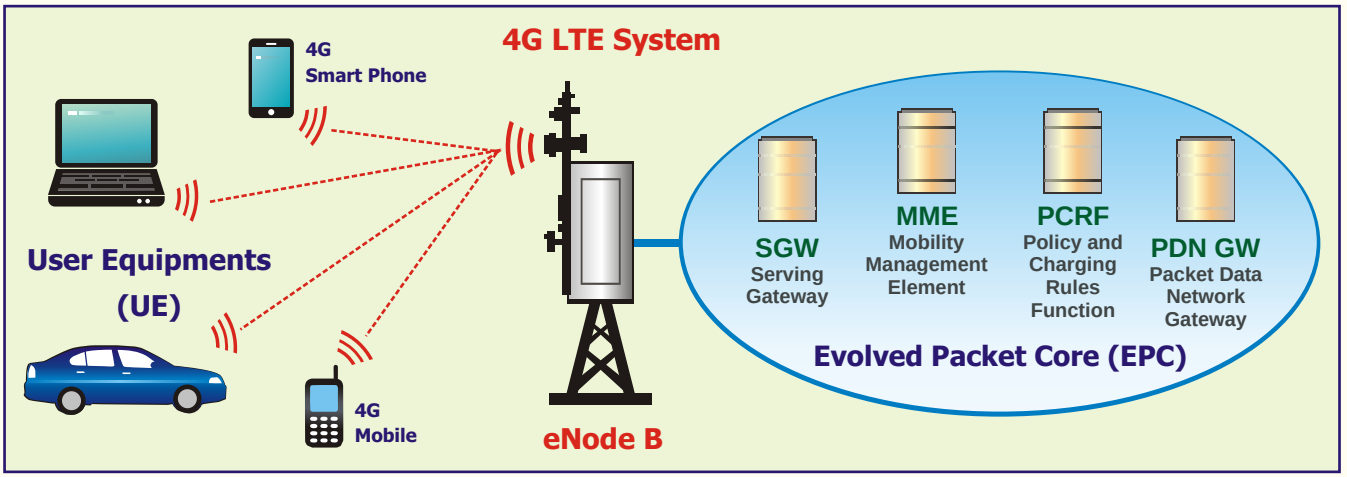
SIGMA

4G LTE MOBILE TOWER TRANSMITTER RECEIVER REAL SYSTEM TRAINER

MODEL - 4GLTE100

This trainer has been designed with a view to provide practical and experimental knowledge of 4G LTE Realtime Mobile Transmitter Receiver System.



What is 4G LTE (Long Term Evaluation)

- 4G LTE system consists of **Mobile Transmission Station** which is Known as **eNodeB** or **ENB** or **eNB**.
- **Users** connecting to this Mobile Tower using their 4G Mobile Phones are known as User Equipment - **UE.**
- LTE works on All IP **Evolved Packet Core** known as **EPC**.

What is EPC ?

- EPC is New, all-IP Mobile Core Network introduced with LTE
- It is End-to-end IP (All-IP) i.e LTE is All-IP, Simplified Network Architecture
- Clear delineation of Control Plane and Data Plane
- Simplified Architecture : Flat-IP architecture with a Single core
- EPC was previously called **SAE (System Architecture Evolution)**
- eNodeB is also called E-UTRAN
- The EPC is a Multi-access core Network based on the Internet Protocol (IP) that enables operators to deploy and operate one common packet core network for 3GPP radio access (LTE, 3G, and 2G), non-3GPP radio access (HRPD, WLAN, and WiMAX), and fixed access (Ethernet, DSL, cable, and fiber).
- The EPC is defined around the three important paradigms of mobility, policy management, and security.

- EPC has four Elements as under:

  Serving Gateway - SGW

  Serving a large number of eNodeBs, focus on scalability and security.

  Mobility Management Element (MME)

  Control-plane Element, responsible for high volume mobility management and connection management (thousands of eNodeBs)

  Policy and Charging Rules Function (PCRF)

  Network-wide control of flows: detection, gating, QoS and flow-based charging, authorizes network-wide use of QoS resources (manages millions on service data flows)

  Packet Data Network (PDN) Gateway

  IP management ("IP anchor"), connection to external data networks; focus on highly scalable data connectivity and QoS enforcement

FEATURES

- This 4G LTE Mobile trainer is designed to explain, teach and experiment Real time 4G LTE system in the laboratory with Mobile Tower and End users - 4G Mobile phones.
- All ENBs and UEs can be reconfigurable as required.
- EPC is preconfigured and can be used upto 1Gbps 5G data speed in future.
- The Trainer is designed with RF / Spartan 6 FPGA Hardware
- It works on Open Source LTE eNodeB software
- Interface between eNodeB and EPC is USB 3.0 by which uplink data speed is 75Mbps and Download data speed is 150 Mbps.
- The system can be configured as SISO or 2 x 2 MIMO.
- Unlimited LTE 4G Mobile Phones, Dongles and 4G Equipments can be connected in Real time.
- Due to Real System students can test their new algorithms and Study eNodeB and UE in class room.

SPECIFICATIONS

(A) General Specifications

1. LTE eNodeB + EPC + UE are made in laboratory by hardware and Software.
2. Frequency Band of Harware : 400MHz-4000MHz
3. LTE Version : Advanced Release 12
4. Throughput : Upto 150Mbit/second
5. Bandwidth : 20MHz - Programmable to 1.4, 3, 5, 10, 15 & 20MHz
   Bands - TDD & FDD Multiplexing
   - FDD LTE Bands : Band 1 to 14, 17 to 31
   - TDD LTE Bands : Band 33 to 44
6. Transmission Mode : SISO & 2X2 MIMO
7. Video Streaming, Voice over LTE support
8. Transmit Power : +5dBm Transmit power & -120dBm Sensitivity Receiver
9. Range : Low power FCC compliant licence free operation to 10m range
10. MIMO : SISO & 2X2 MIMO built in and expandable to 8X8 in future
11. Orthogonal frequency domain multiple access (OFDMA) Download
12. Single-carrier frequency domain multiple access (SC-FDMA) Upload
13.. No recurring cost of software or licences
14. Unlimited UE simultaneous connections
15. Carrier Aggregation support with scheduling
16. Timing Measurement though PRACH
17. Self organising network (SON) features, such as optimization
18. Location services (LCS) to pinpoint the location of a UE
19. Relay nodes to support Heterogeneous Networks
20. Coordinated multipoint transmission and reception
21. Enhanced inter-cell interference coordination (eICIC)
22. S1 and X2 using Stream Control Transmission Protocol
23. Implements MAC, RLC, PDCP and RRC layers
24. Evolved multimedia broadcast and multicast service (eMBMS)
25. X2AP interface between eNodeBs
26. USB 3.0 Super speed Interface to EPC
27. Wireshark LTE Protocol Analyser Software
28. IPV6 supported and NAT based IP routing
29. Handling of UE procure, attach, authentication, security configuration, detach, tracking area update, service access, radio bearer establishment, paging
30. Configurable user database

(B) Downlink Specifications

1.	Frequency Band Capability and Configurability	:	LTE Bands as per 3GPP LTE Specification
2.	RF Cabling	:	RF ports can be connected via SMA cables
3.	RF antennas over the air transmission	:	RF antennas can receive wireless
4.	LTE Channel bandwidths (MHZ)	:	1.4, 3, 5, 10, 15, 20 MHz
5.	Time division and frequency division duplexing	:	FDD & TDD supported Fully
6.	Waveforms	:	OFDMA in downlink
7.	Peak Data Rate	:	Maximum: 150 Mbps @ 20MHz
8.	Antenna	:	2x2 MIMO ready
9.	Modulations supported	:	QPSK, 16QAM, 64 QAM
10.	Channels	:	PDSCH (physical downlink shared data channel) PDCCH (physical downlink control channel) PCFICH (physical control format indicator channel) PHICH (physical HARQ indicator channel) PBCH (physical broadcast channel) Synchronization Channels PSS and SSS
11.	OFDM Size	:	FFT128, FFT 256, FFT512, FFT 1024, FFT 1536, FFT 2048
12.	OFDM Cyclic Prefix type	:	Normal, Extended
13.	Wireless Channel Models	:	AWGN: Additive White Gaussian Noise EPA: Extended Pedestrian A Model EVA Extended Vehichular A Model ETU Extended Typical Urban Model Rician Channel Models Rayleigh Fading Channel
14.	ADC and DAC IQ Sampling Rates 30.72, 15.36, 7.68, 3.84, 1.92, 5, 10 MHZ Any proprietary sampling rate		
15.	ADC & DAC Word length	:	12 bit ADC & DAC
16.	ADC Dynamic Range	:	85Db
17.	Antenna Configuration	:	SISO Diversity, 2X2 MIMO
18.	Diversity Support	:	(a) SFBC (space frequency block coding) (b) STBC (space time block coding) (c) Receiver Diversity (d) Transmitter Diversity
19.	Number of OFDM data subcarrier	:	(a) 1200 subcarriers (b) 900 subcarriers (c) 600 subcarriers (d) 300 subcarriers (e) 128 subcarriers (f) 72 subcarriers
20.	Carrier/Phase recovery tolerance range in Khz and ppm: Frequency Correction Range 75KHz-90KHz		
21.	ADC/DAC/Frequency Clock Stability	:	Less than ±0.1PPM
22.	Equalization	:	LS: Least Squares MMSE: Minimum mean square Equalizer DFT-MMSE: DFT based MMSE
23.	Mobility/Doppler Support	:	Doppler shift upto 300Kmph
24.	Error Correction Coding and Decoding	:	

a. Convolution Encoder and Tail biting Viterbi Decoder. Constraint Length 7 Compliant with LTE

b. Turbo encoder and decoder. Compliant with LTE. Coding rate 1/3. Parallel Concatenated Convolution Code with two 8 state constituent encoders and one turbo code internal inter leaver

25.	Measurement Support	:	(a) SNR versus BER, (b) EVM measuring instruments (c) Spectrum Plots, (d) Time-domain plots

(C) Uplink Specifications

1.	Frequency Band Capability and Configurability	:	LTE Bands as per 3GPP LTE Specification
2.	RF Cabling	:	RF ports can be connected via SMA cables
3.	RF antennas over the air transmission	:	RF antennas can receive wireless
4.	LTE Channel bandwidths (MHZ)	:	1.4, 3, 5, 10, 15, 20 MHz
5.	Time division and frequency division duplexing	:	FDD & TDD supported Fully
6.	Waveforms	:	SC-FDMA in uplink
7.	Peak Data Rate	:	Maximum 75 Mbps @ 20MHz
8.	Antenna	:	Multi User Collaborative MIMO
9.	Modulations supported	:	QPSK, 16QAM, (64QAM handset
10.	Channels	:	PUSCH (physical uplink shared data channel) PUCCH (physical uplink control channel) PRACH (physical random access channel) DRS (demodulation reference signals) SRS (sounding reference signal)
11.	OFDM Size	:	FFT128, FFT 256, FFT512, FFT1024, FFT 1536, FFT 2048
12.	OFDM Cyclic Prefix type	:	Normal, Extended

(D) Hardware Supplied

1.	EPC	:	2 Nos.
2.	UE	:	2 Nos of 4G LTE Mobie Phones
3.	SIM Cards	:	Test SIM - 2 Nos.
4.	ENodeBs	:	2 Nos.
5.	LTE Antennas	:	8 Nos.
6.	Laptops	:	2 Nos

(E) Software Supplied

1.	Operating System	:	Linux
2.	Programming Language	:	ANSI C ++
3.	LTE e Node B Software	:	1 No.
4.	EPC Software	:	1 No.
5.	IMS server	:	1 No.
6.	eMBMS Server	:	1 No.
7.	Protocol Analyser Software	:	1 No. - Wireshark

(F) Accessories Supplied

1. USB 3.0 - USB 3.0 Cables
2. Front Panel Ports and Antenna Connectors
3. Power Supply Adapters
4. RF Attenuators (variable and fixed)
5. SMA Cables
6. SMA-SMA Adapters
7. LTE Antennas Omni Directional
8. **Books for 4G LTE Mobile Communication : 10 Nos in pdf Format**
9. **Mp4 Video Class for Mobile Communication : 40 Classes in Mp4 on Pen Drive**

EXPERIMENTS

1. To Study Theory and Block Diagram of 4G LTE Mobile System
2. To Study eNodeB
3. To Study EPC
4. To Study UE
5. To Study Serving Gateway - SGW
6. To Study Mobility Management Element (MME)
7. To Study Policy and Charging Rules Function (PCRF)
8. To study Packet Data Network (PDN) Gateway
9. To understand Self Organizing Network (SON)
10. To install EPC
11. To install eNodeB
12. To install software for UE
13. To carry out X2AP interface between eNodeBs
14. To configure software to set Mobile country code, Network operator code and LTE band
15. To assign a phone number to each registered phone.
16. To enable call logging of subscribers.
17. To get and set your IMSI.
18. To configure the asterisk communication server for IP PBX and VOIP gateway.
19. To register phone to the LTE network.
20. To transmit and receive an SMS.
21. To make Voice Calls
22. To make Video Calls
23. To establish a data communication link between Mobiles and Computers.
24. To configure and use IMS server
25. To locate UE using Location services (LCS)
26. To measure time though PRACH
27. To Study Carrier Aggregation support with scheduling
28. To capture 4GLTE packets using Wireshark Protocol Analyser Software.
29. To write a Program in C++ for programming of different types Nodes and Ues
30. To Study S1 and X2 using Stream Control Transmission Protocol
31. To Study Enhanced inter-cell interference coordination (eICIC)
32. To study Relay nodes to support Heterogeneous Networks
33. To handle UE procure, attach, authentication, security configuration, detach, tracking area update, service access, radio bearer establishment, paging
34. To establish SISO and MIMO configurations
35. To observe evolved multimedia broadcast and multicast service (eMBMS)
36. To demonstrate and understand different types of faults
37. To understand Glossary and Acronyms used in 4G Mobile Technology

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Dealer:-