

XCAL IOT / Site Acceptance / Field Optimization / Mobile debug

The World's Leading Drive Test Tool

Used extensively on many of the world's largest networks, the intuitive and flexible XCAL series of drive test tools are designed to troubleshoot, monitor, maintain and optimize wireless voice and data network performance – all in realtime. XCAL assesses QoS/QoE and ensures seamless service integration with existing GSM, WCDMA, HSPA, EVDO, Mobile WiMAX, TD-SCDMA, LTE(CA ~ 6CA), LTE-U(LAA), PS-LTE(MCPTT), eMTC(Cat.M1), NB-IoT, **5G TF, 5G-NR and DSS (Dynamic Spectrum Sharing)**

By automatical recording and deciphering messages from the air interface, XCAL detects any network bottleneck and impediments to delivering high quality voice and data services, giving you invaluable input for your network enterprise. Especially strongly recommended for 4G VoLTE measurement and analysis.

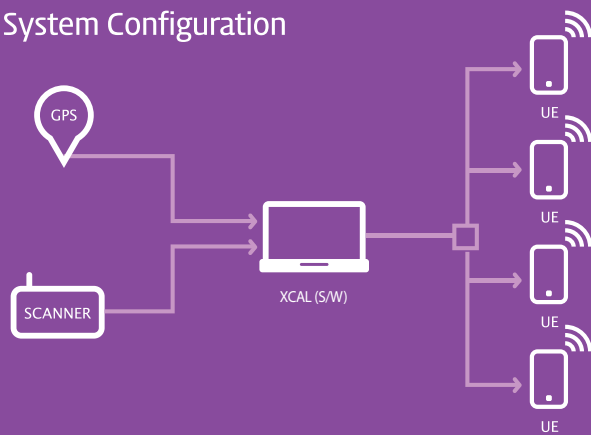
Use XCAL to

- Perform drive tests for service verification and gauge 'success' of network upgrades
- Benchmark network performance
- Carry out QoS, QoE measurements
- Carry out end-to-end application testing (MMS, SMS, video etc)
- Minimise OPEX by automating many labour-intensive workflows
- Intelligently manage massive volumes of drive test data, maps and performance counters
- Conduct indoor and outdoor network performance analyses
- Optimise handover performances
- Carry out Multiple data sessions on each test terminal
- Carry out ADB Script for Smart Phone Performance Measurement

Benefits

- Technology independent : GSM, GPRS, EDGE, WCDMA, HSDPA, HSUPA, CDMA2000, EVDO Rev.0, Rev.A, Rev.B, TD-SCDMA, DVB-H, Mobile WiMAX, LTE, LTE-A, LTE-3CA, LTE-U, LTE-H, PS-LTE, **5G TF, 5G-NR and DSS (Dynamic Spectrum Sharing)**
- Huge return on investment, because many technologies can be measured on the same simple platform (eg. GSM, GPRS, WCDMA, WiMAX and LTE, 5G-NR technology etc)
- Single platform for QoS, QoE and benchmarking
- Intuitive – very simple to use with minimal / no training involved
- Highly customisable, stable and robust
- User modifications (eg. New features/functions) are encouraged and custom delivered
- Easy and low cost maintenance

XCAL System Configuration



Features

- **Collect various data**
Collecting Layer 1,2,3 Message, TCP/IP packet information by interworking with device and scanner
- L1 : PDCCH/PCFICH/PDSCH and so on
- L2 : MAC/RLC/PDCP and so on
- L3 : RRC/NAS and so on
- **Support various chipsets**
Qualcomm, Samsung, MediaTek, Altair, Sequans, Intel, GCT, Nokia, LG and So on
- **Support Text log Format**
- **Support various Scanners**
PCTel, R&S, Anritsu, DRT
- **Support Remote Access Control**
- **Support various wireless technologies**
- WiBro, WiMAX, WiFi
- IS-95A/B, 1xRTT, EVDO Rev0/A/B, GSM/GPRS, EDGE
- WCDMA, HSDPA, HSUPA, HSPA+, DC-HSDPA, DC-HSUPA, MC-HSDPA
- LTE-A(CA ~ 6CA), LTE-U(LAA), PS-LTE(MCTPP), eMTC(Cat.M1), NB-IoT, **5G TF, 5G-NR and DSS (Dynamic Spectrum Sharing)**
- **Support various application automation test**
- Voice, SMS, MMS
- FTP, Ping, Iperf, Email, VOD, VT, WAR, VoLTE, mVoIP, Youtube, Google Play, Android APP automation Test
- Message Talk & Texting (BOLT, Bria, Facebook, Kakaotalk, Line, Skype, WhatsApp)
- VoWiFi

System Requirements

Item	Minimum	Recommended
CPU	Intel i5 2.0GHz or higher	Intel i7 2.0GHz or higher
Monitor	1280 X 1024	1680 X 1050
RAM	4GB or above	6GB or above
Hard Drive	120GB or above	500GB or above
Operation System	Windows XP or higher	Windows 7 (or higher)

XCAL-Mobile

Handy Solution embedded in Smart Phone

Handheld Air interface Field Testing Solution

Capturing RAN performance has never been easier. XCAL-Mobile is a leading handheld air interface monitoring tool that enables QoS and QoE testing across all GSM/WCDMA/EVDO/WiFi/LTE/LTE-A/**5G-NR, NB-IoT technologies and DSS (Dynamic Spectrum Sharing)** Function technologies. It supports extensive application testing and delivers realtime network measurement and visualisation capability in smart devices.

All features can be controlled using the normal handset keys, which means anybody can use it.

XCAL-Mobile supports all major smartphones and can be extended to include Android devices.

Use XCAL-Mobile to

- Record radio interface data to optimise RAN performance (network rollout, tuning, verification and maintenance)
- Calibrate the performance of network services (Voice, FTP, HTTP, Multi-RAB etc)
- Perform QoS and QoE analyses
- Export performance data to either XCAP (ACCUPER's own post-processing tool for deeper 'root cause' analysis) or other 3rd party tools.
- Perform automated tests that are user-configurable
- Reduce OPEX by minimising expenditure on test tools
- Support indoor and outdoor use
- Mobile platform supported : Symbian iPhone and Android

Benefits

- Technology independent (GSM, GPRS, EDGE, WCDMA, HSDPA, HSUPA, LTE, **5G-NR, NB-IoT technologies and DSS (Dynamic Spectrum Sharing)** Function, etc.)
- Inexpensive powerful and intuitive to use, with a high return on investment
- Vendor independent
- Extensive realtime data capture, visualisation and analysis

Application of XCAL- Mobile based solution

Contents	Mobile	Solo	Harmony
Autocall Support	O	O	O
No. of test (Interwork) devices	1	1	12
Field Test	O	O	O
In-building Test	O	O	O
MOS test	O	O	O
Single Benchmarking Test	X	X	O

All key applications supported on Smartphone

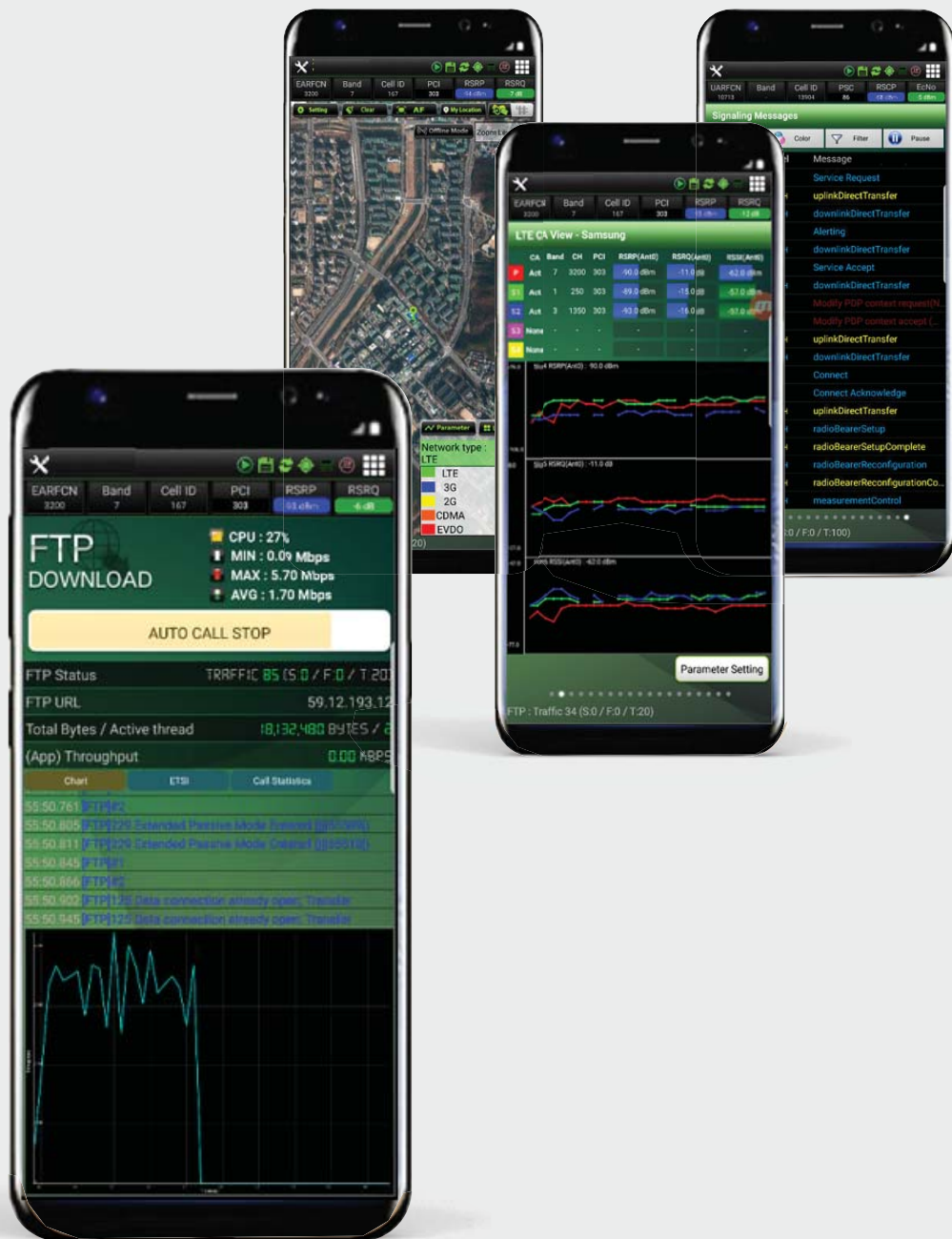


Features

Specification of supporting device	<ul style="list-style-type: none"> • OS: Android OS up to v9.0 (Pie) • Chipset: Qualcomm, Samsung
Technology	GSM/GPRS, CDMA/EVDO, 3G(HSDPA, HSUPA and HSPA), LTE, LTE-A (up to 4CA), TD-SCDMA, eMBMS, SUPL, Cat M1, NB-IOT, 5G-NR, NB-IoT technologies and DSS (Dynamic Spectrum Sharing) Function
Call Type	Voice, VoLTE, FTP, Web/HTTP, E-Mail, Iperf, Ping, YouTube, ARS-incoming, Speed test, Facebook, Multi-Call, Multi-RAB, Multi-Session SMS, App test(Play Store, Instagram, Twitter, Dropbox, Whatsapp, Skype, Facebook Messenger, LinkedIn, Line), ABM, ADB User Custom, PEVQ-S MMS, TraceRT, Netflix
Main Features	<ul style="list-style-type: none"> • RF View : Graph, table and map • Cell Measurement • Layer3 Display • Embedded POLQA (P.863) • Simple Logging • Split log file per time/size/call • In-Building • Call Statistics • SIP/RTP Analysis in VoLTE • TCP/IP packet capture • RAT/Band/Channel Cell Lock • (*It works on certain devices) • Support PCTel iBFlex/DRT 4311B /R&S TSMA6/Venture Scanner TTS Alarm • Replay • ETSI Statistics
Main Supported Terminal	<ul style="list-style-type: none"> • Samsung : Galaxy S series(up to S10 Plus), Galaxy Note series (up to Note 9), etc. • LG : G5, G6, V40, V50 etc. • HTC : One series, HTC10, etc. • Sony : Xperia A / VL / Z / X / XZ / XZP series, etc.
Main RF Info	Android RF Info, WiFi Info, Signal Message, RTP Summary, 5G NR Summary, 5G NR Signal , LTE Summary, LTE Signal, LTE Cell Info, LTE-CA Summary, LTE-CA Signal, LTE-CA Cell Info, LTE SIB Info, LTE Event Report, LTE Handover Info, LTE RACH, RTP Info, Scell Event, SUPL Message, LTE eMBMS, 3G Summary, 3G Signal, 3G Cell Info, GSM Summary, GSM Signal, GSM Cell Info, CDMA/EVDO Summary, CDMA/EVDO Cell Info

XCAL-Mobile

Handy Solution embedded in Smart Phone



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XCAL-Solo

Handy Solution embedded in Smart Phone

Smartphone based network QoS and QoE logging solution including Voice MOS

XCAL-Solo is a handheld Air interface measurement tool for QoS/QoE test for GSM, CDMA, WCDMA, LTE-A(Up to 5CA), **and LTE-A (Up to 5CA), 5G-NR and DSS (Dynamic Spectrum Sharing)** Function without any limitation by attaching portable H/W to Smartphone to cover wide range application testing, including Audio MOS measurement, network measurement and data on the smart phone in real time base.

XCAL-Solo also support creating and editing measurement scenario and various auto call test(Voice, VoLTE, FTP, Web, E-Mail, Iperf, Ping, Youtube, Multi-Call, Multi-RAB, Multi-Session,SMS, Instagram, Twitter, Dropbox, WhatsApp, Skype, Facebook Messenger, Line, PEVQ-S, MMS, TraceRT, Netflix) with user friendly touch interface from Android OS GUI.

Use XCAL- Solo to

- Perform handheld Field Testing and in-building Testing
- Provides real time based RF data monitoring and statistics with message, graph and table
- Portable design for gathering and checking DM log, main KPI information readily
- Collecting full DM data by using smart phone

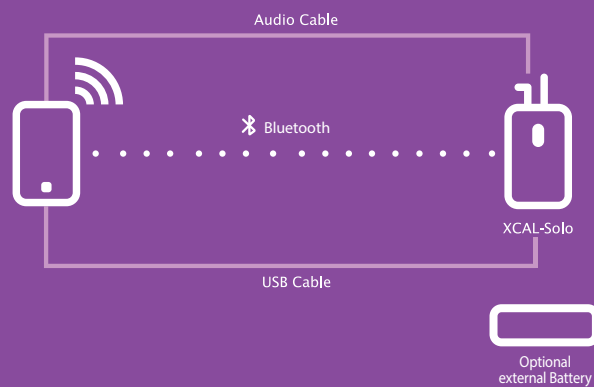
Benefits

- Overcome the limits of XCAL-Mobile by connecting portable H/W
- Can be used without any limitation on the smart phone supporting DM interface and Linux driver
- Support POLQA since it has sound card in portable H/W and audio interface with cable
- With the help of small H/W, DM is collected in portable H/W through USB DM interface like XCAL
- Important KPIs are echoed to a LCD Screen of Smart Phone in real time from a portable H/W
- Auto call is running in XCAL-Mobile and logging file is stored in portable H/W

Application of XCAL- Mobile based solution

Contents	Mobile	Solo	Harmonizer
Autocall Support	O	O	O
No. of test (Interwork) devices	1	1	12
Field Test	O	O	O
In-building Test	O	O	O
MOS test	O	O	O
Single Benchmarking Test	X	X	O

XCAL-Solo System Configuration



Features

Collecting and checking RF information	Collecting RF info from Smart phone in real time
	Show each classified technology of RF info with message, graph, table and Google map
Support in-building measurement	Processing measurement by applying building info and layout of each levels
	Processing measurement of fixed and mobile point of each levels based on arranged auto call scenario
Support automatic call measurement	Create and edit auto call scenario by application in smartphone
	Connect and disconnect voice and data call automatically
Support automatic error reporting	MOS measurement by using POLQA
	Automatic error reporting by screen capture function
Various functions	Automatic error reporting to technical support team
	Uploading and replaying previously measured log file
Real time measurement monitoring	Monitoring and reporting status of H/W
	Check Quick guide manual in application
	Real time monitoring of measured data on application window
	Automatic uploading of measured log file
External Battery	Check history of measurement on Call Result History window
	Check measured data on Google map
	Available for a longer operation

XCAL-Solo

Handy Solution embedded in Smart Phone

H/W Specification

Title	Spec
Operating Power	5Vdc/3.0A(Max)
CPU	2.0GHz ARM Cortex-A15(Quad) + 1.4GHz ARM Cortex-A7(Quad)
OS	Android
Bluetooth	Bluetooth 4.1
Memory Slot	System : 8GB eMMC 5.1 Data : 32GB Micro SD Card
Phone Interface	USB2.0 x1 Line In/Out x1
Weight	241g



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XCAL-MO III Benchmarking (Chipset, Mobile, System, Operators...)

Benchmarking Solution for up to 30 mobile phones in parallel

XCAL-MO III is a benchmarking solution to interface with 30 mobile phones at the same time in parallel.

It's an excellent solution to reduce overall cost with flexibility and portability.

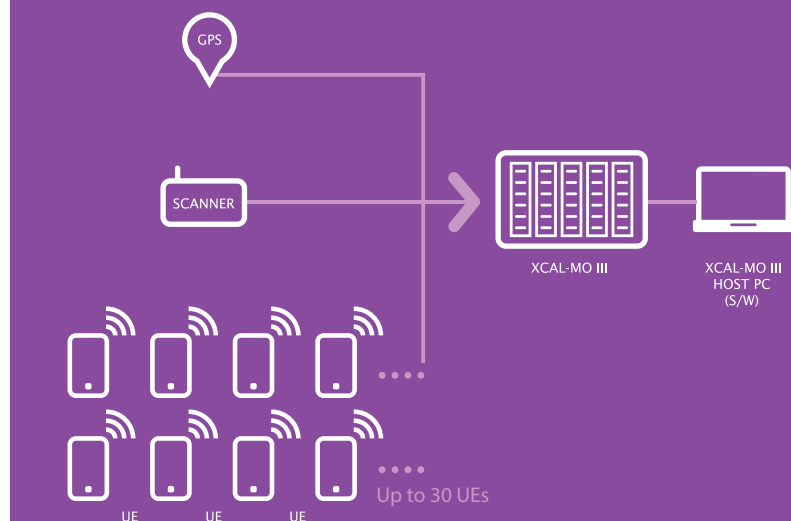
Use XCAL-MO III to

- Support multiple connections up to 30 mobile phones in parallel with full measurement
- H/W solution based on Slot structure up to 5 Slots
- Each slot has an embedded CPUs and Memory optimized for measurement of all Wireless Network
- Support an automated call test and make a benchmarking or comparison measurement with multiple devices
- Benchmarking test among multiple & different service operators, different mobile phones, or networks

Features

- Supporting up to 30 devices
- Interfacing with various devices
 - : Mobile Phone, USB Model
 - : GPS (1 unit)
 - : Scanner (2 units)
- Support standard based MOS test
- Using same User GUI of XCAL series
 - : Display Voice/Data quality test result and RF information in real time
- Independent OS for 5 of each Slot (6 port per Slot)
- No additional equipment required for MOS interworking
- Optimized for Field Test
- Optimized for perator/Vendor/Network Benchmarking Test
- Map Plot in Mobility – Real-time map view with signal level plotting
- Scalable in Cascade form (x2) (Up to 60 mobile phones)

XCAL-MO III System Configuration



XCAL-Smart applicable

- App execution and result reporting by device
- Auto control of Voice/Data Call
- Automation of App execution and operating test App
- Collecting RF information through API
- Real time communication with DM through tethering/tunneling

XCAL PC Based Solution Capacity

Contents	XCAL	MPm4	MPm6	PU9	MO III	MTS
Autocall Support	O	O	O	O	O	O
No. of device interfacing	4	4	6	9	30	60~120 (/ 1 Rack)
Field Test	X	O	O	O	O	X
In-building Test	X	X	X	O	X	X
MOS Test	△ Support with MC-CM132	O	O	O	O	O
Benchmarking Test	X	O	O	O	O	O

XCAL-MO III

Benchmarking (Chipset, Mobile, System, Operators...)

H/W Specification

Title	Spec	Note
Power Input	48VDC (Require external power supply)	
Power Consumption	Typically, 290W Max. 450W	PIU-U6 x 5ea
CPU	Intel Core I7-8665UE TDP : 15W	PIU(Slot)
Memory	RAM : 32 GB DDR4	
SSD	512GB	
PIU	USB 6-Port	
Phone Interface	USB3.1(Gen1, Gen2) / USB2.0 2A, 5V (MAX.)	
External Interface	1-Gigabit Ethernet	2 ports
Size	249 x 193 x 327(W x H x D , mm)	
Weight	< 7Kg	
Accessory	External Power Supply (AC-DC)	

* Components : XCAL-MO III(H/W), Power supply/Cable, Phone Interface Cable, GPS, LAN Cable, Bluetooth Cable, 1:1 MOS Cable



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XCAL-MPm4 MOS measurement

Multi-Port Hub for Voice MOS testing up to 4 UEs

XCAL-MPm4 is the smallest and yet most flexible of Accuver's network benchmarking solutions. The XCAL-MPm4 scales four ports (supporting four simultaneous phones). Each port comes with its own individual sound control, allowing independent standard-based voice quality (MOS) testing that can be used for both mobile-to-mobile or mobile-to-landline test scenarios.

The unique feature of this tool is that any phone that supports Bluetooth, can be used for voice quality analysis – proving that high quality, scalable and robust network benchmarking tools need not cost the earth.

Use XCAL-MPm4 to

- Perform network benchmarking tests using up to four mobile phones
- Voice QoS – carry out standards-based voice MOS tests
- Smartphone-based voice QoS
 - Use any smartphone that has Bluetooth

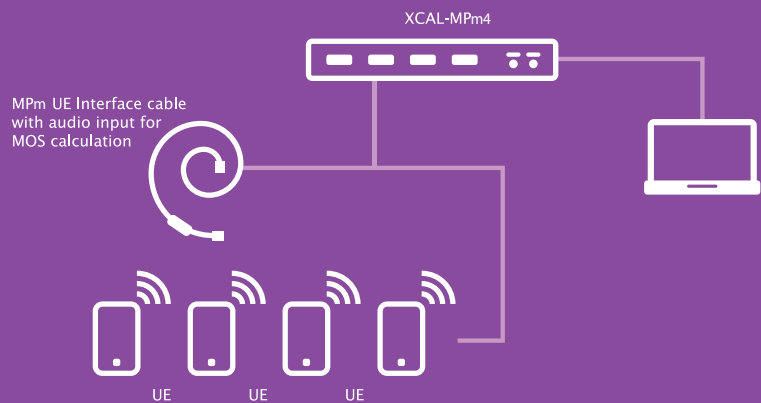
Features

- Support MOS test with XCAL
- Support up to 4 devices
- Support CS and PS call test
- Support VoIP and VoLTE call test
 - : Packet Loss, RTP Throughput, Delay, R-Factor, RTP Packet Count, Round Trip Time, etc.
- Support various QoS algorithm
 - : PESQ : P862, P862-1, P862-2
 - : POLQA : P863 (Super Wide as well) Narrow Band & Wide Band
- Bluetooth – MOS cable interchangeable
 - : Device control and sound source transmission by BT cable
- Support M2E (Mouth to Ear Delay) test
- Capacity Expandable by multi MPm units

XCAL-Smart applicable

- App execution and result reporting by device
- Auto control of Voice/Data Call
- Automation of app execution and operating test App
- Collecting RF information through API
- Real time communication with DM through tethering/turnelling

XCAL-MPm4 System Configuration



Benefits

- Cost-effective solution for competitive network benchmarking and assessment
- Highly portable and lightweight
- Flexible choice of test handsets
- AC or DC powered
- Supports wide range of handsets and CPEs
- Auto-configuration with XCAL
- Standards-based MOS measurement
- Supports both mobile-to-mobile and mobile-to-landline test scenarios
- Supports MOS testing with Bluetooth-enabled features and smartphones
- Supports multiple 4G VoLTE Performance measurements in parallel
- Supports multiple 4G LTE Data Performance measurements in parallel with Smart Feature

XCAL PC Based Solution Capacity

Contents	XCAL	MPm4	PU9	MO III	sMTS	MTS
Autocall Support	O	O	O	O	O	O
No. of device interfacing	4	4	9	30	20 (/ 1 Rack)	60~120 (/ 1 Rack)
Field Test	X	O	O	O	X	X
In-building Test	X	X	O	X	X	X
MOS Test	△ Support with XCAL-S+	O	O	O	△	O
Benchmarking Test	X	O	O	O	O	O

XCAL-MPm4

MOS measurement

Specification

Title	Spec	Note
Power Input	12 ~ 24VDC	Typ. 19VDC Dual power input Connector
Power Consumption	Stand-by : < 10 W Maximum : 50 W (with mobile phone x 4)	
Host Interface	USB2.0 Type-B	USB 2.0
External USB	USB2.0 Type-A	PC Interface port
Phone Interface	Connector : Molex-20 Pin connector USB2.0, UART, Audio In/Out	4 ports
Size	230 x 32 x 117 (mm, W x H x D)	
Weight	< 0.8 Kg	



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XCAL-Pu9

Benchmarking (Chipset, Mobile, System, Operators...)

Versatile 3-in-1 Benchmarking Platform up to 9UEs

XCAL-Pu9 packages drive test, unattended benchmarking and an in-building test solution into a compact, lightweight and powerful tool.

The Pu9 can support up to nine mobile phones that can be provisioned to benchmark a range of competitors over all Key mobile access technologies like 2G, 3G, LTE, LTE-A(CA ~ 6CA), PS-LTE(MCPTT), eMTC(Cat.M1) and NB-IoT.

Thanks to its light weight chassis, it is suitable for walk test.

Use XCAL-Pu9 to

- Perform both manual and autonomous competitive network benchmarking and troubleshooting
- Conduct a wide range of application testing and application performance analysis
- Monitor and improve
 - : Web browsing – HTML
 - : Mobile Messaging – SMS
 - : Downloads and Uploads – FTP/iPerf
 - : Streaming Video and audio – YouTube
 - : mVoIP and VoLTE

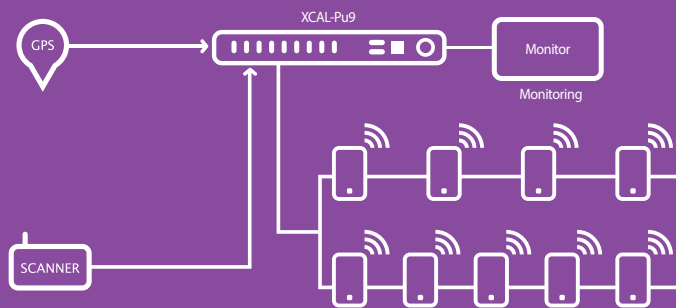
Benefits

- The Pu9 guarantees the best possible mobile experience on the network to ensure customer satisfaction.
- Coupled with XCAP-Vuze, AEGIS, the Pu9 can also be used in end to end network performance assessment and network auditing
 - : Streamlined network application testing
 - : Reduced costs – ‘all in one’ platform means that the Pu9 can be used to perform a variety of tests on one scalable platform
 - : Increase test accuracy and detail
 - : Monitoring the most important live services
 - : Improved time to market for new services
- Perform standard-based Voice MOS Tests

XCAL-Smart applicable

- App execution and result reporting by device.
- Auto control of Voice/Data Call
- Automation of app execution and operating test APP.
- Collecting RF information through API
- Real-time communication with DM through ADB connection

XCAL-Pu9 System Configuration



Features

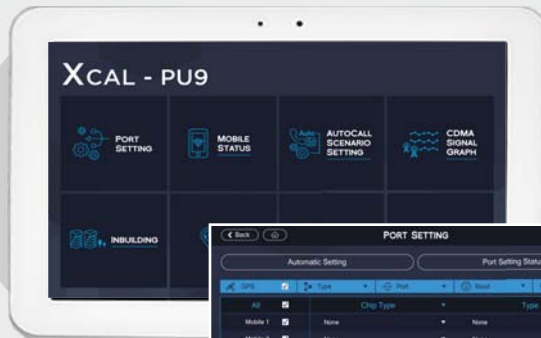
- Interfacing with various devices
 - : Mobile Phone, USB Modem (Smart phone : up to 9 / USB modem : 1)
 - : GPS (1 unit)
 - : Scanner (2 unit)
- Backpack carryable, High mobility for walking test
- External Battery pack applicable
- Support standard based MOS test
- Support various QoS algorithm
 - : PESQ : P862, P862-1, P862-2
 - : POLQA : P863 Narrow Band & Wide Band

* XCAL-Smart function supportable (recommended)

Title	Spec	Note
Power Input	DC 24V	
Power Consumption	Stand-by < 10W (MCU Stand-by) Stand-by < 60W (CPU Stand-by) Maximum < 240W	
CPU	Intel Core i7-4700E 2.4GHz (Haswell)	
SSD/Memory	256GByte / 16GByte	
External Interface	USB3.0 x 4 ports 1Gbps LAN x 2 ports Master Phone Interface x 9	
Phone Interface	Connector : USB 3.0	Maximum : 9 ports
Size	228 x 46.5 x 160 (mm, W x H x D)	
Weight	1.56kg	
Bag (Total Weight)	15.65kg(Bag+9Mobiles+1Battery+etc) 18.35kg(Bag+9Mobiles+2Batteries+etc)	Running Time(Battery): 4H ~ 5H Running Time(2Batteries): 8H ~ 10H

XCAL-Pu9

Benchmarking (Chipset, Mobile, System, Operators...)



PORT SETTING			
Automatic Setting		Port Setting Status	
Chip	Type	Port	Band
All	<input checked="" type="checkbox"/>	Chip Type	Type
Module 1	<input checked="" type="checkbox"/>	Name	Name
Module 2	<input checked="" type="checkbox"/>	Name	Name
Module 3	<input checked="" type="checkbox"/>	Name	Name
Module 4	<input checked="" type="checkbox"/>	Name	Name
Module 5	<input checked="" type="checkbox"/>	Name	Name
Module 6	<input checked="" type="checkbox"/>	Name	Name
Module 7	<input checked="" type="checkbox"/>	Name	Name
Module 8	<input checked="" type="checkbox"/>	Name	Name
Module 9	<input checked="" type="checkbox"/>	Name	Name



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XCAL-Pu12 Benchmarking (Chipset, Mobile, System, Operators...)

Versatile 3-in-1 Benchmarking Platform up to 12UEs

XCAL-PU12 packages drive test, unattended benchmarking and an in-building test solution into a compact, lightweight and powerful tool.

The Pu12 can support up to 12 mobile phones that can be provisioned to benchmark a range of competitors over all Key mobile access technologies like **5G**, 2G, 3G, LTE, LTE-A(CA ~ 6CA), PS-LTE(MCPTT), eMTC(Cat.M1) and NB-IoT. Thanks to its light weight chassis, it is suitable for walk test.

Use XCAL-Pu12 to

- Perform both manual and autonomous competitive network benchmarking and troubleshooting
- Conduct a wide range of application testing and application performance analysis
- Monitor and improve
 - : Web browsing – HTML
 - : Mobile Messaging – SMS
 - : Downloads and Uploads – FTP/iPerf
 - : Streaming Video and audio – YouTube
 - : mVoIP and VoLTE

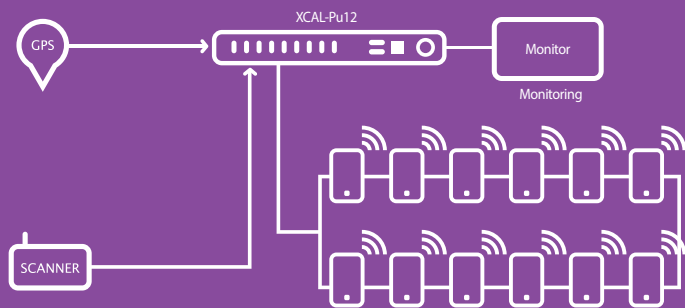
Benefits

- The Pu12 guarantees the best possible mobile experience on the network to ensure customer satisfaction.
- Coupled with XCAP-Vuze, AEGIS, the Pu12 can also be used in end to end network performance assessment and network auditing
 - : Streamlined network application testing
 - : Reduced costs – ‘all in one’ platform means that the Pu12 can be used to perform a variety of tests on one scalable platform
 - : Increase test accuracy and detail
 - : Monitoring the most important live services
 - : Improved time to market for new services
- Perform standard-based Voice MOS Tests

XCAL-Smart applicable

- App execution and result reporting by device.
- Auto control of Voice/Data Call
- Automation of app execution and operating test APP.
- Collecting RF information through API
- Real-time communication with DM through ADB connection

XCAL-PU12 System Configuration



Features

- Interfacing with various devices
 - : Mobile Phone, USB Modem (Smart phone : up to 12 / USB modem : 2)
 - : GPS (1 unit)
 - : Scanner (2 unit)
- Backpack carryable, High mobility for walking test
- External Battery pack applicable
- Support standard based MOS test
- Support various QoS algorithm
 - : PESQ : P862, P862-1, P862-2
 - : POLQA : P863 Narrow Band & Wide Band

* XCAL-Smart function supportable (recommended)

Title	Spec	Note
Power Input	DC 24V	
Power Consumption	Stand-by < 10W (MCU Stand-by) Stand-by < 60W (CPU Stand-by) Maximum < 240W	
CPU	Intel Core i7-7Gen. 2.8GHz x2	
SSD/Memory	512GByte x2 / 16GByte x2	
External Interface	USB 3.1 Gen2 x 4ports 1Gbps LAN x 2ports Master Phone Interface x12	
Phone Interface	Connector : USB 3.1 Gen2	Maximum : 12 ports
Size	228 x 46.5 160 (mm, W x H x D)	
Weight	1.56kg	

XCAL-Pu12

Benchmarking (Chipset, Mobile, System, Operators...)



OPTis-PU12 inside of Sack



**Max.12 5G-NR
Mobile Phone**



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XCAL-ART

Real-Time Multi-cell / Multi-UE Air-interface Simulator

XCAL-ART is combination of Accuver's innovative tools likes of XCAL-MTS + AIS + RPT-Gen + Automation.

1) XCAL-MTS supports real-time load and capacity test with flexibility and reliability for users. 2) AIS (Air Interface Simulator) offers user handover performance test under multi-base stations environment by controlling multi-UEs. 3) RPT-Gen creates user friendly report by automated analysis algorithm. 4) Automated regression testing solution can use time efficiently than manual regression testing.

Introduction of XCAL-ART will improve your life with high efficiency of usage of lab hardware, software and human resources and delivers results in a fraction of time.

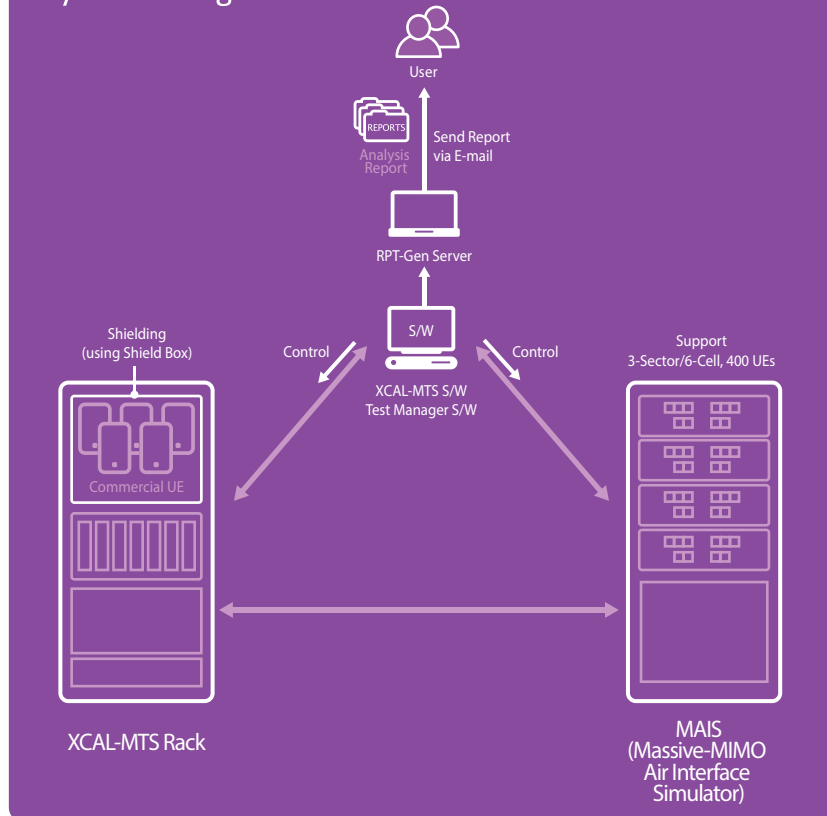
Use to

- System capacity verification in multi-UE, cell-edge, moving UE environment
- Package verification prior to customer release
- logging and analysis of SINR, RSRP, RSSI, Tx Power, RB/MCS, Throughput, etc.
- Troubleshooting with quick reproduction of problems
- System Parameter optimization of RRC, MAC, PHY
- Multi-UE Handover/Cell Reselection testing using AIS
- Repeat testing per each test case using automation scheduler
- Automatic analysis using RPT-Gen, applying algorithms per test case

Benefits

- Real-time simulation and logging in the LAB
- No need for drive-test and on-site for cluster preparation
- Efficient use of resources
- Test environment for user-defined test scenarios
- Group operation for multiple tests at the same time
- Perform test cases automatically without control by a user (Automation)
- Provides automatic analysis of event call
- Benefits of **"Real UE Test"**
 - : Good for **Reproduction Test** of Call drop/fail/issues
 - : Easy to analyze detailed causes of call events
 - : Able to test the **Real Actions of Mobiles** (Data throughput, Call performance, reaction to Rx change, etc.)
 - : Easy to use functions for testing **Handover of Multi Cells**
- M to M (Call between mobiles) test available
- MOS(Voice/Video) and Video streaming test available

System Configuration



H/W Specification

Channel Bandwidth	Up to 100MHz with CA Support
Number of Port	A single 10U chassis can be equipped with up to 64RF ports
Frequency Range	300~6,000MHz
Calibration Tolerances	(Amplitude) <0.35dB, (Phase) <3degree from any BS port to any UE port stays calibrated up to 72 hours
Transmission Standard	3-Sector/6-Cell
Channel Models	ITU Ped. A/B, Veh. A/B, EPA, EVA, ETU, 2D/3D SCM, HST, User-defined
Number of Multi-Path	8 (Expandable)
Doppler Frequency	Up to 1350MHz (560km/h@2.5GHz)
AWGN	built-in at each RF port

* Customized features per User's request

XCAL-ART



<RPT-Gen>

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XCAL-Harmonizer

Multi-Smartphone based benchmarking solution

Indoor Smartphone based Network QoS and QoE benchmarking

Easy to use, lightweight, scalable indoor/walk network test and benchmark platform, performing service testing on up to 12 smartphone devices and collection of RF scanner data, all controlled via a single easy to use GUI on a tablet device. Supplementary battery pack and XCAL-Solo hardware extends the use of the platform for up to 8 hours.

XCAL-Harmonizer Overview

• Deployment types

- Indoor Network Optimization
- Operator and Service benchmarking
- Small cell and DAS deployment verification
- Deployed for discreet test requirements

• User Groups

- Network Operators
- Services Companies
- System Vendors
- Infrastructure leasing companies
- Regulators
- Train Operators
- Mass gathering Hosting Venues (Stadiums, Concert Halls)
- XCAP post processing software
- Small cell and DAS deployment verification

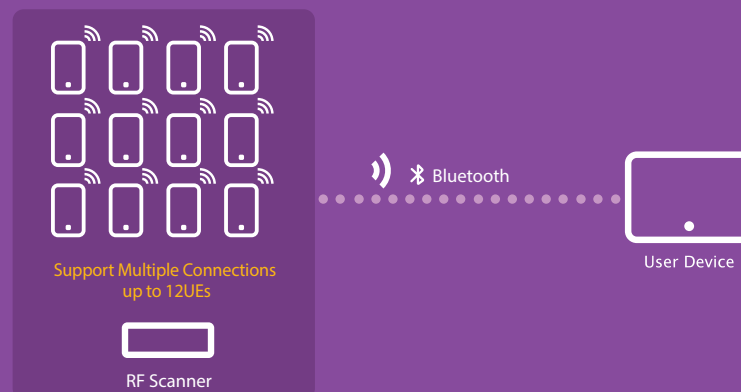
Benefit

- Cost effective and Rapid deployment
- Using proven XCAL-Mobile platform to record full optimization dataset
- Part of the XCAL family of products, sharing commonality in log file format and analysis
- XCAP post processing software
- Small cell and DAS deployment verification

Application of XCAL- Mobile based solution

Contents	Mobile	Solo	Harmonizer
Autocall Support	O	O	O
No. of test (Interwork) devices	1	1	12
Field Test	O	O	O
In-building Test	O	O	O
MOS test	O	O	O
Single Benchmarking Test	X	X	O

XCAL-Harmonizer System Configuration



Features

Configuration Setup	Management of Connection with UE	Connection/Disconnection available for each UE by Bluetooth Display Connection Status
	Measurement Scenario setting for Each UE	Support FTP, CSFB, VoLTE, Multi-call, HTTP, Ping, WiFi measurement, Email, SMS, Youtube, Multi-RAB, MULTI SESSION, MMS, TraceRT, Iperf, IDLE, MCPTT
Monitoring	Log data info	
	Display Autocall Status including Log data info	
In-building	Setup for In-building Measurement	Display Autocall Statistics including RF/ENDC/LTE CA Info/Signaling Graph/Cell Measurement/Signaling Msg/User Defined)
		Support setup function for In-building measurement
		Get address from GPS information
		DB selection of saved building available
		Choice of building type and type of measurement site available
MAP	Support scan list	Photographing and transmitting pictures of measured sites available
		Display location and result on Google Map in real time
		LTE Enhanced TopN signal(FD-LTE/TD-LTE)
		GSM color Code
		RSSI Scan (FD-LTE/TD-LTE/WCDMA/GSM/CDMA/EVDO)
PCTEL iBflex Scanner Management	Support scan list	Blind Scan(FD-LTE/TD-LTE/WCDMA/GSM/CDMA/EVDO)
		WiFi (AP scan)
R&S TSMA scanner management	Support scan list	LTE Signal (FD-LTE/TD-LTE)
		5G NR
Log File Management	Log File Management Function for each device	Display a list of log file that saved at each mobile
		Support log file deleting function
		Support upload of log file through designated FTP server

XCAL-Harmonizer

Multi Handy Solution embedded in Smart Phone

H/W Specification

XCAL-HarmonizerKIT (4 Mobiles)		
Size	234x450x100(mm)	
Weight	3.1K	Box Only
Weight (4smart phones)	4.7Kg	Including 4 smart phones and 2 x20000mAh battery pack for 8 hour testing
XCAL-HarmonizerKIT (6 Mobiles)		
Size	320x450x100(mm)	
Weight	4.2Kg	Box Only
Weight (6smart phones)	6.4Kg	Including 6 smart phones and 3 x20000mAh battery pack for 8 hour testing
XCAL-HarmonizerKIT (8 Mobiles)		
Size	Open : 470x450x100(mm) Close : 234x450x200(mm)	Harmonizer(4 Mobiles) x 2
Weight	6.3Kg	Box Only
Weight (8smart phones)	9.7Kg	Including 8 smart phones and 4 x20000mAh battery pack for 8 hour testing
XCAL-HarmonizerKIT (12 Mobiles)		
Size	Open : 642x450x100(mm) Close : 320x450x200(mm)	Harmonizer(6 Mobiles) x 2
Weight	8.4Kg	Box Only
Weight (12smart phones)	12.9Kg	Including 12 smart phones and 6 x20000mAh battery pack for 8 hour testing

XCAL-HarmonizerSW



XCAL-Harmonizer

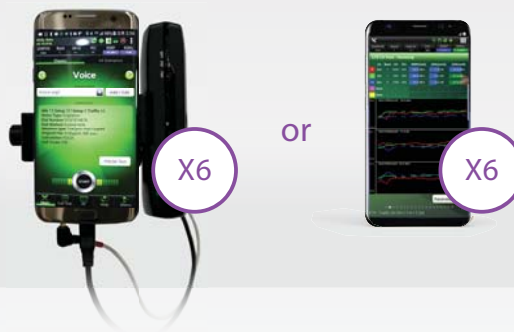
Multi Handy Solution embedded in Smart Phone

Flexible View Mode

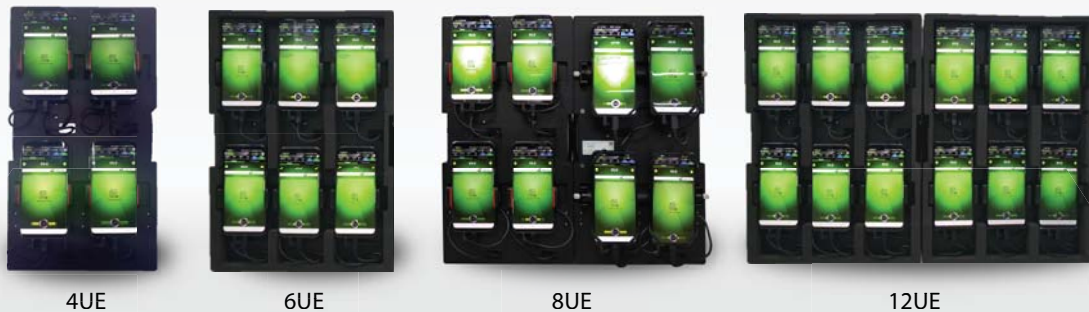
- Able to detect both device and Monitoring UI automatically for users
- **Combo Mode** supports both Harmonizer H/W and Solo at once via Bluetooth connection
- **Solo Mode** (Only controls device connected to Solo) : Solo 6UE
- **Harmonizer mode** (Only controls device connected to Harmonizer H/W) : Harmonizer 4UE/ 6UE / 8UE / 12UE
- **Combo mode** (Controls device connected to both Solo and Harmonizer H/W)
: Harmonizer 4UE + Solo 4UE / Harmonizer 6UE + Solo 3UE

Solo Mode

(Any combination of Solo and Mobile is available)



Harmonizer Mode



Combo Mode

(Any combination of Solo and Mobile is available)



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XCAL-MTS with Real UEs and Mobile emulators

Combine real call test with mobile handsets and virtual call test with mobile emulators

Multi-Test System - Realtime, Measurements & Verifications

MTS is designed for load and capacity testing with up to 40 UEs connectivity at the same time. MTS allows users to troubleshoot, analyze and benchmark wireless network environment. Its GUI capability enables to have various type of connections which is specialized for system verification. This innovative solution offers user friendly interface such as various type of graphs, filtering messages, visible & audible alarm indication. It allows user to monitor and identify problems in real-time

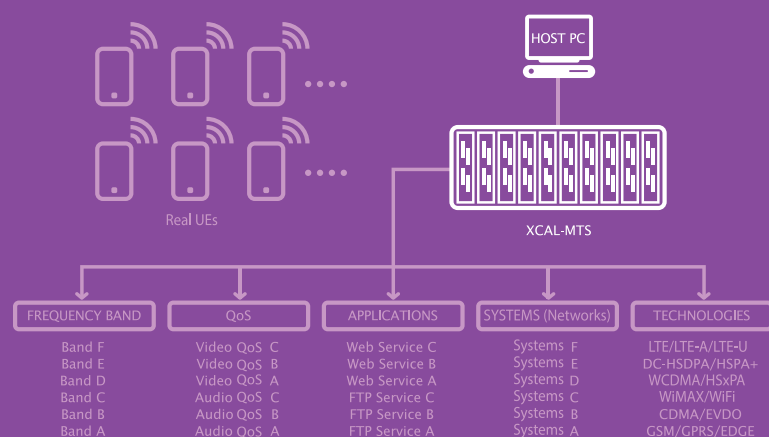
Use XCAL-MTS to

- Support multi-number of USB Modems and Mobile Devices
- Measure UE performance (Data & Voice Capacity)
 - Scalable Capacity in Cascade
 - Support up to 40UEs per 1unit (Shelf)
- Measure Layer 1, 2, 3 and TCP/IP performance with intensified analysis
 - Serving Cell Info, SINR, Rx/Tx Power, DL/UL Rate, RSRP, RSRQ, CQI
- Support various type of automation test
 - Network Entry, FTP/HTTP/Ping
 - VoLTE/VoIP/YouTube
 - Data Throughput, Packet Loss, RTT, etc
- Integrate with MAIS (Massive-MIMO Air Interface Simulator) to create Field environment in Lab
 - 3G/4G/5G Channel Emulation in Lab (with real UE)
 - System Capacity Verification in Multi-Cell, Multi-UE, Cell Edge, UE Mobility Environment
 - Measure Cell Performance
 - System Parameter Optimization

Benefits

- Powerful performance verification solution
 - Combined with Mobile Emulators (MobiPass)
 - Connect with Real UEs
 - Mobile emulator to take measurement of hundred UEs
 - Virtual UE Emulator

XCAL-MTS System Configuration



Test Cell or Network



Test UE



MTS Full Rack

XCAL-MTS with Real UEs and Mobile emulators

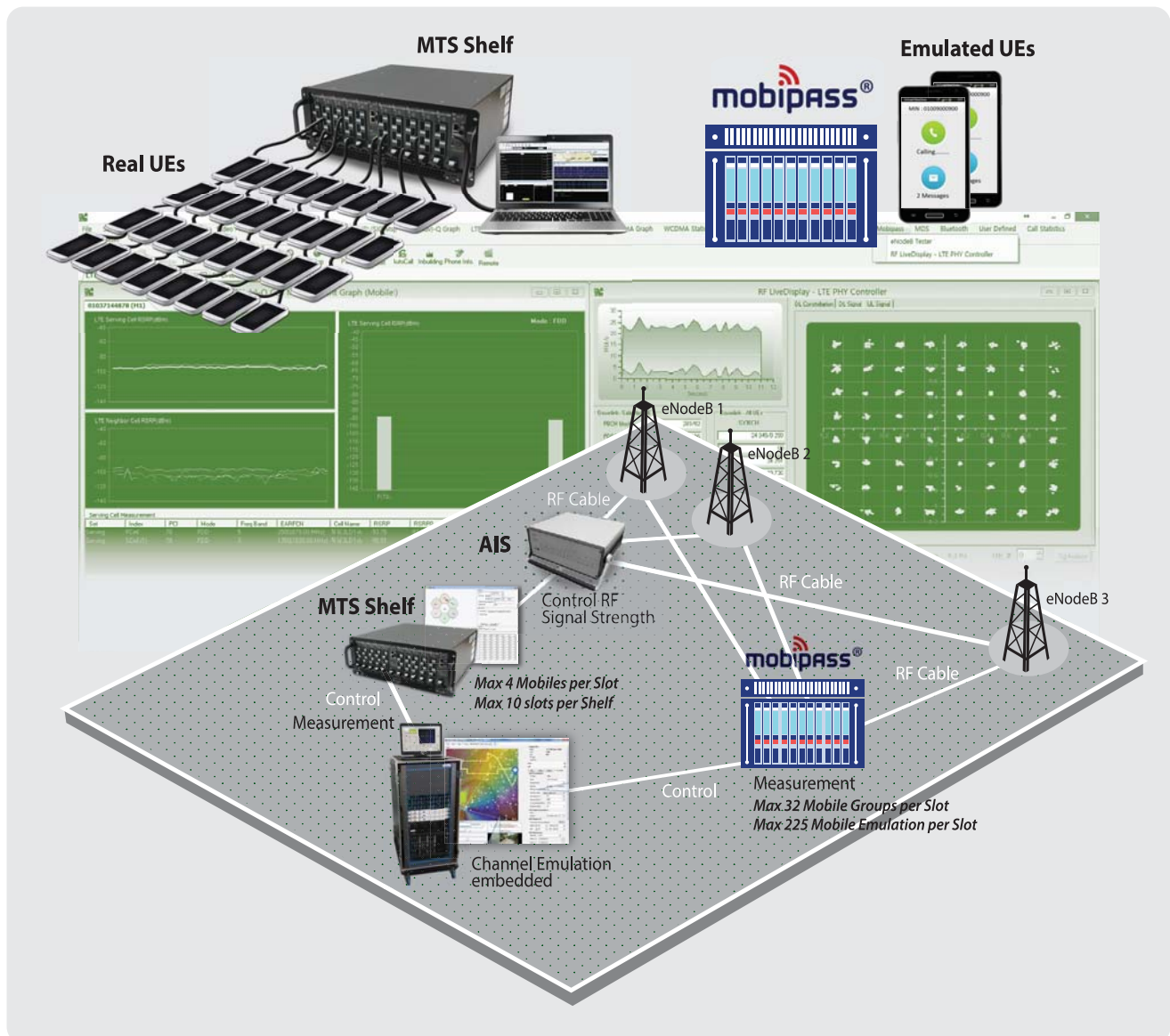
Combine real call test with mobile handsets and virtual call test with mobile emulators

Features

Rack suitable solution for test bed system
Easy to extend capacity

Powerful Performance Analysis

- 1 unit (Shelf) : up to 40 Active UEs
 - 2units (Shelves) : up to 80 Active UEs
 - 4units (Shelves) : up to 160 Active UEs
 - More units (Shelves) can be added up to customer requirements
-
- Performance Analysis per UE
 - Performance Analysis per Cell
 - Verify RB Management per Cell



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XCAL-Ranger outdoor

XCAL-Ranger Smartphone based enclosure which allows installation on vehicles, trains, ships and buildings where it needs to be managed remotely. XCAL-Ranger offers unmanned solution for users who collects all the data through the server for automated processing.

Use to

Deployment types

- Cars, Trains, Buses, Building, remote sites

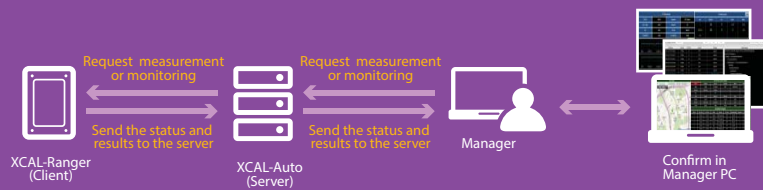
User Groups

- Network Operations department
- Customer Services department
- QoS departments Vendors
- Network engineering department
- Train Operators

Benefits

- 24 hour measurement
- Reduce manual test costs
- Collection of data on a continuous basis
- Enhanced and wider coverage network testing
- More detailed view of network service status
- Eliminates errors in manual testing
- Part of the XCAL family of products, sharing commonality in log file format and analysis

XCAL-Ranger Configuration



* Real time monitor feature updates every 1 second

Features

Provide Auto recovery feature when error occurs	Automatically performs recovery for errors during measurement
Provides status report feature	Reports current device status for Remote Monitoring feature
Supports Automated call feature	Supports various types of measurement including Voice, VoLTE, FTP, HTTP, Youtube, etc
Provides Schedule feature for measurement	Provides various schedule feature to perform automated measurement according to the configured schedule Schedule setting type: set Date, set Time, Always
Provides Auto log file upload feature	Log files can be uploaded automatically based on log file auto upload option setting provided by XCAL-Auto Server
Provides Auto log file delete feature after upload	Log files in XCAL-Ranger can be deleted automatically after time configured by log file Auto delete feature

XCAL-Ranger

Autonomous mobile network probe

H/W Specification

XCAL-Ranger (1Mobile)

Size	160 X 260 X 65(mm)	
Weight	1.75kg	Box Only
fan	Fan size(4x4) X 3	Auto On/off



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XRO

Server-based Measurement, Analysis, Auto-Report Solution for Rollout

XRO (XCAP Roll Out) is a total automation solution that is based on Android mobile application and Server. XRO provides non-stop measurement and analysis solution comprehensively by conducting and monitoring measurement tests, analyzing collected log data, and publishing various reports in real time. XRO maximizes test efficiency especially for initial network optimization projects such as Site Acceptance Test and Cluster Acceptance Test.

Use XRO to

- Perform various voice & data service tests
- Offer drive route GPS and real-time monitoring by using smart phones
- Monitor network KPIs, RF Parameters and Layer 3 messages in real-time across all wireless technologies from any PC with internet access
- Issue reports automatically
- Provide simple analysis features for fail reason
- Analyze Signaling & Packet messages based on web in detail
- Provide statistic data of measurement and overall process status

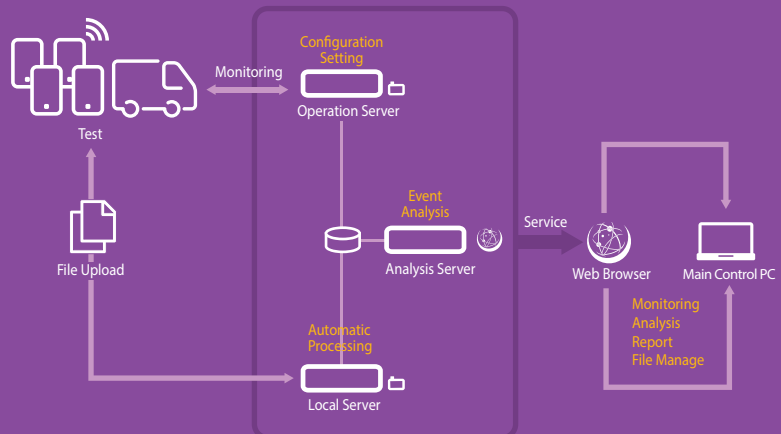
Benefits

- **Cost & Time Effectiveness**
 - Test conducting by non-experts
 - Prompt result monitoring and quick decision on test re-conduction
 - Time save by providing auto test result and report
- **Higher Availability**
 - Simultaneous process of large capacity data
- **Convenience**
 - Web-based anywhere anytime tool
- **Powerful Functionality**
 - Outperformed analysis on Signaling and Packet messages (L3/SIP/RTP)
- **Accuracy**
 - Check Measurement route in real time to find out abnormal area or necessary of re-measurement and take immediate field action

New Updates

- **Add 5G Samsung and Qualcomm**
- **Add 5G Roll out KPI**
- Provide the non-measurement cause and issue content photo registration function
- Provide comparison report according to site tuning
- Provide the share of analysis content between analysis engineers

XRO System Configuration



XRO Web browser

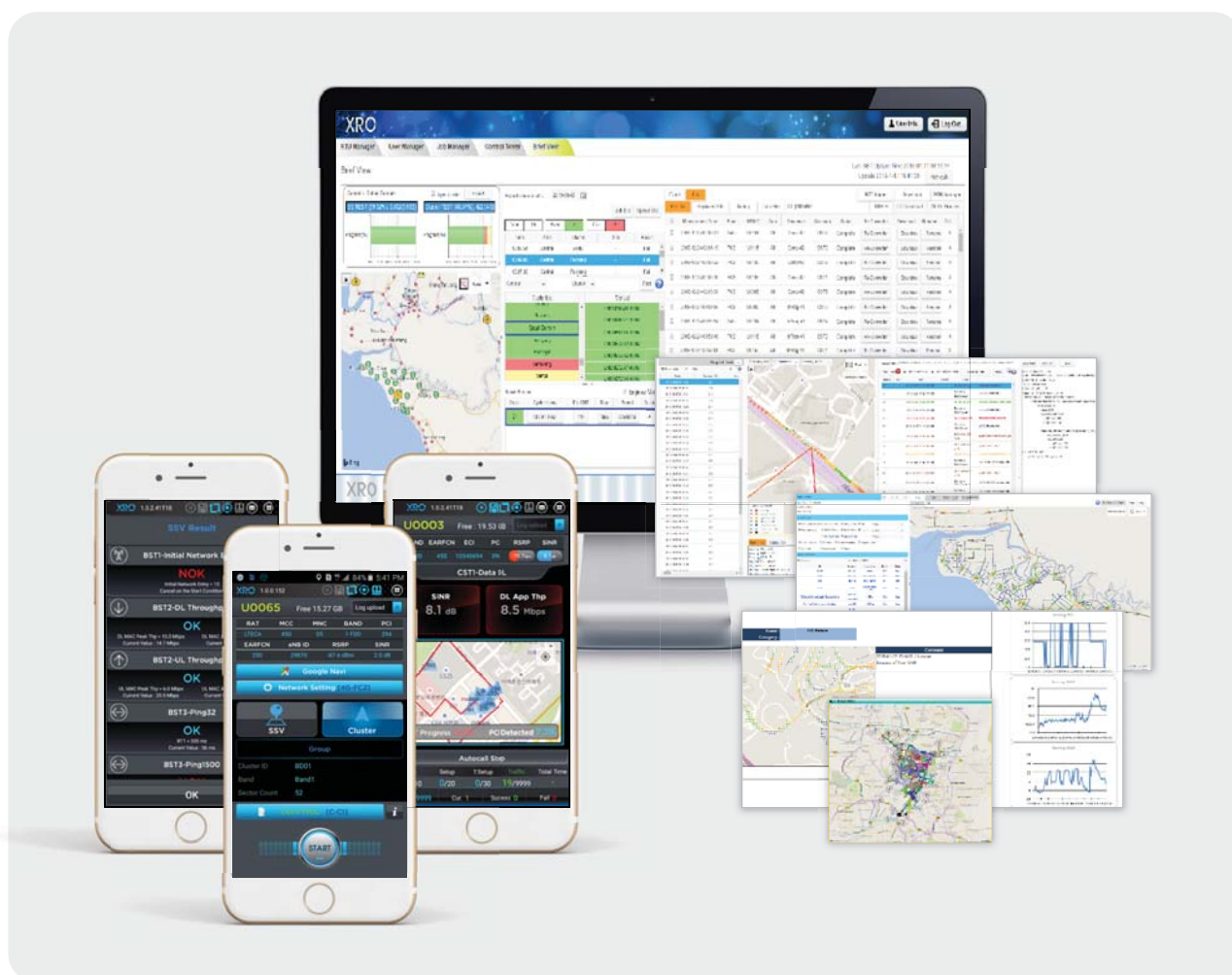
XRO Mobile client

XRO

Specification

Contents	Stand alone
OS	Windows Server 2012 Standard
CPU	Above CPU 2.13 GHz 2 Processor (2 * 8 Core)
RAM	Above 64GB
HDD	Above 1TB
SQL	SQL Server 2012 R2 Standard
Map	Bing Map

** XRO is also available on cloud server*



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XCAL-Auto

Unattended & Remote Network Quality Monitoring

Server-based Auto Data Collection System

XCAL-Auto is a server-based, integrated measurement solution that enables operators to make plan and monitor real-time measurement data. Operators can perform large-scale wireless measurements using various remote test unites (X-Remote Series; Smartphone based apps, PC based XCAL Series, Various kinds of scanners and Benchmarking solutions). Operators also can validate the measurement result via report on the web within an hour after the measurement finished. New XCAL-Auto solution can reduce cost effectively across all measurements from wireless network rollout to optimization.

Use XCAL-Auto to

- Perform various voice & data service tests
- Manage field testing via remote control
- Monitor network KPIs, RF Parameters of multi devices in real-time
- Perform automatic call test via sending the test schedule and drive route
- Detect and trouble shoot call performance issues, coverage limitations and capacity bottlenecks in real time
- Perform In-Building testing & analysis

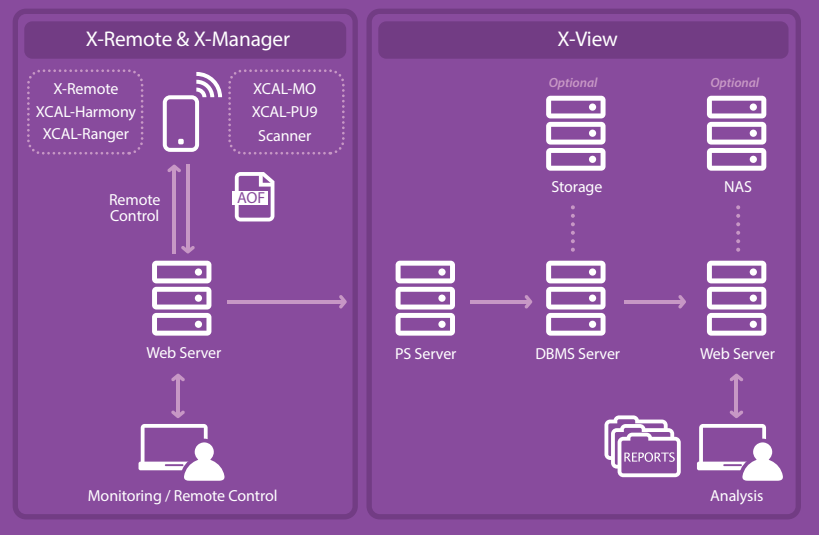
Benefits

- **Flexibility**
Measurement in various types depending on the purpose your wants, such as rollout or optimization
- **Expandability**
Server-based remote control allows you to extend your measurement range without having to worry about area and time at the same time
- **Usability**
Simple GUI and easy operation make it easy to use for non-professional users
- **Accuracy**
Check Measurement route, call statistics and KPI in real time to find out abnormal area or necessary of re-measurement, change scenario and take immediate field action
- **Economics**
Easy to cover large are with simple method, Cost saving by easy enough to use anyone without additional training

New Updates

- Add 5G Samsung and Qualcomm on X-Manager and X-View
- 5G Monitoring Page (including Cell Throughput)
- Analysis 5G on Summary View, Call Table, Processed Data Management
- Support PCTEL Scanner
- Add Multi Client Viewer for Massive Call test

System Configuration



Features

Monitoring	<ul style="list-style-type: none"> - Measurement device condition and location - Monitoring main KPIs in real-time - Communication history data management
Remote Control	<ul style="list-style-type: none"> - Remote monitoring and control - Management test devices (Alarm Event)
Work Order & Measurement Plan	<ul style="list-style-type: none"> - Measurement schedule management - Scenario (Autocall setting) editing / transmission - Logmask (measurement list) editing / transmission - Drive test route editing / transmission
Centralized Management	<ul style="list-style-type: none"> - Test scenario generation and management - Management of test version - Management of alarm setting
Simple Analysis	<ul style="list-style-type: none"> - Verification test results on the web - Support various statistics, coverage and event
Report	<ul style="list-style-type: none"> - Automatic report generation with preset format - Support KPIs and call statistics for easy analysis
Installation	<ul style="list-style-type: none"> - Non installation by web base - Support open street map

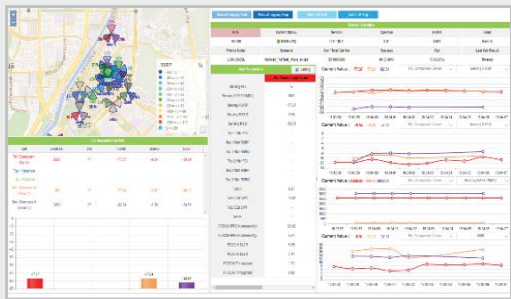
XCAL-Auto

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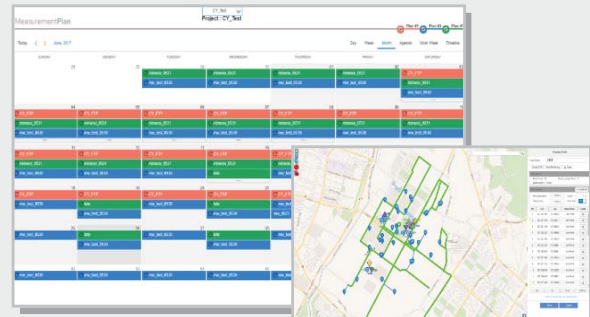
Specification (Client 100EA)

Products	Description	Specification	Quantity	Redundancy
PS Server	Preprocessing Server (for converter)	<ul style="list-style-type: none"> - CPU: Intel Xeon E5-2697V2 2 CPU / 24 Core - Memory : 32GB - HDD: 300GB x 6 (RAID 10) - NIC: 10Gbps 2P, 1Gbps 2P (Bonding Interface) - OS: Windows Server 2012 R2 	1pcs	Possible to process within 8 hrs
DBMS Server	DBMS Server (Postgre SQL)	<ul style="list-style-type: none"> - CPU: Intel Xeon E7-4830V2 4 CPU / 40 Core - Memory: 256GB - HDD: 300GB x 6 (RAID 10) - NIC: 10Gbps 2P, 1Gbps 2P (Bonding Interface) - OS: Windows Server 2012 R2 	1pcs	DBMS & Web Server
Web Server	Web Server (IIS)			
Storage	Storage for DBMS	SAN Switch 5TB (RAID Configuration)	1pcs	Optional
NAS	Storage for log file	10 Gbps NIC Minimum 10TB (RAID Configuration)	1pcs	Optional

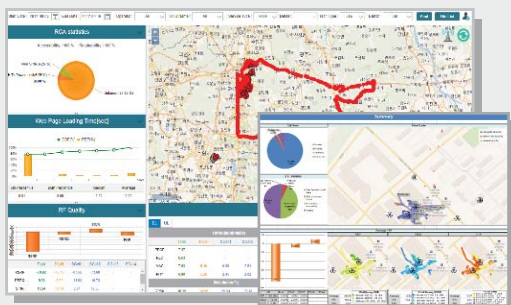
* Based on X-Remote 100EA, conduct test 8 hours per day and save log file for a year.



[Monitoring]



[Work Order]



[Outdoor Test]



[In-Building Test]

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