2G MOBILE COMMUNICATION LAB MCL02

Features:

- 2.5G GSM Voice, SMS & GPRS BTS + UE + Backhaul replication in Lab
- 400MHz to 3400MHz Software Configurable Radio Transceiver for Quad band GSM operation
- Low power for FCC compliant license free safe operation
- No recurring cost of software or licenses
- ASIC Architecture: combines LNA, PA driver, RX/TX Mixers, RX/TX Filters, Synthesizers, RX Gain control, TX power control
- +5dBm Transmit power & -120dBm Sensitivity Receiver
- FPGA programmable transmission and reception for low latency
- Supports both TDD & FDD Full Duplex as per 3GPP standards
- Calibrated +0.1ppm TCXO frequency reference

Description:
The Amitec MCL02 is intended for lab use and ideal for universities, testing labs. It allows to replicate small 2.5G GSM (Voice + GPRS) cellular network and start making calls in less than an hour. It allows you to connect a standard GSM mobile phone directly with VOIP networks as SIP endpoint to call PSTN landline or mobile phone on other networks in other locations using a software based GSM BTS . The lab is complete with base transceiver station, multiband cellular phones, backhaul radio. Base station controller (BSC) functions and operations/maintenance (O&M) and network management system (NMS) functions for controlling the base stations with software provided for exceptional value & performance.

A multiband software configurable radio performs the function of BTS which facilitates wireless communication between User Equipment UE or GSM cellular phones in this case. Users can bring their own devices or the android phones provided with special apps that allow calculation of ARFCN, measurement of RF signal level of BTS for call handover handoff study and various other experiments. Users can roam about in lab environment while connected on a voice call inside and outside the cell radius of BTS.

The system is based on a reconfigurable RF/FPGA/ARM hardware platform as Um air interface and a BTS software which implements the lower three layers of GSM protocol stack.

The system replaces the conventional GSM operator core infrastructure with inbuilt BSC and radio resource management function. Multiple systems can share a common VOIP soft switch or PBX to form larger networks.

ASIC houses complete RF and DAQ subsystems on a single board. It hosts onboard RF Transceiver subsystems capable of tuning frequencies from 400MHz to 3.4GHz.

Area & scope of Experiments:
1. Introduction of mobile communication equipment BTS, BSC & UE.
2. To measure the spectral distribution of GSM frequencies at given location and find a free channel.
3. To configure the BTS software to set Mobile country code, Network operator code, GSM band and ARFCN channel.
4. To configure the BTS Software to enable open/limited registration.
5. To assign a phone number to each registered phone.
6. To enable call logging of subscribers on BTS.
7. To get and set your IMSI.
8. To configure the asterisk communication server for IP PBX and VOIP gateway.
9. To register phone to the BTS network.
10. To transmit and receive an SMS using BTS.
11. To list the TMSI of the phones registered on network.
12. To establish a voice phone call as echo on mobile phone using BTS.
13. To establish a voice phone call to another cellular phone using BTS.
14. To establish a voice phone call to another cellular phone using
14. To establish a voice phone call to another cellular phone on different network/country using BTS and VOIP gateway.
15. To establish roaming between BTS and UE.
16. To capture GSM packets using Wireshark.
17. To establish a data communication link using GPRS.
18. To study hard & soft call handoff.
And many more.

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Hardware Technical Specifications

ASIC Architecture	Combines LNA, PA driver, RX/TX Mixers, RX/TX Filters, Synthesizers, RX Gain Control and TX Power Control
Interfaces	For operation, Administration and Maintenance Centre
Supports	Remote s/w upgrade and power system monitoring with easy CLI
Frequency band	400-3400 MHz includes GSM Quad Band
Channel Center Freq.	Conforms to GSM Specifications
Channel	200 KHz
No of RF Carriers	124/374
Carrier spacing	200 KHz
Duplex spacing	(TX-RX Separation) 45 MHz / 95 MHz
Access ch. per carrier	Conforms to 3GPP TS 45.002
Frame structure	Conforms to 3GPP TS 45.001
Time slot per RF carrier	8
Modulation	GMSK, 8- PSK
Demodulation	Coherent
Transmission bit rate	270.83 Kbps
Data Transmission rate	> GPRS,
Channel Coding Rate	Rate 1/2 convolution code with
interleaving pulse	Error detection
Delay Equalization	20 micro sec

Interference Specification -

(a)Co-Channel interference f0	C/Ic
(b)Interference on first adjacent channel (f0 ± 200 KHz)	C/Ia1
(c)Interference on second adjacent channel (f0 ± 400 KHz)	C/Ia2
(d)Interference on the third adjacent channel (f0 ± 600 KHz)	C/Ia3

(e)Where Ia1 = adjacent channel interference
Ia/Ic = adjacent channel interference
C/Ia1 = threshold from C/Ic (Ic: co-channel interference)
Adjacent channel power -69 dBc or -36 dBm whichever is higher
Combiner Inter-modulation -70 dBc or 250 nW whichever is higher

Inter-modulation atten.	70 dB
Idle Channel Noise	Conforms to 3GPP TS51.010-1.
Quantization Distortion	Conforms to GSM Specs
Spurious and Harmonics	Conforms to radio regulations of ITU-R

(a) 250nW (-36 dBm) in band 9 KHz to 1 GHz
(b) 1-uW (-30 dBm) in band 1 to 12.75 GHz

Frequency stability	better than 0.05 PPM
Interleaving scheme	Conforms to GSM TS 45.003
Access Technology	TDMA
Duplex techniques	FDD
Speech CODECs support	FR (Full Rate)
Speech CODEC Bit Rate	13Kb/s

BER at input level of -85 dBm of non-protected bits for -

(a) Static	< 10 -4
(b) Mobile Channel	< 3%
Clock Extraction	Adaptive or GPS

One way transmission delay on Abis , except for A-bis on Satellite < 60 ms
Output power at antenna 1mW

Base Station Receiver	Conforms to 3GPP 45 and 3GPP 51.021.
Frequency hopping	support in non BCCH TRX
Power control	in non-BCCH TRX
Data Streaming	Upto 400MS/s
Backhaul Support	
(a) Radio	
(b) Satellite	
(c) Leased line	
(d) IP Network over Fast/Gigabit Electrical / Optical Fiber	
(e) E1 NetworkIs	
Compliance & Proof	EMI/EMC
Mount	On the mast or inside the vehicle
Overall weight	< 3Kg
Cooling	The BTS is designed for self cooling and not require any forced cooling
Interface	USB 3.0 Super Speed between Host controller & BTS Transceiver
BTS software	Supports unlimited TRX.
GPRS	Supports functionality
PDCH	Supported
GSM Antenna Specification	
(a) Operating Frequency	700- 2700 MHZ
(b) Type of Antenna	Omni & Directional
(c) Minimum Gain	6 dBi for Directional Antenna 1 dBi for Omni Antenna
(d) VSWR	better than 1.5
(e) Nominal impedance 50 ohm	
Antenna mount	All the fixtures required for mounting are provided
Beam width	90 Degree for Directional 360 Degree for Omni
Lightening Protection	DC grounded
Weight	<1Kg
Antennae Tilt	Easily adjustable
Processor CPU	64 bit >2GHz
Onboard Graphics	Intel HD
RAM	4GB DDR3@1.6GHz
R/W Speed	>100MBps
Ports	Gigabit LAN
Mobile User Equipment	Quad Band GSM + 3G + 4G + WiFi
OS + CPU + GPU	Android 4.4, Snapdragon + Adreno
Backhaul Radio	6GHz, 100Mbps, Ptp/PtMp, 802.11a/n, 16dBi antenna
Modulations Backhaul	OFDM: BPSK, QPSK, 16 QAM, 64QAM DSSS: DBPSK, DQPSK, CCK
Deliverables	BTS X1pc, UE X1pc, Antenna Directional & Omni X2pcs, Mast X1pc, Blank SIM X1pcs, SIM Programmer X1pc, Backhaul X1pcs
Options	GSM Power Amplifier 100mW to 10W for increased range to 64 sq. km for licenced users

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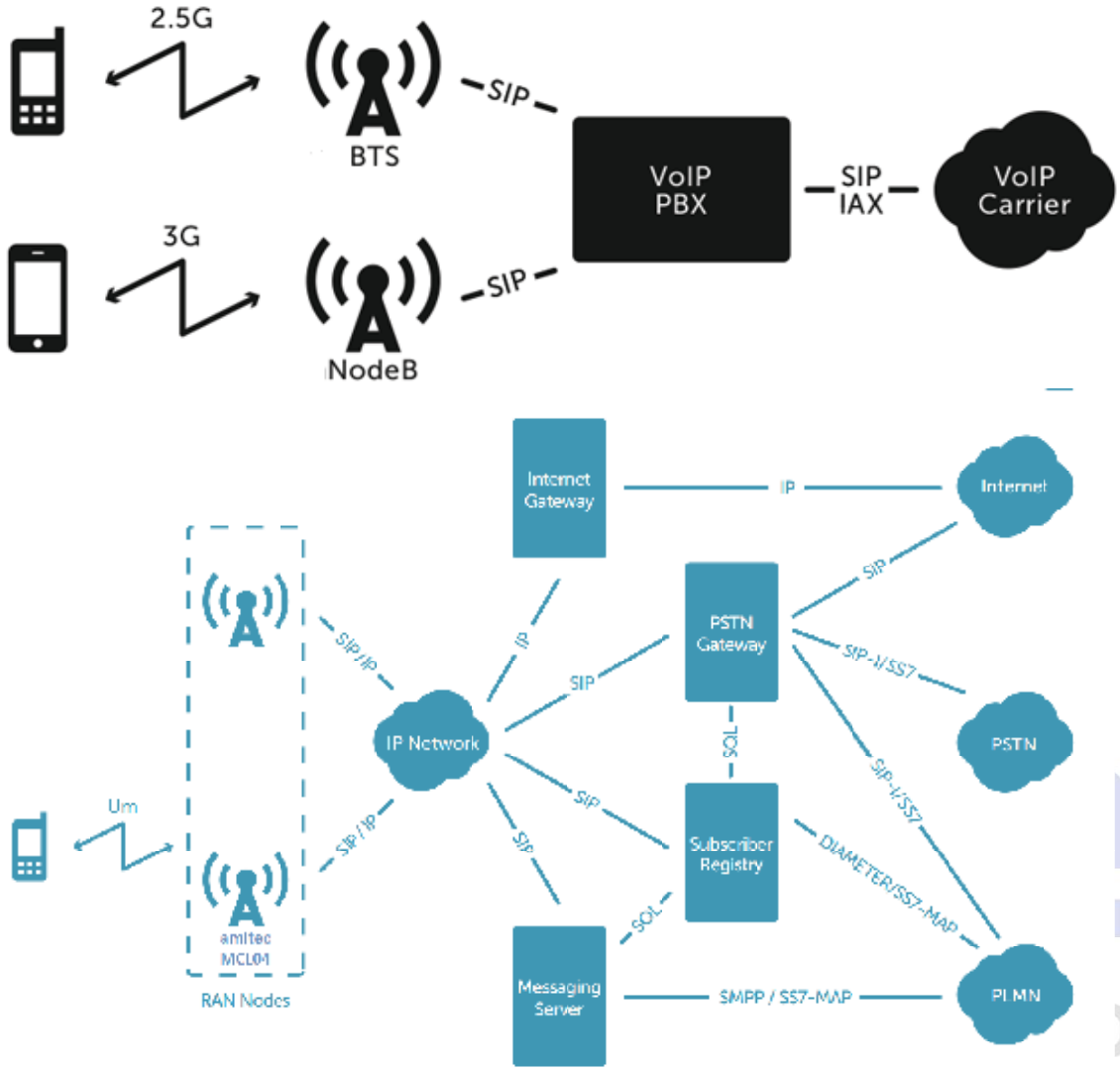

The figure shows a full-scale amitec MCL02 network with complete integration into the internet, PSTN (Public Switched Telephone Network) and legacy PLMN (Public Land-Mobile Network). All of these components are deployed in single Network in Box provided!!!

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Overview

Amitec MCL02 is a new breed of network equipment. It is meeting the demand for low cost, easy to install GSM cellular networks for remote rural service, rapid deployment and private industrial networks on ships, oil rigs or in mines.

The main feature of amitec systems is the replacement the conventional 2G/3G network's SS7-MAP structure (Signaling System #7 is a protocol that has dominated telephone system core networks since the 1980's. It is the basis for ISDN and Intelligent Network technologies. The Mobile Application Part (MAP) is an extension added to SS7 in the 1990's to support functions required by cellular networks.) and all of its various components (MSCs, BSCs, TRAUs, SGSNs, etc.) with a more modern SIP network, but without any changes to the handsets.

This approach offers the following advantages:

• much lower deployment costs (CAPEX), especially for small operators

• much lower operating costs (OPEX), for carriers of all sizes

• plug-in compatibility with existing SIP-based core networks

• plug-in compatibility with future IMS core networks

The key ingredient that makes this change possible is a software defined radio SDR implementation of the GSM radio access network that presents normal GSM handsets as virtual SIP endpoints. In other words, through SDR BTS, any GSM handset appears as a SIP device, without the need for any special software on the phone.

Significant cost savings from this approach are due to several factors:

• For small networks, the core network hardware can be reduced to a single commodity server, or core network applications can even be run on excess resources in the base stations themselves.

• For larger networks, the core network hardware is based on commodity servers and IP routing equipment, making it possible for the provided to have one shared IP network for both data and voice.

• Because all of the cellular network software runs on Linux and connects with commonly used TCP/IP and UDP/IP protocols, the core network can even be virtualized and run in a “cloud” service, like Amazon's Ec2.

• All of the proprietary software found in a conventional GSM network can replaced with open-source applications like open-source applications like SIP Express Router (SER), Yate, Apache web server and MySQL database server, eliminating recurring licensing fees.

• Because the new core network is based on IETF internet-age protocols, newly graduated engineers and software developers do not require additional training to deal with archaic SS7 technologies.

Beyond cost savings, the conversion of the network from legacy telco protocols to internet protocols gives the operator new opportunities to implement custom speech, text and USSD applications, using web service technologies like Apache and Ruby, or through cloud-based application platforms like Tropo or Twillio. These applications can even be installed in individual cell sites to provide locally-tailored service.

The components of the network are RAN Nodes, Subscriber Registry SR, PSTN Gateway, Messaging Server MS, Internet Gateway implemented in MCL02.

The system allows network to be integrated to PSTN, Legacy PLMN for SMS and Roaming support, 4G IMS Networks, Small Network for rapid deployment, Satellite backed small sites and Mixed 2G/3G/4G networks.

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