



Overview and Functioning of the Main Parts of Cellular Communication System

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ABSTRACT: Wireless communication technology takes off since the discovery of electromagnetic (EM) waves. It has been evolving from Italian inventor Guglielmo Marconi (1874-1937) developed, demonstrated and marketed the first successful long-distance wireless telegraph and in 1901 broadcast the first transatlantic radio signal. Cellular communication is one example of wireless communication system that allows users to communicate using EM waves in open space without wires.

A cellular network is a radio network distributed over land through hexagonal shaped cells where each cell includes a fixed location transceiver known as cell site. Main role of these cells is to provide radio coverage over geographical areas so that user equipments such as mobile phones able to communicate. Cellular network formed by the public switched telephone network (PSTN), mobile telephone switching office (MTSO), cell site equipments (CSE) and mobile subscriber unit (MSU). This paper presents information about the structure of these main parts of cellular network and functioning of these parts in cellular communication network.

KEYWORDS: Public switched telephone network, Mobile telephone switching office, Cell site equipments, Mobile subscriber unit

I. INTRODUCTION

Communication has always been a focus point for exchanging information among parties at location physically apart. In past, telephones have replaced the telegrams and letters. The term 'mobile' has completely revolutionized the communication. Early mobile communication systems were based on Amplitude Modulation (AM). As demand increased to get more efficient mobile radio communication, Frequency Modulation (FM) technique developed. After that cellular concept developed in the 1960 at the Bell Laboratories and mobile communication began to serve wider population. In 1970 development of newer and better technologies enabled mobile users to connect with Public Switched Telephone Network (PSTN). Since the deployment of Advanced Mobile Phone System (AMPS), wireless services experiencing rapid growth [1].

As shown in figure.1, cellular communication uses a basic unit called cell. Each cell consists of small hexagonal area with a cell site located at the center of the cell which communicates with the user. A Mobile Subscriber unit (MSU) communicates to a fixed cell site that enables it to communicate to the desired user at the other end. The MSU consists of transceiver, control circuitry, duplexer and an antenna. Cell site consists of transceiver and channel multiplexer along with antennas mounted on the tower. Mobile Telephone Switching Office (MTSO) is the central and most vital part of cellular communication system. Mobile Switching Centre (MSC), field monitoring and relay stations are the main parts of MTSO. They perform operation of switching calls from cell sites to wire line Public Switched Telephone Network (PSTN) [2].

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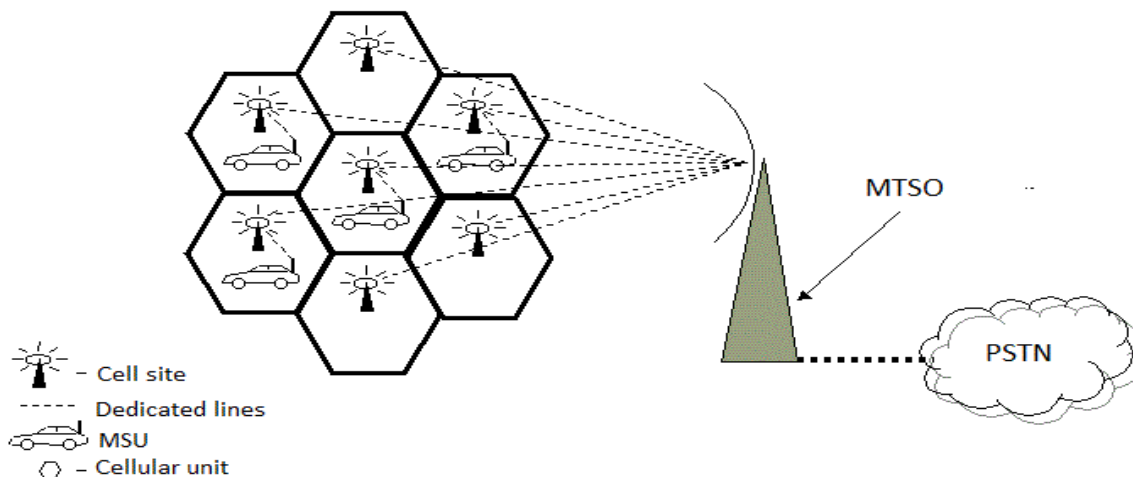


Figure.1 Basic cellular network

II. PSTN

PSTN is short form of public switched telephone network. It is interconnected voice-oriented public telephone networks. It has been evolving since Alexander Graham Bell made the first voice transmission over wire in 1876 [3]. It mainly consist of the transmission, switching, signalling and intelligent networks.

Transmission network contain links and nodes for carrying traffic in the form of voice, video, data, etc. Nodes are called multiplexers for multiplex / demultiplex traffic and links are optical fiber, coaxial cables, etc. Using nodes and links helps to replace thousands of cables by fewer and it leads to reduce size of large network.

As shown in figure.2 multiplexer combines several traffic signals into one signal over shared channel and demultiplexer reverses the process of multiplexer.

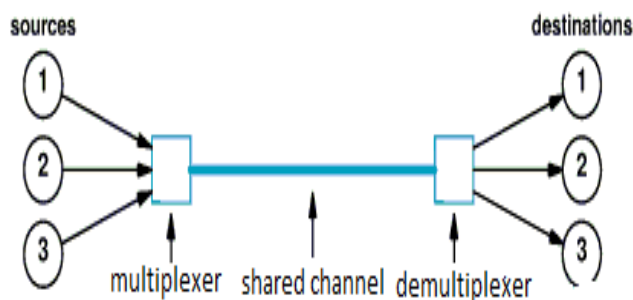


Figure.2 Transmission network

In switching network, for communication of voice over long distance demands switched telecommunication network. It is a collection of switching elements arranged and controlled in such a way as to setup a communication path between any two distant users so they can communicate more conveniently. The voice network is using the circuit switching technology which provides voice services. Circuit switching was developed during the early days of telephony when calls were connected by operator at a manual switchboard. In circuit switching channel of fixed bandwidth is dedicated between two users for the duration of a call [4]. Circuit switching provides connection-oriented services for voice subscribers that enable them to exchange their traffic.

In signalling network, signalling system no.7 is a global standard for telecommunications. It defines the procedures and protocols by which network elements in the public switched telephone network exchange information over a digital signal network [5].

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Signalling information in the form of data carried over signalling network. All switches on the path exchanges signalling information for reserving resources during exchanging traffic that is shown in figure.3.

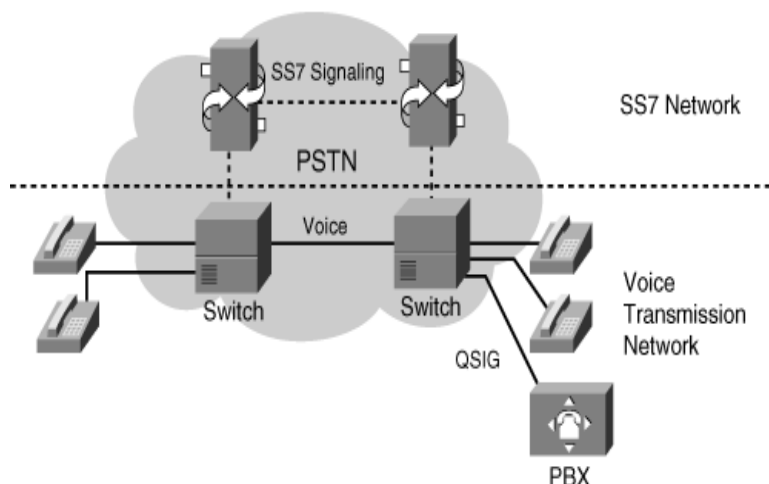


Figure.3 Signalling network in PSTN

Intelligent Network (IN) is a service-oriented network. It provides various kinds of value-added services. Some of the IN services are Free Phone Service, Card Calling Service, Number Portability Service, Premium Rate Service, Universal Access Number Service, Universal Personal Communication Service, Televoting Service, etc. The service specific software is separated from the Basic Call Processing and is run on the Service Control Point(SCP) and Service Management System (SMS) manages functions of the IN system[6].

III. MTSO

MTSO organizes and controls the activities of the call sites which are connected to mobile switching centre (MSC). Main function of MSC is to route mobile phone calls. MTSO interconnects mobile telephone with land telephone network and provides mobile customers with services like direct dialled mobile-to-mobile, mobile-to-land, and land-to-mobile calling [7]. It contains communication trunks to connect base stations and the PSTN.

As shown in figure.4, Home Location Register (HLR) and Visitor Location Register (VLR) are two databases located within the MTSO. Primary job of HLR is documenting personal information about the users of the mobile network. VLR temporarily holds the information for the user. Authentication Centre (AC) in MTSO use for security purpose, it verifies the mobile user and encrypt all wireless communication between the phone and the network. The Equipment Identity Register (EIR) keeps a record of blacklisted mobile phones [8].

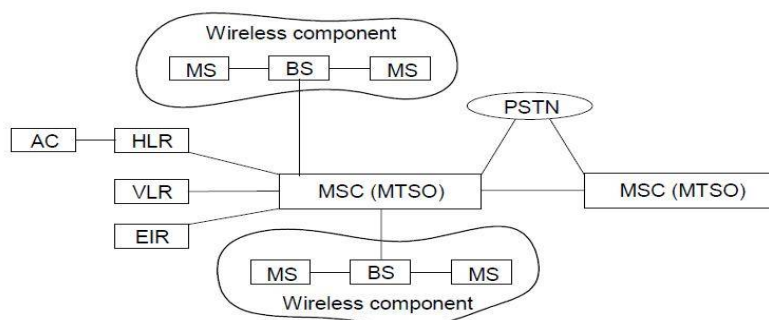


Figure.4 Basic Network Architecture

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IV. CELL-SITE EQUIPMENTS (CSE)

Distribution of cellular network over land area called cells. Hexagonal cell shape is perfect over square or triangular cell shapes because it cover an entire area without overlapping and any regional gaps. As shown in figure.5 each and every cell has its own transceiver or cell-site or cell tower to serve. A cell site or cell tower contains antenna and electronic communication equipments. Tower or other high places prefer to locate these equipments to cover a targeted cell area.

Transceiver is single device with an integral transmitter and receiver in one unit. It functions as locating receivers and provides simultaneous two- way voice and data communication between the cell site and subscriber's mobile telephone [9].

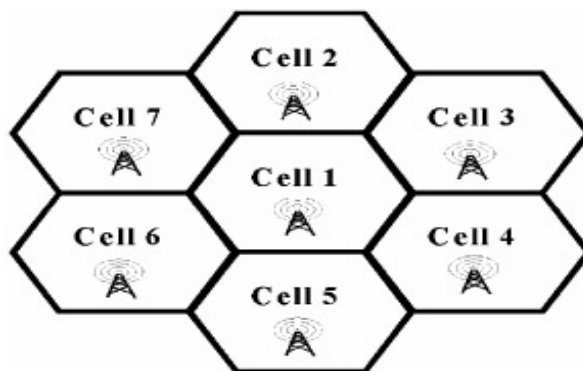


Figure.5 Large Cells with Omni directional Antennas

V. MOBILE SUBSCRIBER UNIT (MSU)

The mobile subscriber unit consist of a control unit and transceiver that transmits radio transmissions to a cell site and receive from cell site. Unit radios nearest cell site and when it turns on, it sends a message via radio that's picked up by the antenna on cell site.

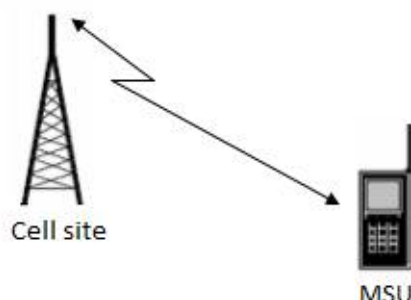


Figure.6 Transmission between MSU and Cell site

MSU are devices like mobile phones, WLL phones, computers with wireless internet connectivity, Wi-Fi and Wi-MAX gadgets etc. They use network that of any of the wireless communication technologies like GSM, CDMA, WLL, WAN, Wi-Fi, WI-MAX etc [10].

V. CONCLUSION

This paper introduces main parts of cellular communication system and their functions. PSTN, MTSO, CSE and MSU plays vital role in cellular system. PSTN is public telephone network uses wired medium to carry voice data.



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Transmission, switching, signalling and intelligent networks are the integral part of Public switched telephone network. MTSO contain switching equipments and provides the interface between the cellular mobile system and the land telephone network. In cellular system each hexagonal shaped cell has its own cell tower to locate users and it contains transceiver for two way communication between cell site and user. Mobile Subscriber Units are the equipments use various network of wireless communication technologies. It transmits and receives radio frequency signal to and from cell site.

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BIOGRAPHY

Dr. Abhijit Mitra obtained his Phd in ECE from IIT Kharagpur. He was faculty member of IIT Guwahati till Dec. 2011. Presently, he is the director (R&D) of CIT Ranchi. He has received education and research related awards, including Young Scientist award by URSI. His broad area of expertise includes signal processing and wireless communications.

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