Features:

- Courseware designed at Indian Institute of Technology Delhi
- Learn next generation communication & convergence technologies (Software Defined Radio, Cognitive Radio including white spaces, Cooperative Communication, Communication over Cellular Network, Femto Cell, Wireless Network, Mobile Adhoc Network, Research in 4G/5G)
- Works with Linux GnuRadio, Compatible to MATLAB Simulink™ but does not need one!
- Open-licensing of experimentation and study material with No recurring cost!
- Latest generation of ASIC architecture with integrated LNA, PA system for communication, RX/TX Mixers, PLL, Synthesizers, RX/TX Filters, RX Gain control, TX power control
- Frequency Range: 70 MHz to 6 GHz
- Transmit Power of >10dBm and Receiver Sensitivity of -120dBm
- FPGA based transmit and receive architecture for superior performance
- Differential baseband signals
- Transmit Modulation Bandwidth programmable to 60 MHz
- Receiver Modulation Bandwidth programmable to 60 MHz
- Support for TDD and FDD configuration
- Highly stable +/- 250 ppb TCXO
- Up to 5GbpS/s USB 3.0 Data Streaming to Computer• MIMO Capability – 2X2
- Dual-Channel Transmitter and Dual-Channel Receiver
- Multiplexing Configuration: 1X1, 1X2, 2X1, 2X2 MIMO. Expandable to 64X64 MIMO
- Support for 4G LTE advanced waveform and protocol. Suitable for 5G testing
- Hundreds of experiments and growing

Description:

The Amitec SDR-LAB is a software programmable hardware transceiver which allows limitless communication laboratory experiments to be performed on a single device. The entry barrier is lowered to include the under graduate students by providing a graphical programming environment. The burden on faculty is lowered by using courseware designed at IITD from simple FM to most complex MIMO. Lab technicians are eased by integrated hardware and software from same source for trouble free performance.

The system is ideally suited for applications requiring high RF performance and great bandwidth such as physical layer prototyping, dynamic spectrum access and cognitive radio, spectrum monitoring and even networked sensor deployment. The Superspeed USB 3.0 interface at 5Gbps serves as the connection between the SDR-LAB and the mobile workstation. This enables the user to realize 60 MS/s of real-time bandwidth in the receive and transmit directions, simultaneously (full duplex). FPGA is autoloading so hardware is plug and play as a pen drive! No need to program the FPGA for most cases!

The systems offer MIMO capability with high bandwidth and dynamic range. Two units may be connected to realize a complete 2x2 MIMO configuration. External PPS and reference inputs can also be used to create larger multi-channel systems. ASIC houses complete RF and DAQ subsystems on a single board. Coupled with these benefits it hosts onboard RF Transceiver subsystems capable of tuning frequencies from 70MHz to 6GHz.

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Hardware Technical Specifications:	
MIMO Capability	**2X2, 2X1, 1X2, 1X1**
Cognitive Radio capability	**Dynamic Spectrum allocation and Spectrum sensing algorithm provided.**
Diversity	Space, Polarization, Time, Frequency
Number of Transmit Channel	2
Number of Receive Channel	2
Transmit Frequency Range	70 MHz to 6 GHz
Receive Frequency Range	70 MHz to 6 GHz
Clock synchronization	External, GPS 1PPS
Ingress Protection level	IP40
Frequency Band Upgradable	Upgradable to DC on lower Side upto 100 kHz and 60 GHz on upper side
Compatibility	Works with Linux GnuRadio, MATLAB, Simulink
Accessibility	OSI layers for signal processing and development
Wireless transmission and reception	Over the air transmission through SMA
Signal Capture	The IQ Vectors at any part of signal chain. User can process the IQ data
Modulations supported	Any, Custom Modulations possible
ADC/DAC IQ Sampling Rates	Any sampling rate, Max. 61.44 MSPS
Antenna configuration	SISO, MIMO
Transmit Diversity Codes	SFBC, STBC, STTC, Custom Codes
Receiver Diversity	Selection combining (SC), Maximal Ratio Combining (MRC), and Equal gain combing (EGC), Custom algorithm
Advanced MIMO support	Supports Beamforming and Mu-MIMO
Mode	Full Duplex, TDD, FDD
Architecture	ASIC, FPGA, Zero IF
Transmit Baseband Bandwidth	60 MHz
Receive Baseband Bandwidth	60 MHz
Frequency Resolution	<3Hz
Maximum RF Output Power	+10 dBm
Receiver Sensitivity	-120 dBm
TX SMA Impedance	50 Ohm
RX SMA Impedance	50 Ohm
PLL Phase Noise	-125dBc/Hz at 1MHz
Spurious Output	-50dBc
TX Gain Control Range	>50dB
RX Gain Control Range	>50dB
TX Gain Control Step	1 dB
RX Gain Control Step	1 dB
Rx Noise Figure	< 5dB
IQ Phase Error	3 degree
IQ Amplitude Error	0.5dB
PLL Settling time	<20us
ADC/DAC Resolution	12 bits
SFDR	80 dBc
FPGA	Altera Cyclone
FPGA Logic Elements	40,000
Integrated Transceiver	>3 Gbps
Input Amplitude	1Vp/p differential
Output Amplitude	250mV p/p differential
MTBF	Greater than 20 years
Other Connectors	JTAG Pinout and GPIO
Onboard Memory	Minimum 256 MB
RF Cable	RG316 SMA-SMA X 4
Antennas	Directional LPDA 0.4-6.5 GHz X 4, Omni Directional Dipole 0.4-6 GHz X4 will be provided
Shipping List Deliverable	SDR X 2 pcs, Antennas X8, SMA-SMA Cables X 4 pcs, Attenuator 20dB - 4pcs, Signal generator Instrument, USB 3.0 cables X 2 pcs

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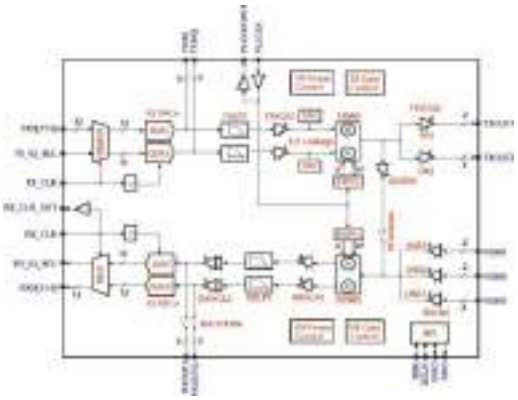
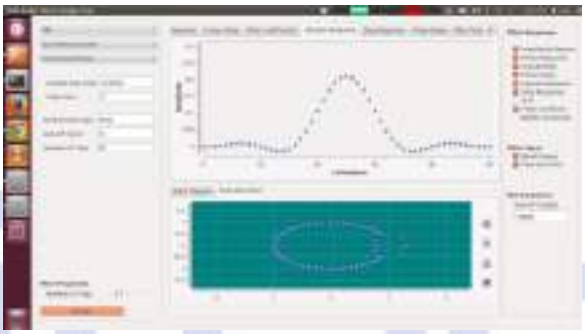
Scope of Experimentation

- Introduction to SDR-LAB Hardware and Software environment
- On air transmission and reception using Analog modulation and demodulation techniques like AM, DSBSC, SSB, Narrowband FM, Wideband FM, Stereo FM,
- On air transmission and reception using Digital Modulation and Demodulation techniques like ASK, FSK, BPSK, DBPSK, MSK, GMSK, MQPSK ,DQPSK, QPSK, OQPSK, pi/4QPSK, 8PSK,16QAM, 64QAM, 256QAM, CPFSK, GFSK, and other variants,
- Spread spectrum techniques like CSS, DSSS, FHSS, THSS
- Multiplexing techniques like TDM, FDM/WDM,SDM, Polarization, Spatial, Packet Switching, MC-SS, OFDM
- Analog Channel Models like Noise (Uniform, Linear, Laplacian, Gaussian, Phase noise), Interference (Cross talk, Co-channel, Inter symbol), Distortion (Inter modulation), Frequency response (Attenuation & phase shift), Group delay, Propagation Doppler shift, Fading modeling slow, fast, selective/dispersive, Multipath, Rayleigh, Rician),
- Channel Coding & decoding-Convolutional, Viterbi, Trellis,
- Channel performance measurements (spectral bandwidth, Symbol Rate, Bit Rate, Channel Capacity, Channel Utilization, Signal to noise ratio, Bit Error Rate BER, Latency, Jitter, Eye Diagram, Constellation diagram, Oscilloscope, Spectrum Analyser, Waterfall display
- Line Coding & Decoding Digital Baseband
- Filters-IIR, FIR, Pulse Shaping-RRC root raised cosine, High pass, Low pass, Bandpass, Band stop, FFT, frequency translating filter,
- Equalizer adaptive-CMA, Kurtotic, LMS DD
- Synchronizers-Costas Loop, Clock Recovery, Frequency locked loop, phase locked loop, correlate and sync, carrier acquisition,
- Modeling mathematical equations
- Networking- TCP, UDP, Socket, Broadcasting,
- Encoding decoding for data, voice & video-PSK31, MPEG, CVSD and more
- On air link for Voice, Data, Video,
- OFDM complete on air implementation
- GSM on air decoding from live signals
- CDMA Introduction



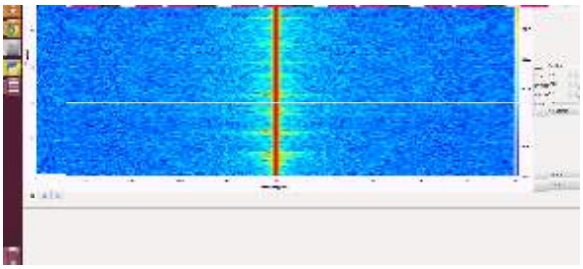
SDR Arc hitec ture



FIR RRC Filter Designing

GSM BTSDownlink On Air Capture

Optional*:
Upgradable to 60 GHz frequency range
Vector Signal Generator Implementation*
Vector Signal Analyser Implementation*
MIMO 2X2 implementation*
Jammer Implementation*
4G LTE Implementation*
OFDM Implementation*
RFID Implementation*
Phased Array Antenna Beamforming*
Radar, SAR, Doppler, FMCW Implementation*
Smart Distributed RF Sensors*
WiFi Implementation*
GPS/GNSS Implementation*
GSM BTS and Network Implementation*
Satellite Radio Implementation*
Radio Astronomy*
Amateur Radio*
Student projects Research And more....



Doppler Radar Implementation

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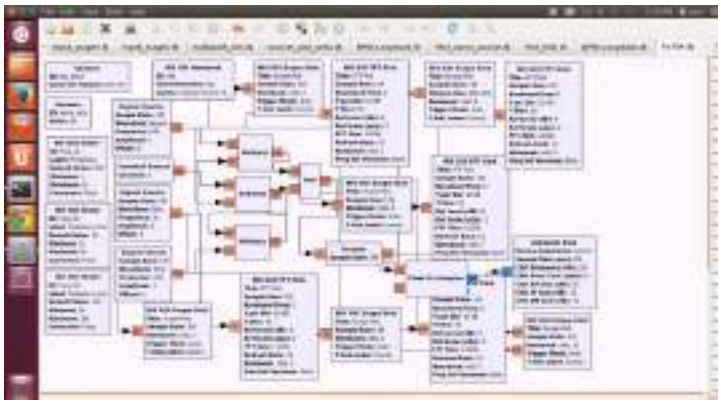
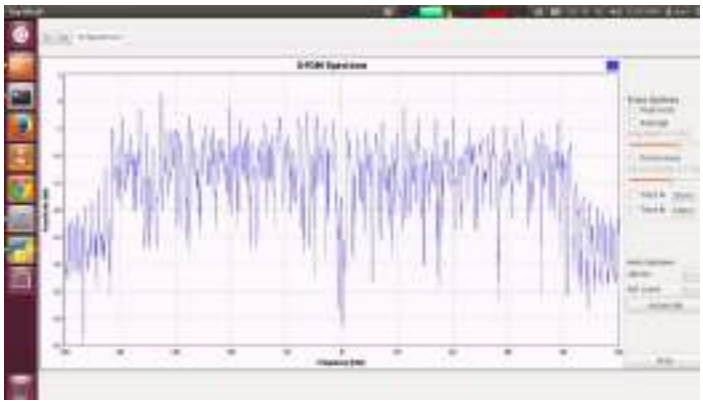
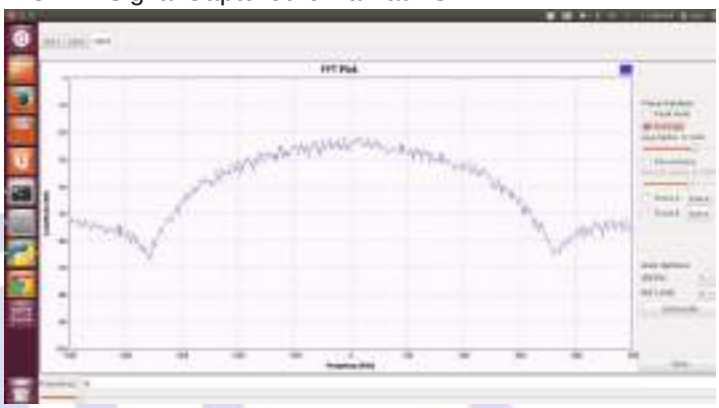


Graphic al Programming Environment

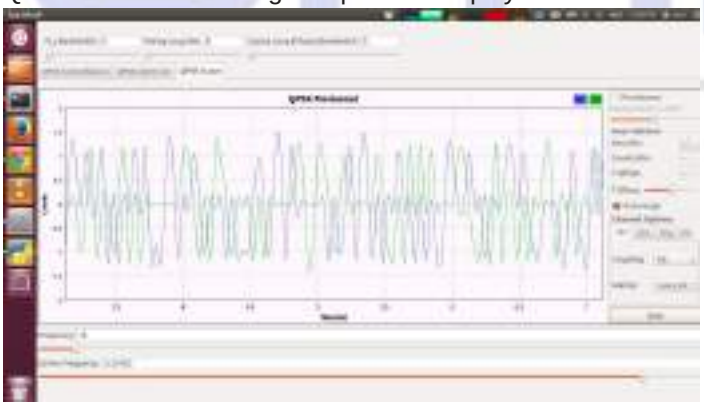


OFDM Signal Captured on air at 1GHz

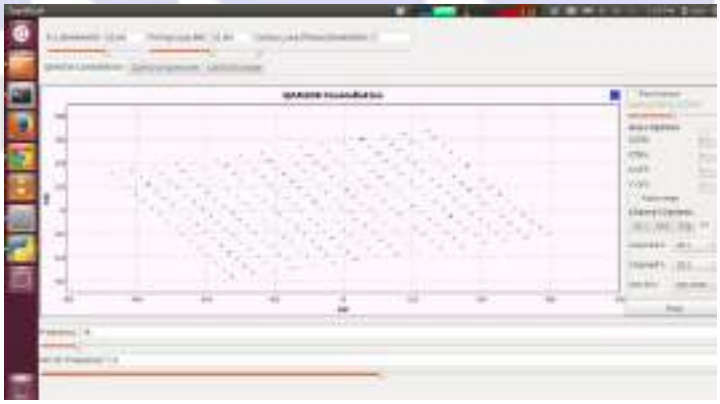
QAM 256 Rec eived Signal Spec tral Display at 1GHz



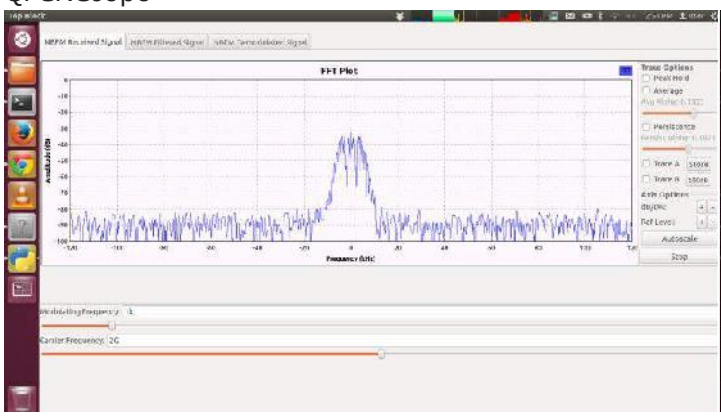
GMSK FFT



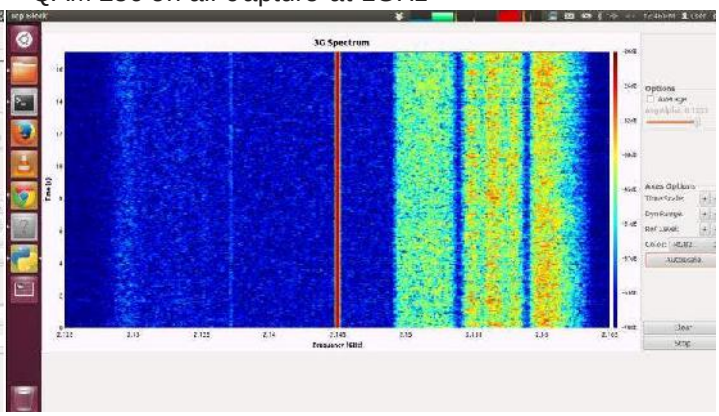
QPSK Scope



QAM 256 on air c apture at 1GHz



Narrow Band FM signal c aptured on air



3G spec trum on Air

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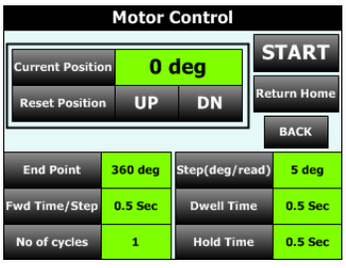
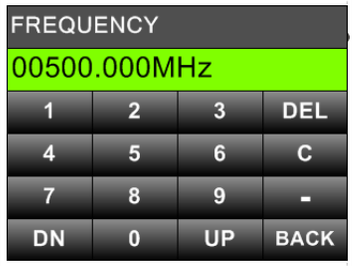
Features

* Signal generator with 320X240 pixel TFT Touch Screen display
* PLL synthesized transmitter and receiver 0.04-4 .4 GHz
* 1 KHz to 1 GHz step size with measurement in 0.1 dB resolution
* 60 dB dynamic range.
* Accuracy : 1ppm
* RF Level : 0dBm typical.
* USB interface with Windows compatible polar/cartesian plottingsoftware

Signal generator

Technical Specifications





Display	:	320X240 pixel TFT Touch Screen
Frequency range	:	0.04-4.4 GHz PLL synthesized
Step size	:	1KHz to1GHz
Accuracy	:	1ppm
RF Level	:	0dBm typical
Measurements	:	RF level in dBm & 22 other units
Resolution	:	0.1dB with a dynamic range of 60 dB
USB interface	:	To PC for antennaplotting software

2 Dedicated Branded Laptops will be provided with the complete system:

i5 Processor
Hard Disk 500 GB
RAM 4 GB
Display 14 inch
OS :UBUNTU/CentOS

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