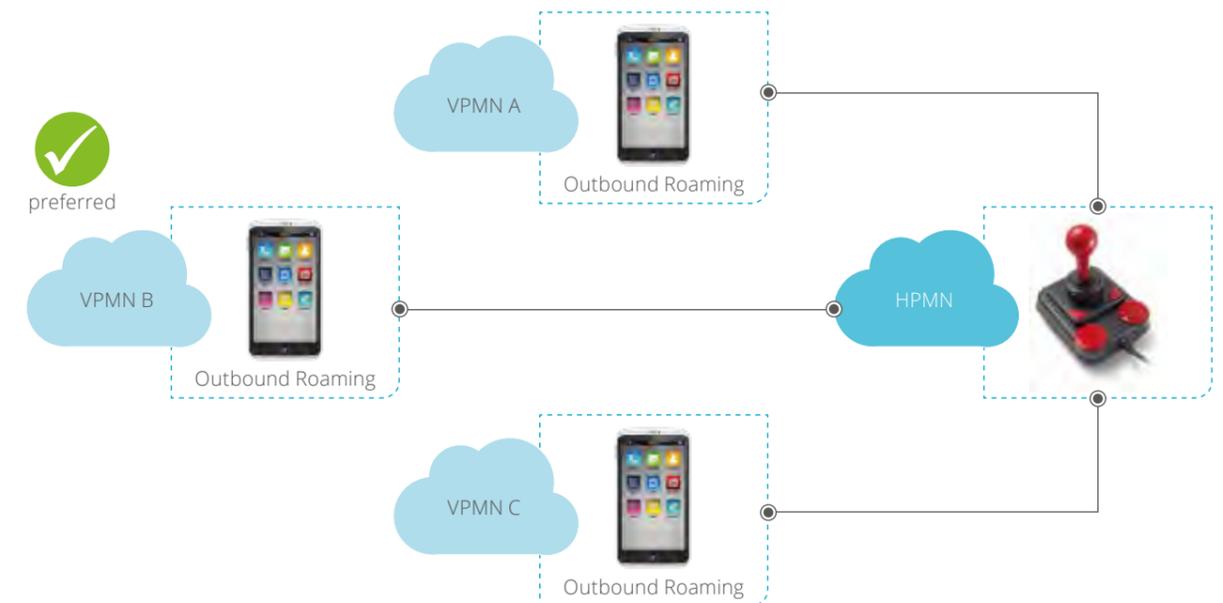
Are you also facing loss of control of roaming revenue and decrease in Quality of Service to your subscribers?

Solution

With SIGOS' Steering of Roaming testing, the quality evaluation of mobile network operators' preferred roaming partners is an easy task.

SITE and GlobalRoamer offer an SoR testing solution not only geared to test the deployment of SoR servers according to GSMA IR 73 but also capable of detecting usage of anti-SoR practices by non-preferred VPMNs according to IR 89.

By controlling the traffic distribution to preferred partners, roaming can be kept within groups, best service levels for voice and data can be achieved and cost efficiencies can be considerably increased.



Benefits

Ensure roaming with your preferred roaming partners abroad!

- Direct your outbound roamers to preferred VPMNs in the roaming destinations
- Detect short- and long-term deviations from target distributions
- Test potential deterioration of customer experience caused by SoR
- Decrease roaming costs and increase your revenues

// Roaming Testing

Roaming Radar

Challenge

Keeping an eye on the SS7 connectivity in the core network for both inbound and outbound roaming scenarios. A software update in a network element may affect the connectivity to your roaming partners' MSC/VLR, SGSN or HLR, resulting in routing problems. As a consequence, service is down, ultimately leading to a drop in revenues.

Solution

With Roaming Radar you can test the availability of MSCs/VLRs, HLRs and SGSNs first on the core network level. By checking for these problems initially, operational costs and time spent can be kept low. Receive real-time alerts for connectivity problems over the SITE platform and get to the root of network problems with network messages (SS7/SIGTRAN), provided to you via SMS, e-mail or SNMP.

Tests to investigate the cause of the problem in both inbound and outbound scenarios are needed to verify and improve any network service difficulties. This is often costly and time-consuming.

While ad hoc tests, recommended as an extension to international-roaming testing, ensure that connectivity problems with (new) roaming partners are discovered before costly service tests have to be run, permanent monitoring can detect problems even in regions with fewer subscribers.



Benefits

Save time and money to identify connectivity problems in the core network!

- Identify issues before customers complain
- Test routing anywhere, irrespective of the location
- Test frequently with low complexity and operational costs
- Receive real-time outage alarms very fast due to the dense schedule
- Perfect to correlate with E2E testing through SIGOS solutions

// International Carrier Quality Testing (ICQT)

Periodic QoS Testing

Challenge

Are you experiencing service quality problems and suspect them on the carrier side?

The immediate and large-scale impacts of the interconnection carrier on your subscribers' QoS: Evident poor service

quality, including call success rate, CLI transmission and voice quality, will lead to shorter calls, no callback, false billing and customer dissatisfaction, ultimately decreasing revenue and market shares.

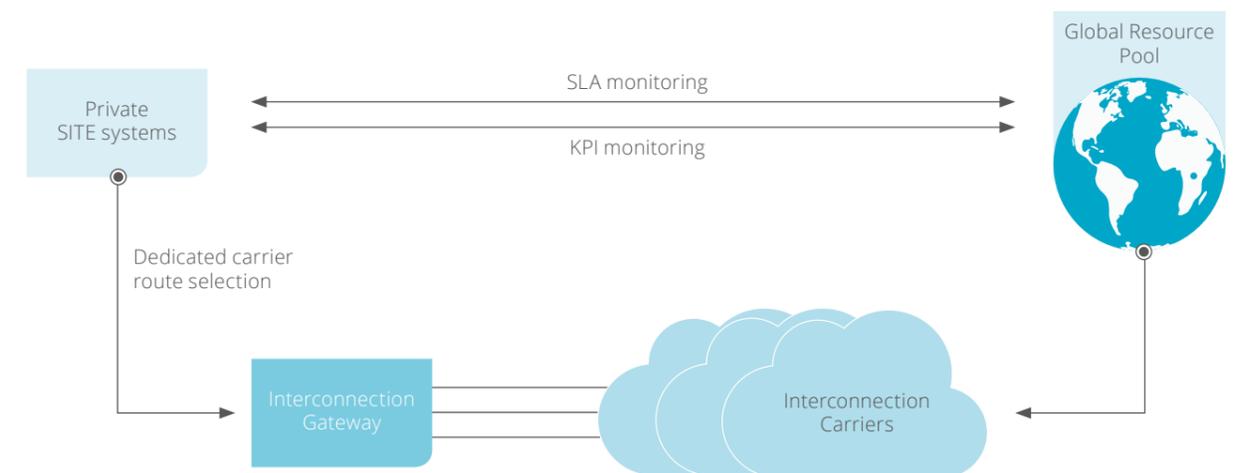
Solution

Testing interconnection carriers with an active monitoring system not only supports operators in guaranteeing QoS to their end subscribers by performing carrier benchmarking but also enables carriers with the valuable tool to ensure that traffic is not rerouted.

ICQT with GlobalRoamer couldn't be easier: Access the largest worldwide network test system from anywhere via the web interface, use the standard test cases or adapt them to

individual needs, test real end-to-end customer experience with multiple KPIs for effective QoS testing and measuring.

The ability to connect a private SITE system to GlobalRoamer's worldwide testing probes via Global Resource Pool (GRP) offers even more flexibility so that dedicated interconnection carrier testing can be performed at the international gateway exchange.



Benefits

Ensure consistently high quality on your network and at your international interconnections

- Detect quality problems and service outages fast
- Access the worldwide largest testing probes infrastructure and adapt your test cases
- Test and troubleshoot before too many customers are affected
- Maximise revenue by maintaining high levels of QoS

// International Carrier Quality Testing (ICQT)

Early Charging Detection

Challenge

Are your customers complaining about inaccurate billing?

Sometimes, calls are connected or charged inaccurately without ever reaching the receiving party. These fraudulent billings often go unnoticed because the billed call duration per user lies just within a fraction of a second; however, it could also have a greater impact on customer satisfaction. Interconnect Fraud also contributes to early charging and false answers of connecting calls. This may be caused by VoIP

Solution

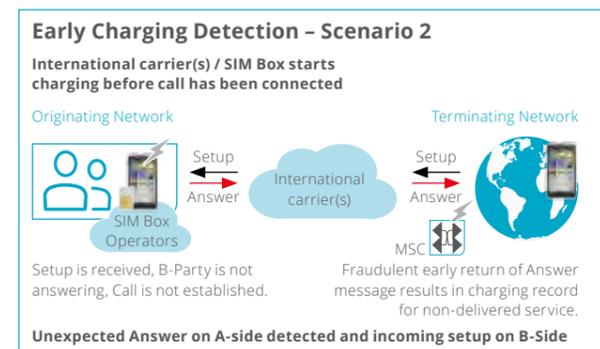
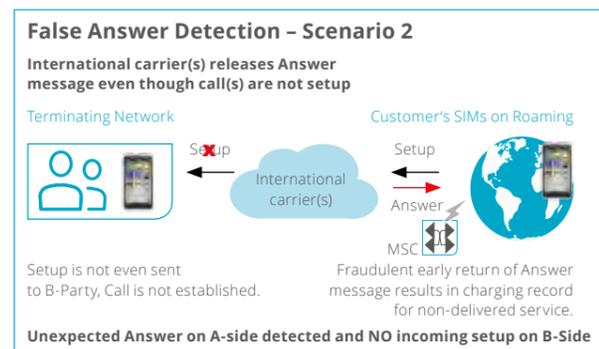
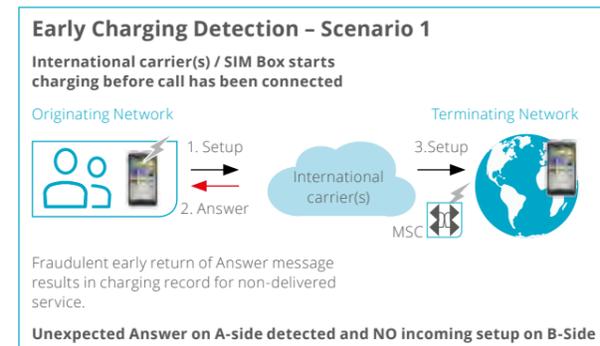
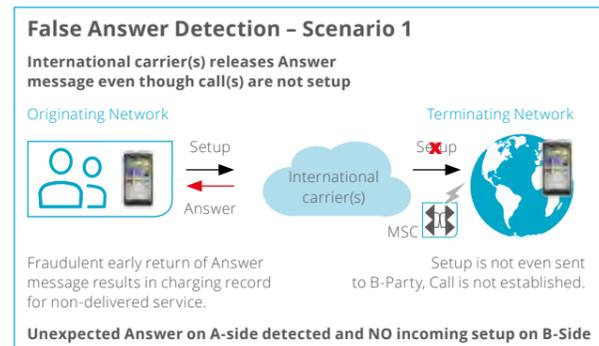
SIGOS offers an end-to-end testing solution that detects the causes behind early charging / false answer in order to help you ensure customer satisfaction.

By using GlobalRoamer, the leading reference system for

traffic via illegal gateways or faultily configured carrier equipment. Also, prepaid SIMs used in SIM Boxes often cause false answers in the instance of mailbox announcements which are being charged as a call connection, all resulting in wasted SIM credit.

The outcome is always the same: customer complaints and dissatisfaction with the service.

worldwide testing, you can identify illegitimate charges to your subscribers. Just access the large number of networks and locations across the globe to fight inaccurate and fraudulent billing on a much larger scale.



Benefits

Verify correct billing and ensure customer satisfaction!

- Active end-to-end monitoring ensures consistency in billing
- Reduce customer complaints caused by incorrect charging
- Fight Interconnect Fraud

// International Carrier Quality Testing (ICQT)

Late Disconnect

Challenge

A Late Disconnect occurs when a call is terminated by the called party but the disconnect message is not passed by the transit carrier back to the originating network for a few seconds or even longer.

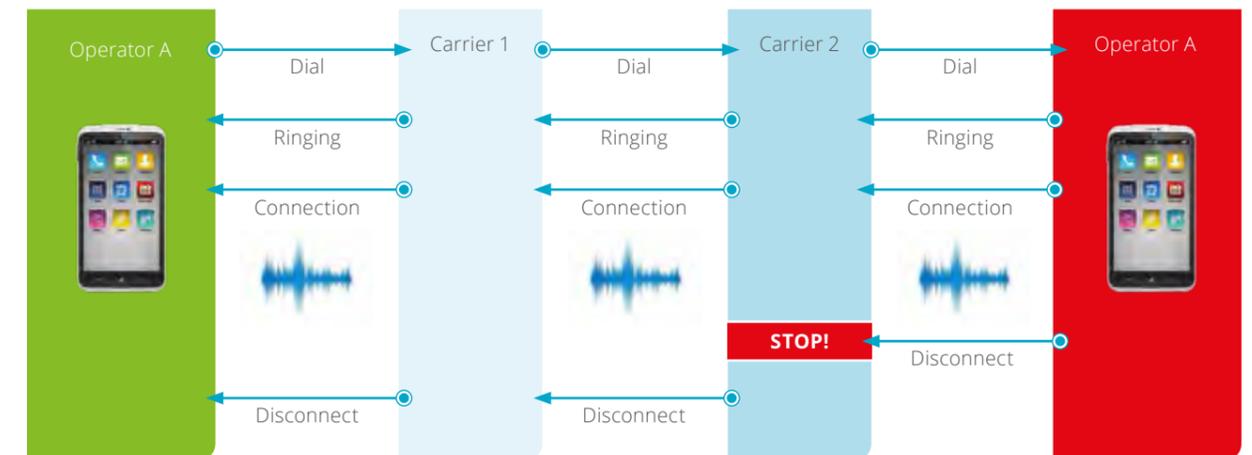
This allows the transit carrier to charge extra, resulting in the A-side having to pay more than expected. These few seconds for a carrier may be significant.

Solution

SIGOS offers an end-to-end testing solution that detects the causes behind late disconnect in order to help you ensure customer satisfaction. By using GlobalRoamer, the leading reference system for worldwide testing, you can identify illegitimate charges to your subscribers.

Late Disconnect can occur due to fraud or misconfiguration issues caused by one of the carriers transferring traffic between operator A and operator B. Within an SLA, mobile operators should aim for a Late Disconnect Ratio of 0%.

Just access the large number of networks and locations across the globe to fight inaccurate and fraudulent billing on a much larger scale.



Benefits

Verify correct billing and ensure customer satisfaction!

- Active end-to-end monitoring ensures consistency in billing
- Reduce customer complaints caused by incorrect charging
- Fight Interconnect Fraud

// Fraud Detection and Interconnect Verification

SIM Box Detection

Challenge

Saturated telecom markets force operators to launch cheaper subscriptions and promotions. SIM Box operators become more and more sophisticated using high-tech equipment incorporating the latest new features to hide their activities. And the mobile operators? They lose revenue...

SIM Boxes (also known as GSM Gateways) generate important interconnect revenue losses for mobile operators by bypassing official interconnections and making the operators lose millions of wholesale minutes. SIM Boxes also have a negative impact on the call quality perceived by end customers like unavailable CLI and background noise.

Solution based on Active Testing

In order to stay ahead of the ever-evolving fraudsters, we continually improve our system to ensure SIM Boxes continue to be discovered with absolute accuracy and to avoid being detected by advanced SIM Box fraudsters.

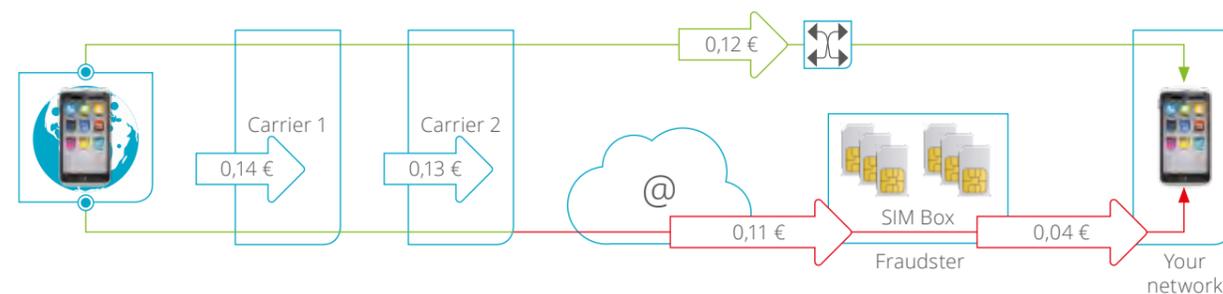
SIGOS is working within a full service model. Each customer is allocated a dedicated Interconnect and Fraud Consultant who follows up the trends in the results on a continuous basis and

adapts and optimises the test schedules accordingly. Detailed analyses are made and a continuous follow-up guarantees the maximum results.

With SIGOS' detection methodology, you are 100% sure that the detected numbers are used in SIM Boxes. We rapidly identify these so you can deactivate the relevant SIM cards automatically before they become profitable.

Originating Network:

- // PSTN
- // Mobile
- // VoIP
- // Carrier Select (CS)
- // Calling Cards
- // Carrier Pre-Select (CPS)



The mobile operator suffers a direct revenue loss of 0,08€/minute

Benefits

Stop your interconnect revenue losses!

- Ensure first-class end-user experience through quick SIM Box elimination
- Detect grey routes and get real-time alerts of SIMs that are used in SIM Box equipment
- Real-time reporting with drill-down function to full call data and timestamp
- BABT certified
- Unchallenged market leader with more than 150 MNO up and running, with superior technology and service

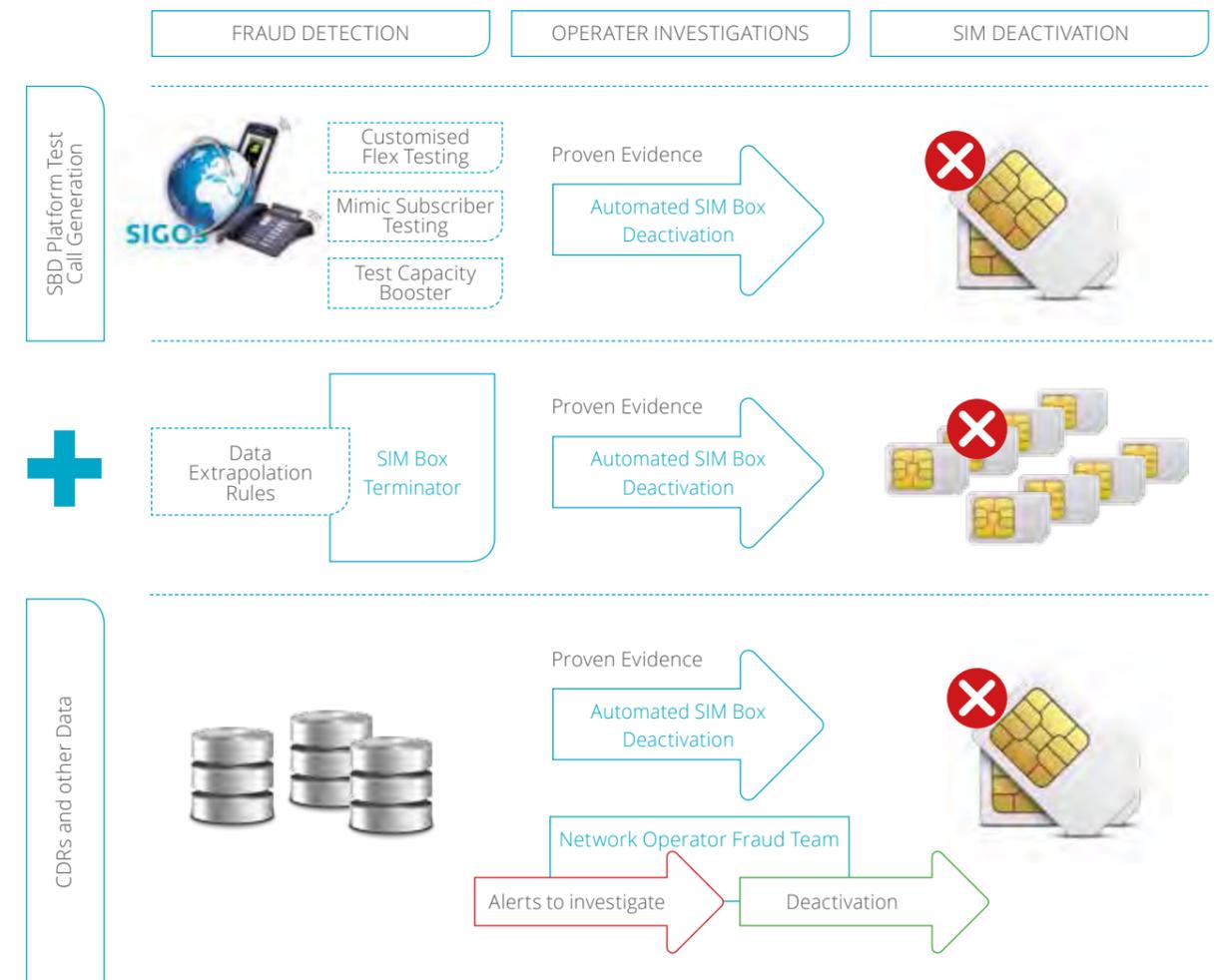
// Fraud Detection and Interconnect Verification

SIM Box Terminator

Solution based on Active Testing and CDR Profiling

We believe that 1+1=3. In order to cope with the ever-evolving market and its demands, we have developed a combined solution based on active testing and CDR profiling.

Combining the speed and effectiveness of active testing with extrapolation through CDR profiling and fingerprinting, leads to intelligent and proactive identification of SIM Boxes. More SIM Boxes will be found faster.



Benefits

Stop your interconnect revenue losses!

- Full service model
- Guaranteed stop of revenue losses
- Quick detection of interconnect bypass losses

// Fraud Detection and Interconnect Verification Voice Bypass Detection

Challenge

The interconnect path holds many steps and each of these steps could hold a security breach causing revenue losses for you. Verifying the entire interconnect path and monitoring all events are crucial.

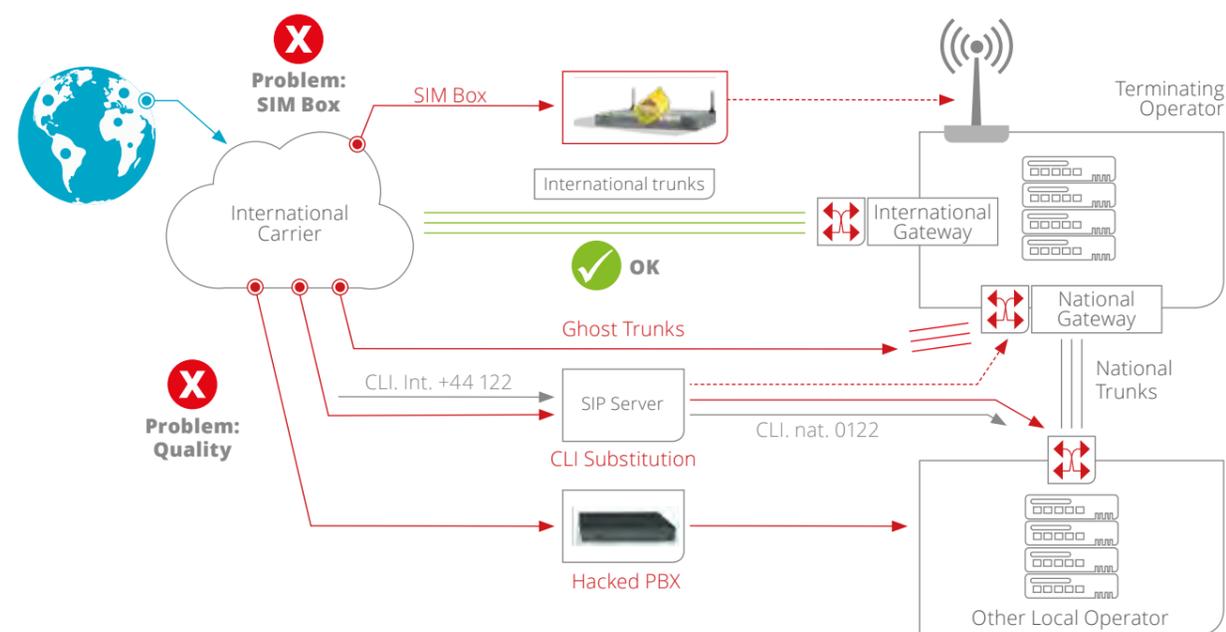
Ghost trunks, refiling, missing CDRs, arbitrage, ... all of these contribute to you not having a correct view on your incoming traffic or worse, not monetising this part of your business correctly.

Solution

SIGOS is able to set up international test calls towards your network and perform a detailed CDR matching. All details are analysed, from timings to trunks, and a full audit report pinpointing possible flaws is provided.

Using carrier connect as well as many other possible call connection scenarios, the Bypass Detection covers the largest possible footprint. This allows you to fight Voice Bypass fast and efficiently.

The worldwide footprint of the SIGOS Fraud Detection Solution covers 98% of all countries.



Benefits

Stop your interconnect revenue losses!

- Automatic end-to-end measurements
- 24/7 365 days a year
- Guaranteed stop of revenue losses

// Fraud Detection and Interconnect Verification OTT Bypass Detection

Challenge

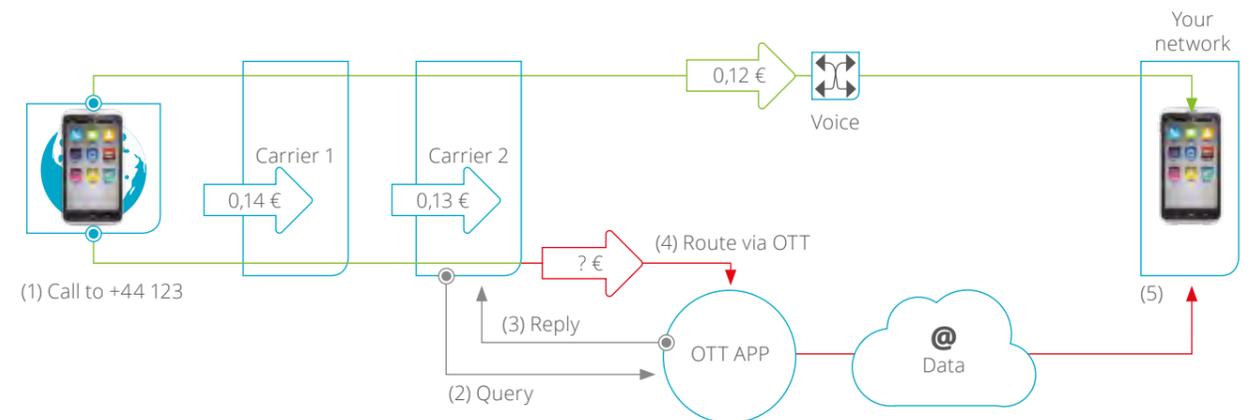
OTT players have been actively challenging the mobile operators over the past years, mainly on SMS and data level. Now, the next step in this market change has been taken: OTT players are actively terminating international traffic originating from standard voice calls. Fraudsters intercept the call flow and reroute this traffic via OTT infrastructure. The loss of wholesale minutes for the mobile operators runs in the millions.

OTT players have the capability to attract international traffic and terminate it through their applications. While you should receive the international termination rate for every internationally incoming call, there is no termination fee for traffic entering via these applications. Your international incoming traffic goes down, together with the revenues the termination fee should generate for you.

Solution

SIGOS' end-to-end active testing helps you identify these interconnect bypass losses efficiently. Our solutions are based on innovative call methods, using a limitless number of international routes, all in a fully managed service.

based on innovative call methods, using a limitless number of international routes, all in a fully managed service.



- (1) A regular international call is made to a regular mobile number
- (2) Intermediate carrier has a relation with OTT and queries if destination is reachable via OTT app
- (3) OTT checks: Destination number online? Data quality OK? User OK? ...
- (4) Carrier reroutes call to OTT app
- (5) Termination over IP directly on the OTT app instead of on the regular interconnection

Benefits

Stop your interconnect revenue losses!

- 100% reliability
- Guaranteed stop of revenue losses
- Fully managed service

// Fraud Detection and Interconnect Verification SMS Bypass / Imbalance Detection

Challenge

SMS revenues maintain high. More and more there is a growing discrepancy between the amount of incoming and outgoing SMS caused by enterprise generated SMS traffic (A2P) fuelling the potential of monetising the SMS traffic further. Safety measures to ensure correct termination of this traffic are paramount. With OTT trying to get their share of this billion dollar business, other players with easy access to SS7 and

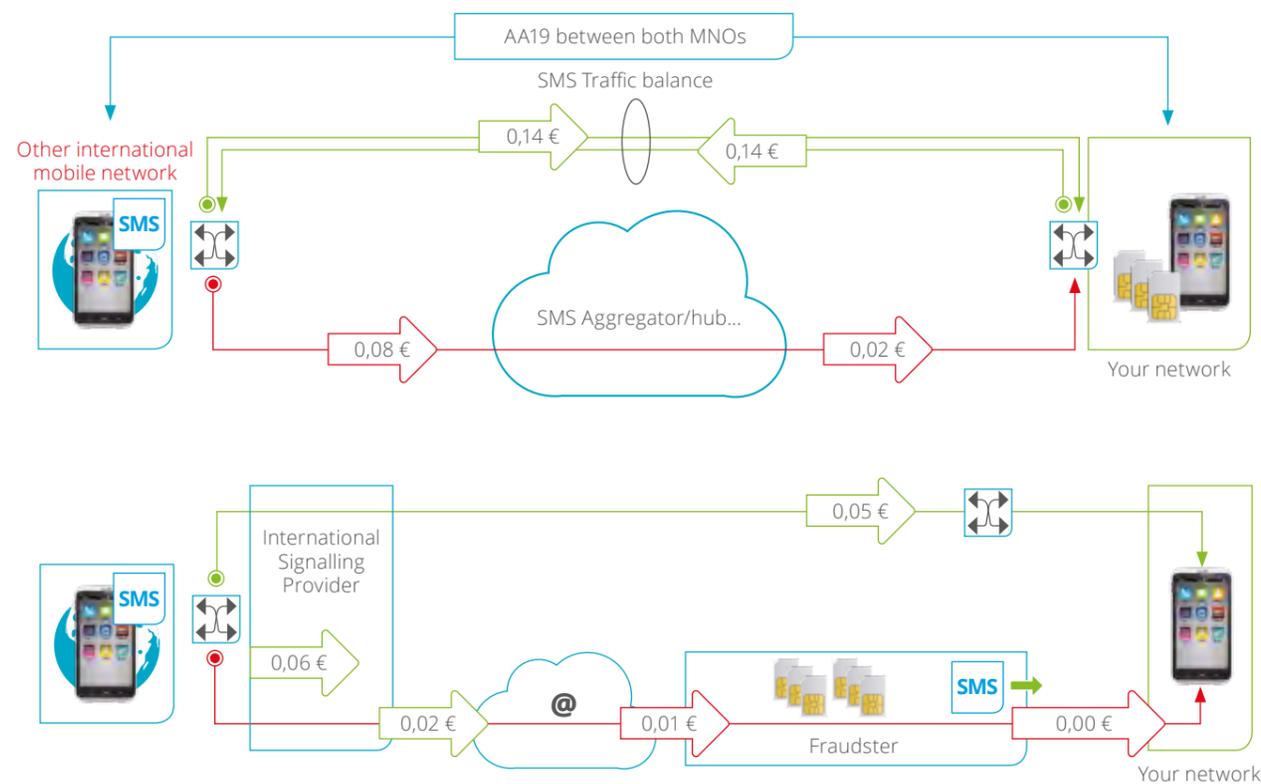
fraudsters happily hacking into the systems, SMS termination needs to be carefully monitored.

SMS traffic, as any other interconnect traffic, is subject to revenue leakages on different levels. Arbitrage, SIM Boxes or Relay operations, third-party routing, abuse of open SMSC and spoofing are big contributors to your daily losses. You need to verify these if you plan on monetising your incoming SMS traffic.

Solution

SIGOS' services help you to identify the actual SMS flow. The solution sends multiple SMSs from SIMs as well as generates

web-based SMS traffic in a fully managed service.



Benefits

Stop your interconnect revenue losses!

- Automatic end-to-end measurements
- 24/7 365 days a year
- Irregularities are reported automatically
- Limited internal effort from your staff
- Fully managed service

// Revenue Assurance CDR Comparison and Testing

Challenge

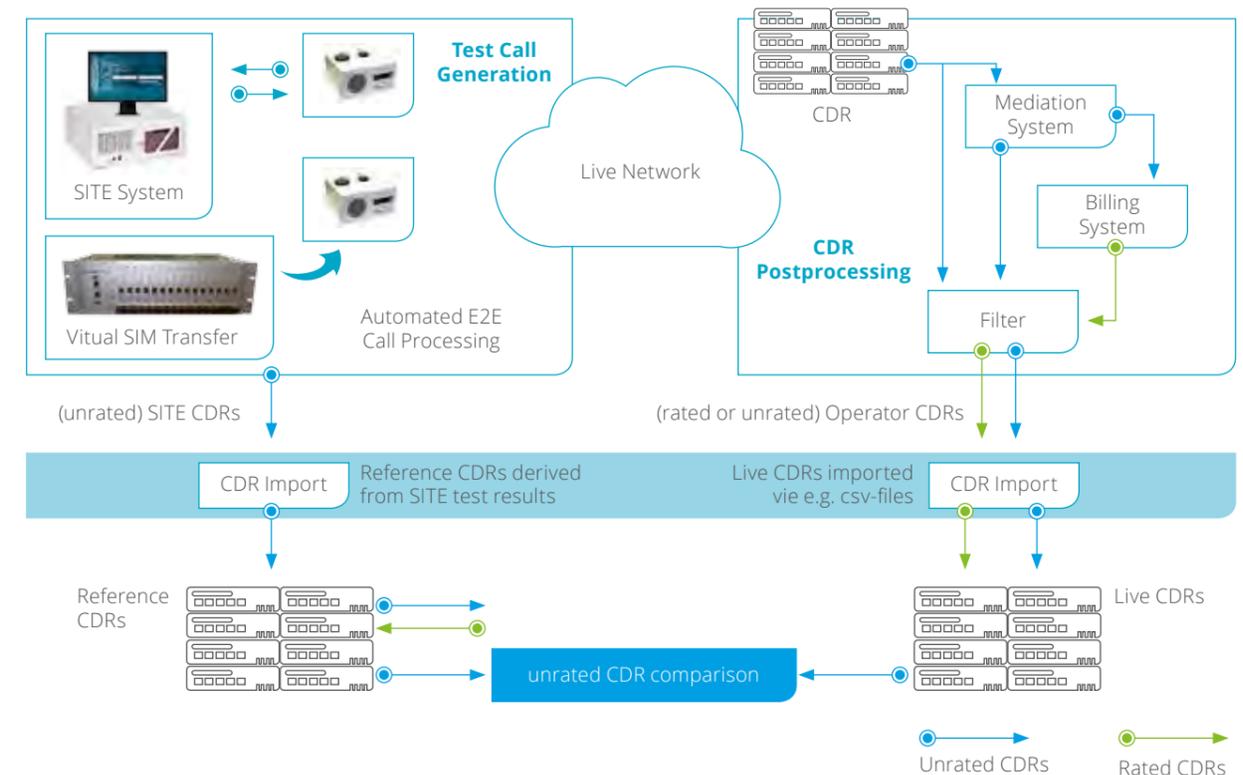
Are you sure that the correct call durations and the correct data volumes are being charged to your customers? All your revenues depend on the correctness of CDRs. In most countries accuracy of metering and billing is mandatory

to comply with legal regulations. Even if this is not the case, all operators should validate their billing in order to avoid revenue leakage or image problems due to overcharging and incorrect invoices.

Solution

The SIGOS SITE system acts as a test call / event generator. It is capable of importing 'live' CDRs from the network and automatically comparing them with the reference CDRs generated by the system. All 'live' CDRs can be extracted at a chosen point in time during post processing. This helps to detect, for

instance, inaccurate CDR fields such as faulty timestamps and incorrect call duration and GPRS data volume. Full reports will provide you with the right summary about how many calls have not been charged and how many minutes or what data volume has been counted inaccurately.



Benefits

Detection and prevention of future revenue leakages!

- Fast detection of discrepancies in the number of call minutes and data volume charged to your customers
- Comprehensive concept: any services, any subscribers, any locations
- Highly automated reporting and alarming

// Revenue Assurance Billing Verification

Challenge

Are your newly launched tariffs billed correctly?

As markets have become increasingly competitive, operators have used innovative tariffs, product/service bundles and discounts to differentiate themselves, gaining extra market shares.

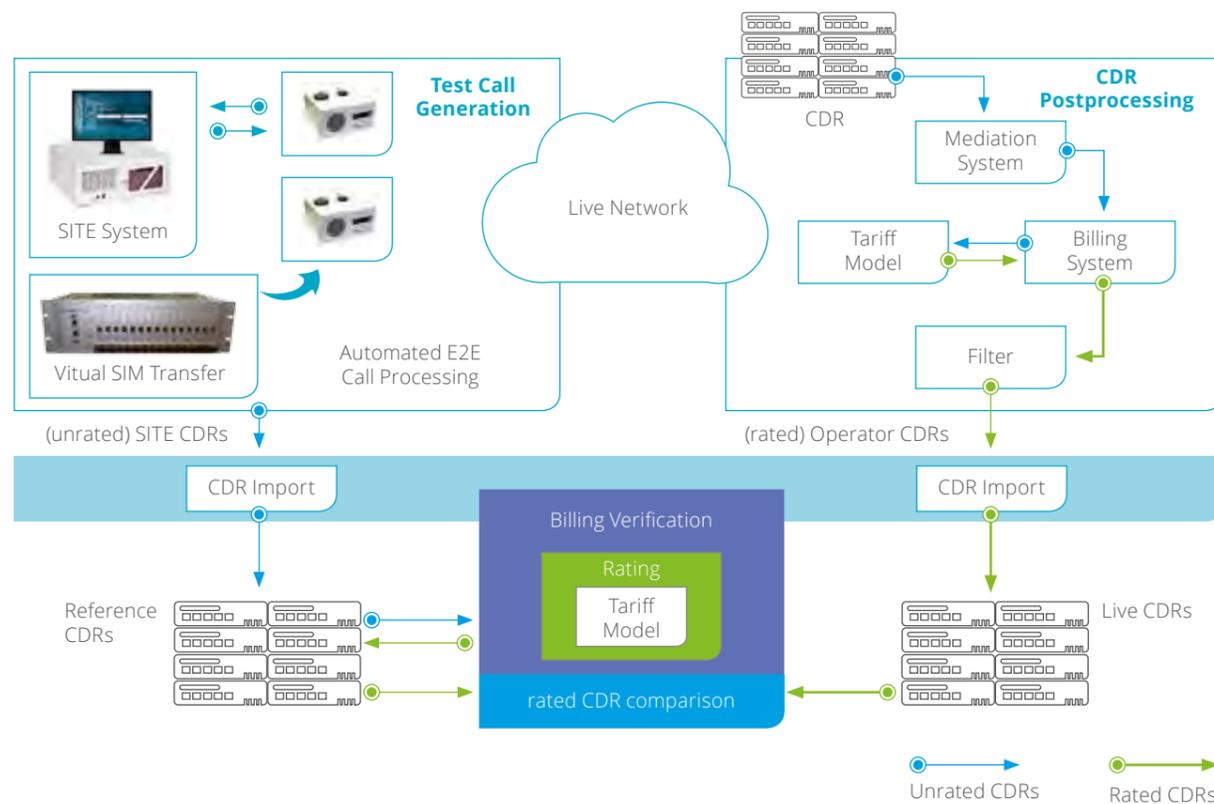
Complex and fast-changing tariffs inevitably create challenges with over-billing, resulting in customer dissatisfaction and potential penalties by regulators, while under-billing affects your revenues.

Solution

At the heart of the billing system is the rating engine, which takes CDRs from the network and applies the appropriate rating plans. Within SITE a specific tariff model can be replicated, giving you the opportunity to compare not only the raw data of CDRs but also the correct billing of a service.

Fast regression testing of new pricing plans against a variety of test cases can be performed to detect flaws in the billing process at an early stage.

Reports give valuable insights if too many or too few funds have been debited, relating to a specific tariff and throughout particular billing periods.



Benefits

Detect billing errors before they turn into customer complaints or revenue losses!

- Proactively monitor tariff plans against a variety of test cases
- Monitor different scenarios within different time/tariff limits
- Receive detailed test reports and revenue stream audits
- Make sure your revenues are congruent with your roaming tariff updates

// Revenue Assurance Prepaid SIM Recharging

Challenge

Can you ensure that your customer SIM Recharging is functioning accurately?

Worldwide, more and more MVNOs offer prepaid data packages for local and foreign customers alike. In some markets

even more than 90% of subscribers rely on prepaid SIMs and, as with any other service, expect fast and accurate operation of this service.

Solution

Both SITE and GlobalRoamer can check if recharging procedures of prepaid SIMs have been performed successfully. Test cases collect information about the current balance and then check the account balance for its accuracy after a SIM

card has been recharged. The test systems also have extensive voucher depository functionality and are able to manage numerous numbers at the same time.

In addition to that, customer-specific account verification methods (e.g. via SMS) are also supported on request.



Benefits

Correct SIM Recharging for you and your customers!

- Simplified prepaid SIM card handling in the central SIM Multiplexer
- Detect SIM card recharging discrepancies
- Increase customer satisfaction and spending by error-free SIM card recharging

// Revenue Assurance Test Call / Event Generation

Challenge

Are you unsure if your new products will have an influence on your revenues?

The launch of new products requires extensive prelaunch testing in order to be sure that the new products are accurately

Solution

SIGOS makes generating calls to test the correct function of a network or its subsystems an easy job.

SITE is ideally suited as a test call and event generator for Revenue Assurance projects because it generates its CDRs to be referenced with the networks' 'live' CDRs. All CDRs can

and reliably billed. Especially when the new product is a great success among customers, revenue leakage due to inaccurate billing would be dramatic.

Wouldn't it be much easier if calls could be generated automatically to receive CDRs for further reconciliation?

then be stored to perform verification and detection of errors automatically.

SITE and GlobalRoamer enable you to get a comprehensive testing perspective for any of your services, anytime, anywhere.



Benefits

Find faults and possible network problems before new products arrive on the market!

- Assure future revenues through product prelaunch testing
- Combat revenue losses due to incorrect billing after product updates
- Save time with fully automated test scheduling

// Boundary Free Testing QoS Testing on the Move

Challenge

Are you offering best Quality of Service on the move?

Quality of Service is important in stationary situations as it is the ideal and most cost-efficient approach to ensure full visibility on performance and fault analysis. At the same time,

Solution

Equivalently to the behaviour of static Local Units, the SITE system collects a variety of network measurements from moving test probes in vehicles like taxis, trucks or trains. The raw information is then processed into KPIs and displayed in a Google Maps view or on a colour-coded geographical map. As the real-time results are stored in a centralised database,

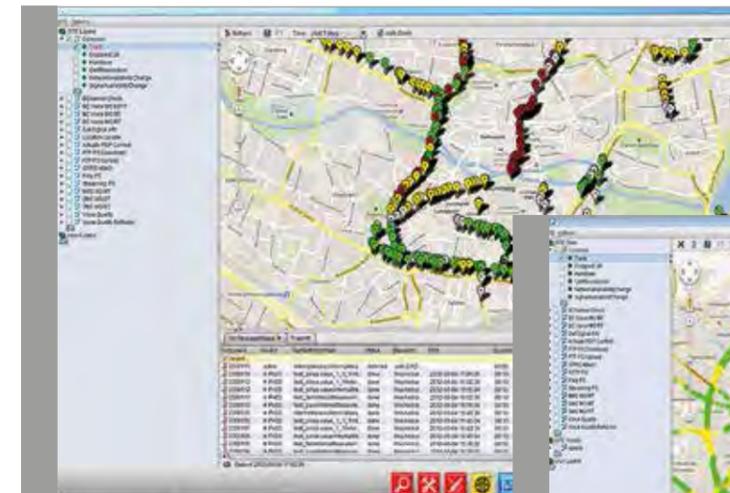
it leaves the question of whether it truly reflects the moving subscriber pattern.

Testing during movement is therefore an important complementary approach in addition to stationary testing.

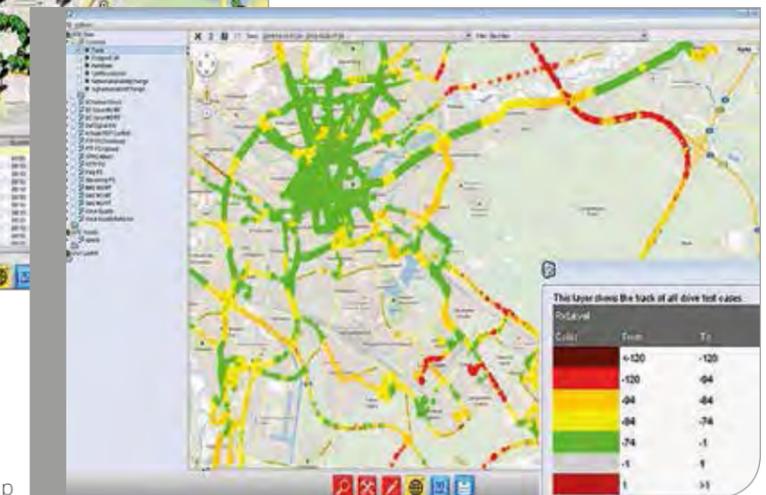
QoS Testing on the Move offers an independent view of end-to-end quality across your entire network.

With up to two LTE modules per Mobile Local Unit (MLU), you can also test-drive your LTE networks and benchmark your competitors on the move autonomously.

Fast, easy and reliable!



Drive Service Testing GIS



Drive Service Testing Heatmap

Benefits

Test Quality of Service on the move!

- Available as an extension to any existing SITE architecture
- Completely autonomous system after installation
- Easy installation and removal
- Highly customisable reporting (KPIs and maps)
- Comprehensive service assurance for benchmarking and network optimisation

// Boundary Free Testing Nomadic and Venue Testing

Challenge

Are you looking for a portable testing solution for flexible deployment?

Considering the average size of mobile networks, many relevant locations cannot easily be covered with test equipment. Especially localities like event venues, airports or train stations do not offer adequate rack space for such test equipment.

Solution

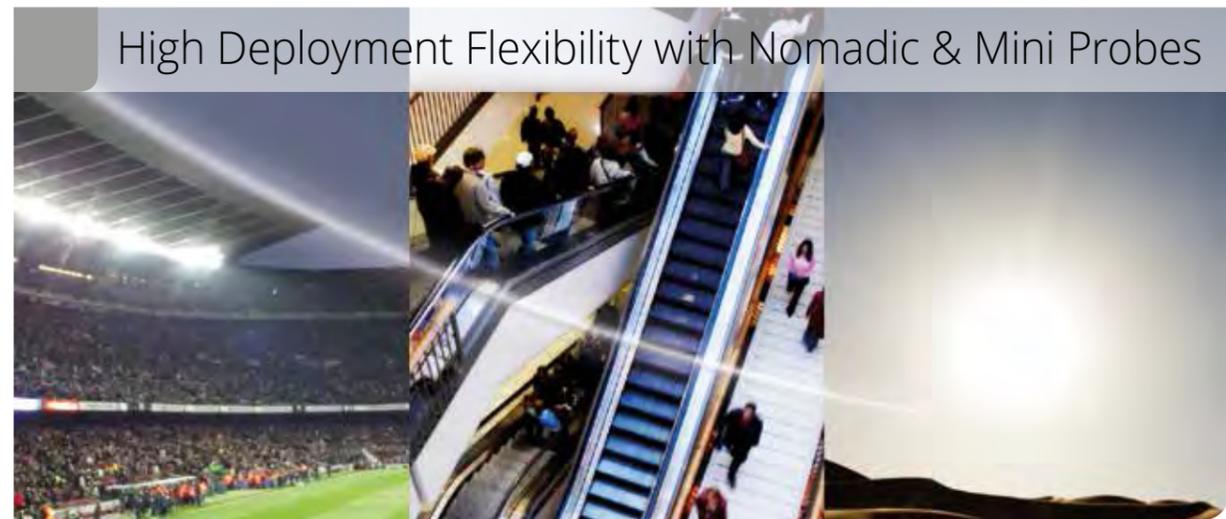
The SIGOS Nomadic Probe, together with the Mini Probe family, offers a versatile extension to your SITE system. Made to be moved around, they are characterised by their light weight, robustness and ease of deployment.

Communicating via IP Ethernet or via wireless mobile network, the probes can be moved from one location to another, while the Nomadic-M provides even higher flexibility for testing along the way which produces mobility KPIs.

Likewise, high QoS has to be guaranteed when large numbers of outbound roamers come together at mega events like sporting matches or social gatherings, all expecting faultless services and a seamless 'at home' experience. An easy in-and-out, pragmatic solution is therefore required to optimise your mobile services.

The cost-efficient Nomadic and Mini Data Probes can be deployed to test full coverage inside a building with very precise measurements, plus are ideally suited for campaigns of short time frames and where quick actions need to be taken.

Even if no fixed IP connection is available, the Nomadic-W, Nomadic-M and Mini Data are perfectly suited for flexible deployment, giving you time to optimise your network performance and increasing your revenues.



High Deployment Flexibility with Nomadic & Mini Probes

Benefits

Never miss an opportunity to test!

- Ad hoc and flexible deployment
- Precise measurements and mass deployment
- No wired IP connection required (Nomadic-W / Nomadic-M / Mini Data)
- Single tool for a variety of simultaneous tests, including benchmarking, troubleshooting and network optimisation
- Configurable to suit rough environments

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SIGOS Customers

North America

- Aruba
- Canada
- Dominican Republic
- El Salvador
- Guatemala
- Haiti
- Honduras
- Jamaica
- Mexico
- Panama
- USA

South America

- Argentina
- Bolivia
- Brazil
- Chile
- Colombia
- Ecuador
- Paraguay
- Peru
- Suriname
- Uruguay

Europe

- Albania
- Austria
- Belarus
- Belgium
- Bosnia
- Bulgaria
- Croatia
- Cyprus
- Czech Rep.
- Denmark

- Estonia
- Finland
- France
- Georgia
- Germany
- Greece
- Hungary
- Iceland
- Ireland
- Italy
- Kosovo
- Latvia
- Liechtenstein
- Lithuania
- Luxemburg
- Macedonia
- Malta
- Moldova
- Monaco
- Netherlands

- Norway
- Poland
- Portugal
- Romania
- Russia
- Serbia
- Slovakia
- Slovenia
- Spain
- Sweden
- Switzerland
- Tajikistan
- Turkey
- UK
- Ukraine

Africa / Middle East

- Algeria
- Angola
- Bahrain
- Benin

- Burkina Faso
- Cameroon
- Chad
- Congo Brazzaville
- Democratic Rep. of Congo
- Djibouti
- Egypt
- Ethiopia
- Gabon
- Ghana
- Guinea
- Guinea-Bissau
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- Ivory Coast
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- Kenya
- Kuwait
- Lebanon
- Libya
- Madagascar
- Malawi
- Mali
- Mauritania

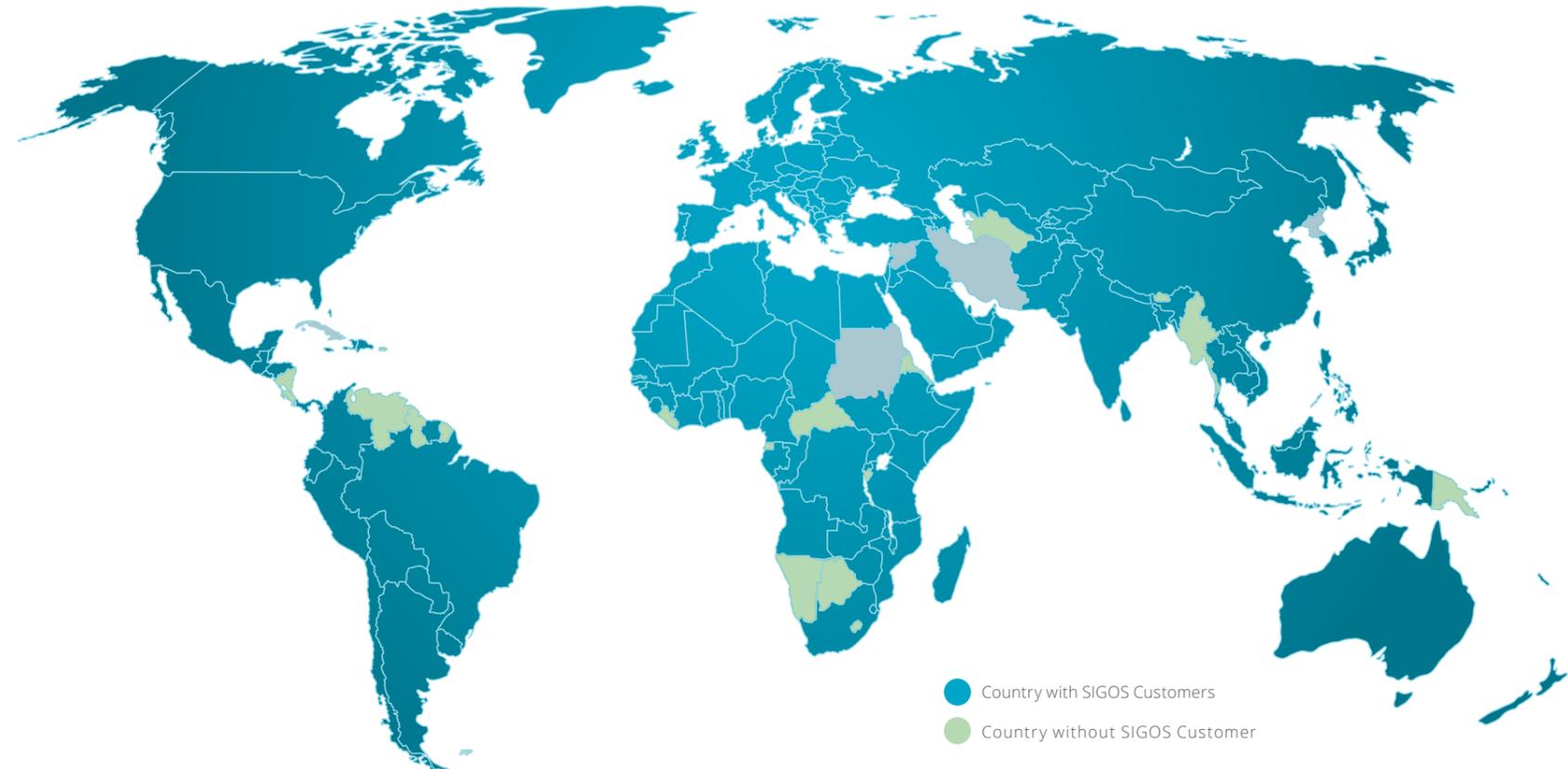
- Mauritius
- Morocco
- Mozambique
- Niger
- Nigeria
- Oman
- Palestine
- Qatar
- Réunion Island
- Rwanda
- Saudi Arabia
- Senegal
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- South Sudan
- Tanzania
- Togo
- Tunisia
- UAE
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- Yemen
- Zambia
- Zimbabwe

Asia Pacific

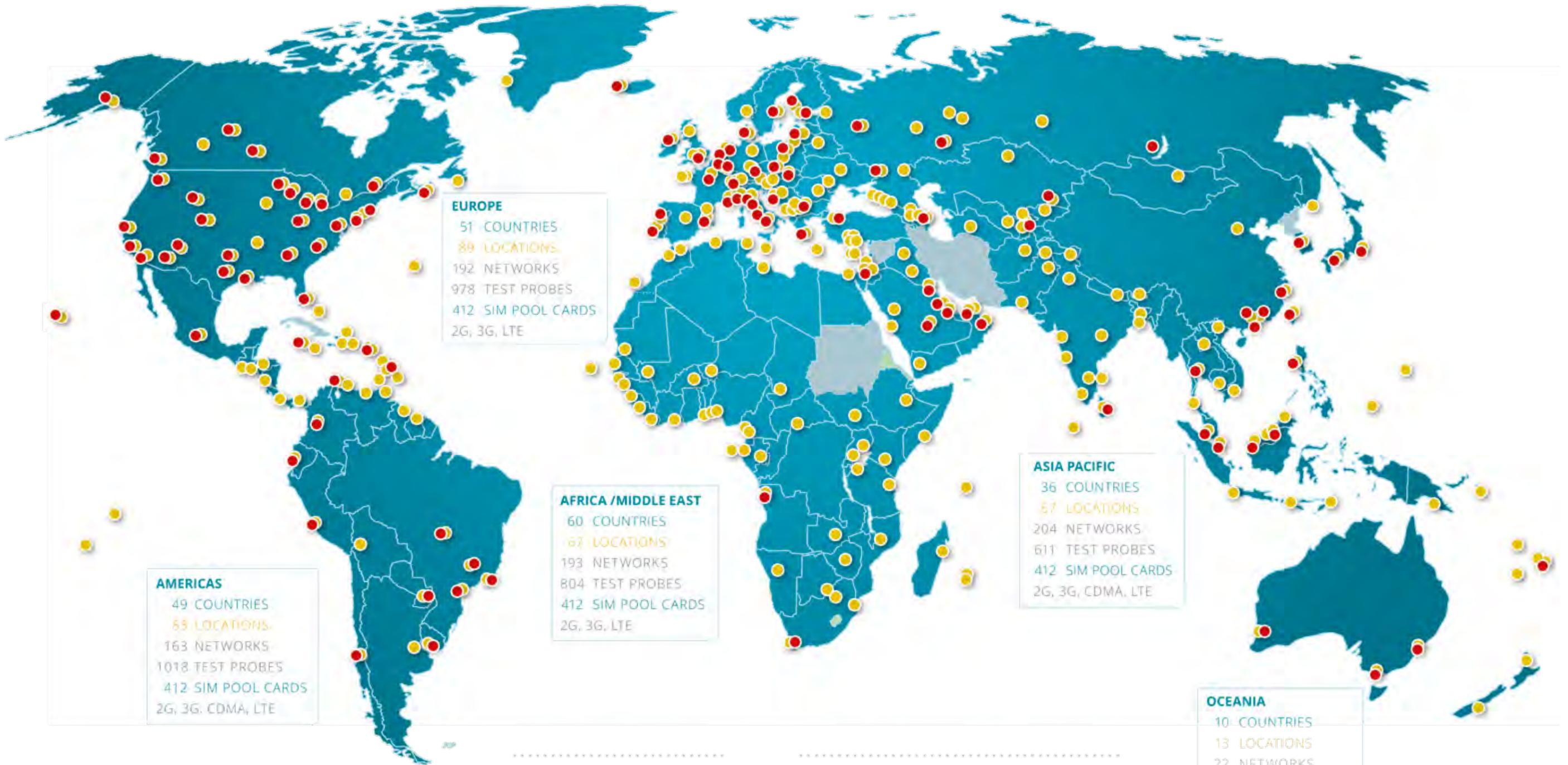
- Afghanistan
- Armenia
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- India
- Indonesia
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- Laos
- Macau
- Malaysia
- Maldives
- Mongolia
- Nepal
- Pakistan
- Philippines
- Singapore
- South Korea
- Sri Lanka
- Taiwan
- Thailand
- Timor-Leste
- Uzbekistan
- Vietnam

Oceania

- Australia
- Fiji
- Guam & Northern Mariana Islands
- New Zealand



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AMERICAS
 49 COUNTRIES
 65 LOCATIONS
 163 NETWORKS
 1018 TEST PROBES
 412 SIM POOL CARDS
 2G, 3G, CDMA, LTE

EUROPE
 51 COUNTRIES
 89 LOCATIONS
 192 NETWORKS
 978 TEST PROBES
 412 SIM POOL CARDS
 2G, 3G, LTE

AFRICA /MIDDLE EAST
 60 COUNTRIES
 67 LOCATIONS
 193 NETWORKS
 804 TEST PROBES
 412 SIM POOL CARDS
 2G, 3G, LTE

ASIA PACIFIC
 36 COUNTRIES
 57 LOCATIONS
 204 NETWORKS
 611 TEST PROBES
 412 SIM POOL CARDS
 2G, 3G, CDMA, LTE

OCEANIA
 10 COUNTRIES
 13 LOCATIONS
 22 NETWORKS
 108 TEST PROBES
 412 SIM POOL CARDS
 2G, 3G, CDMA, LTE

April 2015

- GlobalRoamer Country
- GlobalRoamer Location
- LTE / CSFB Location

*Map includes GlobalRoamer Q2 rollout plan

.....
 206 COUNTRIES

 309 LOCATIONS

 774 NETWORKS

 412 POOL SIM CARDS from

 368 DIFFERENT OPERATORS

More than 410 customers
in the global telecommunications industry
rely on SIGOS solutions.

Communication is everywhere –
and so is the worldwide reference network
test system by SIGOS.

Some of our worldwide customers

