IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

SITES

Smart And Innovative Technologies In Engineering And Sciences

Gyan Ganga College of Technology

Vol. 3, Special Issue 4, November 2016

LTE: User Equipment (UE) States

Jyotsna Agrawal[1], Dr. P. Mor[2], Dr. J.M. Keller [3,] Dr. P. Dubey[4]

Research Scholar, Physics and Electronics Department, R.D.V.V. University, Jabalpur (M.P.), India[1]

Scientific Officer, Physics and Electronics Department, R.D.V.V. University, Jabalpur (M.P.), India[2, 4]

Professor, Physics and Electronics Department, R.D.V.V. University, Jabalpur (M.P.), India[3]

Abstract: The number of mobile users and the demand for better communication is increasing day by day. So to meet up customers demand lots of advancement is being done in the field of communication. Latest communication technology LTE pays large emphasis on providing users with faster data rates and better communication quality. LTE has specified two UE states i.e. Idle mode and connected mode to avoid unnecessary signalling. When the UE does not have any data to send it is said to be in idle mode, and when the data is being send or communication is taking place then the UE is said to be in connected state. Idle mode is important as it saves battery life and also reduces unnecessary signalling. This paper gives a brief overview of both these UE states.

Keywords: Long Term Evolution (LTE), User Equipment (UE), Radio Resource Control (RRC), Radio Resource Control idle state (RRC_IDLE), Radio Resource Control connected state (RRC_CONNECTED)

I. INTRODUCTION

It is seen that in the past few decades the use of mobile and the number of mobile users has increased very rapidly. As the demand of communication increased mobile companies have tried to provide their users with better technology and facilities. Lots of advancements have been done in the form of different generations. Each generation has its own benefits and features which were better than its predecessor. The latest communication technology LTE, which is more commonly known as 4G (Fourth Generation), not only focuses on voice communication but also provides the users with speedy data access, better mobility, efficient radio usage, high level of security, flexible spectrum utilization, reduced delay/latency and cost efficient deployment along with many advanced user applications. LTE is an all IP based network which supports IP-based services well. LTE also places emphasis on saving the overall system energy and reducing the unnecessary signaling when the UE is not in use. This becomes important so that users can use device for a longer time. To satisfy these conditions some states are defined by LTE.

II. USER EQUIPMENT STATES

UE states in LTE are divided into two categories, idle mode and connected mode depending upon the conditions. eNodeB handles the switching between both these states. A short overview of these states is given below:

A. UE in the IDLE Mode

This state is named as idle as in this state user is not using UE for communication. In the IDLE mode UE is not known by the eNodeB but is known by the network and can communicate with the network when it notices any incoming call and has an IP address. In this mode the mobility management is done by the UE by cell selection and re-selection whenever handover is required or a better connection is available. Network does not control UE's movement in this state, UE automatically selects new cell as it moves. If UE enters a new location area, based on hearing information from base station, the UE informs the network of the new tracking area it has entered. The UE does not transmit or receive any data in this state. It merely monitors the paging and broadcast channel so as to maintain the connectivity.

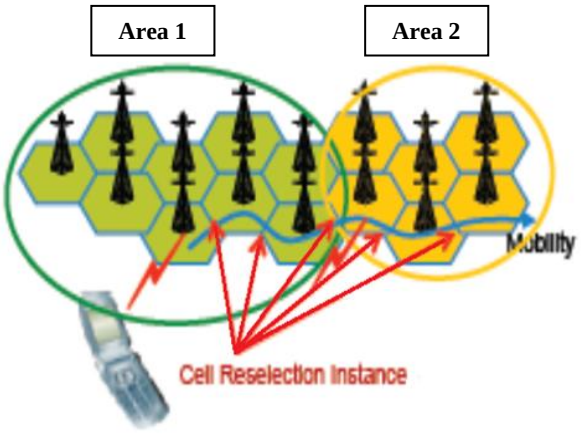

Fig. 1.Cell Re-selection

UE moves from idle mode to the connected mode when RRC signalling connection is established. The idle mode saves the overall power of both the UE and the network as this period avoids unnecessary signalling and communication. As the UE has limited power, this feature of LTE increases the user equipment life time.

IARJSET
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
SITES
Smart And Innovative Technologies In Engineering And Sciences
Gyan Ganga College of Technology
Vol. 3, Special Issue 4, November 2016

B. UE in the CONNECTED Mode

In this state the UE is known by both the eNodeB and the network. Moreover the radio is in the active state as the data is being communicated. The mobility management in this state is done by the network and it is based on handover. In the "Connected Mode" UE keeps its transmitter and receiver always ON i.e. the UE's radio is in the ON state.

In the Connected Mode the UE constantly communicates with the network and so it knows its location at the cell level. Depending upon this cell level, it can make decision that when the handover is required and when it is not necessary.

The network here controls the mobility decision based on UE measurement reports from the cells and other RAT reachable by the UE. UE moves from connected mode to the idle mode when RRC connection is released. By releasing the RRC connection it means that there is no incoming call or data to send by the UE.

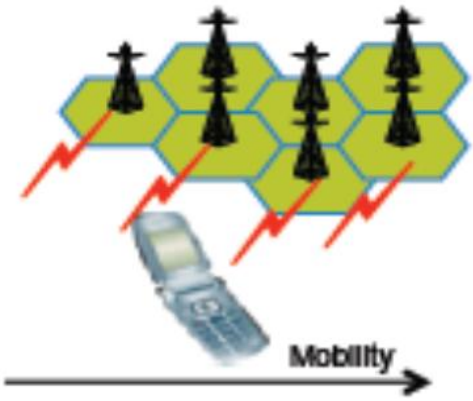

Fig. 2. Connected Mode - UE constantly communicating with the network

When the network is not communicating for a particular period of time, called the inactivity period, the network moves the UE's state to idle-state.

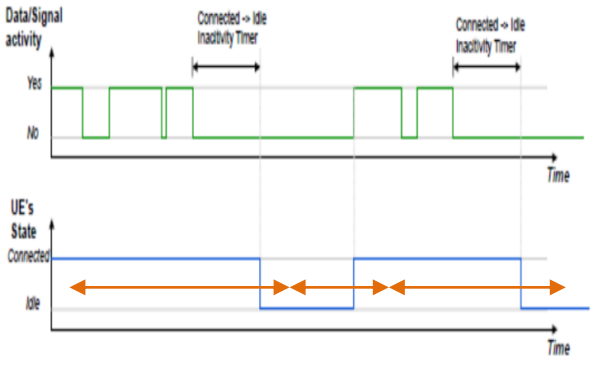

Fig. 3.UE's IDLE and CONNECTED states

As shown in the figure below the duration for which the data is being transmitted the UE remains in the connected mode (slot 1).

If the data is not being transmitted by the UE for a particular period i.e. for the inactivity period then the UE moves from connected state to idle mode (slot 2).

When the UE have data to send then it again starts transmitting the data, at this time the UE moves to connected state from idle state (slot 3). This state of UE keeps on changing according to the measurement reports and data availability for communication.

C. UE RRC States

In LTE there are only 2 RRC (Radio Resource Control) states i.e. RRC_IDLE and RRC_CONNECTED. During the RRC Connection setup state, the UE makes transitions from RRC-Idle to RRC-Connected, and vice-versa.

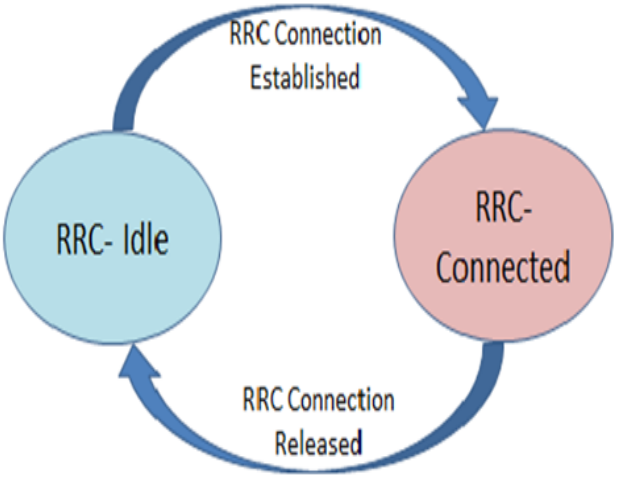

Fig. 4.UE states and state transitions

RRC_IDLE:- This state indicates that signaling radio bearer is not established i.e. no RRC connection is established. Here UE monitors the control channels to determine whether any data is scheduled for communication or not.

UE in this state performs neighboring cell measurements, cell selection or re-selection, collects measurement reports and acquires system information.

RRC_CONNECTED: - This state indicates that signaling radio bearer is established i.e. RRC connection is established. In the RRC_CONNECTED state transfer of data to/from the UE takes place.

There handover and other network controlled mobility are handled by UE. UE also monitors the control channel. UE provides channel quality, acquires system information, monitors control channel and does paging.

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

SITES

Smart And Innovative Technologies In Engineering And Sciences

Gyan Ganga College of Technology

Vol. 3, Special Issue 4, November 2016

III. CONCLUSION

A UE can be attached to a network and can use the services provided by it regardless of its location by exchanging control signaling messages with the network. The UE remains in the CONNECTED mode when the RRC connection is established and if there is no RRC connection establishment then the UE is in the IDLE mode. Both these states are important as it allows the UE to manage mobility, cell selection and re-selection, paging control, broadcast and many other functions. These states also save the radio resources and battery.

REFERENCES

[1] S. Sesia, I. Tou_k, and M. Baker, editors. LTE - The UMTS Long Term Evolution: From Theory to Practice. John Wiley & Sons, 2009.
[2] www.3gpp.org.
[3] "LTE mobility enhancements", Qualcomm, February 2010.
[4] "Long Term Evolution (LTE): A Technical Overview", technical white paper, Motorola, June 2007.
[5] www.teletopix.org.
[6] P. Lescuyer, T. Lucidarme, "Evolved Packet System: The LTE and SAE Evolution of 3G UMTS", Wiley, 2008.
[7] "LTE mobility enhancements", Qualcomm, February 2010.