Basics of SIM Card: Technical Overview

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ABSTRACT: Technical overview on the basics of SIM card is presented in the present article. Physical size, electronic parts and operating system of SIM card are discussed in simple language, so that beginners can understand it. The functions of flat pin connector of SIM as well as the power management section are also discussed. The role of microcontroller as well as different type of memories is also presented. This article is helpful to the beginners in the field of mobile computing and trouble shooting.

KEYWORDS: SIM, flat connector, inside SIM, SIM memory.

I. INTRODUCTION

SIM card is a type of smart card similar to the credit or debit card. SIM stands for Subscriber Identification Module and it is just like an identity card of subscriber. It is supplied by service centre of SIM service provider companies like idea, airtel, etc. These service centres provide SIM card after subscriber's identity verification. The verification includes checking of UID number and biometric finger print analysis. A nominal fees is charged by the centres as the cost of card and its activation. Subscriber should have a mobile handset at the time of activation of SIM card. [1]

SIM card contains unique information that identifies the specific mobile network, which allows the subscriber to use the communication features of the mobile handset. The memory of SIM card stores following: international mobile subscriber identity, personal identification number (PIN), network specific data like carrier frequency channels, short message (SMS), contacts and last dialled numbers.

Work carried out in the present paper includes detail study of SIM card and its role in the mobile communication. Technical study of inside of SIM card that is the electronic circuit enclosed in it is carried out for understanding its applications. The main parts of the system i.e. processor, power management unit and the flat connector are studied at the basic level. Evolution of SIM card from first to fourth generation is also included in the present work. The function of operating system in SIM for the authentication, power management, network connectivity, and subscriber's services are studied. The shapes and sizes of SIM card are presented with the help of illustrative diagrams.

II. SHAPE AND SIZE OF SIM CARD

Shape of SIM card is rectangular with some thickness and a cut off corner to help prevent incorrect insertion into the handset. It is made up of plastic with flat metallic connectors on its one side and size of erasable memory is printed on the other side. Its shape is shown in figure 1a. [2] Shape of card is described by form factor (FF). SIM cards have emerged in different forms over the year, at first their size resembled credit card, these SIMs were used in older handset, whereas now a days, Nano SIM is used in smart phones as shown in figure 1a and 1b. The physical dimensions of SIM card are given in table 1. Demand of different sizes is due to the available SIM card holder socket in the mobile handset.

Figure 1(a): Shape of SIM card   Figure 1(b): Sizes of Mini, Micro, Nano SIM cards

Table 1: Size of SIM card

Name of SIM	Form factor(FF)	Size in mm(length x width x height)	Use	Launched year
Full	1	85x53x0.76	Obsolete	1991
Mini	2	25x15x0.76	Old mobile handsets	1996
Micro	3	15x12x0.76	Smartphone	2003
Nano	4	12.3x8.8x0.67	Smartphone	2012

III. INSIDE OF SIM

Inside of SIM card contains an electronic circuit which is printed on plastic paper. Now a day it is called universal integrated circuit card (UICC). The electronic circuit is a small capacity processor system on paper (SoP) that contains everything required for low level programming except for power-ON reset and clock circuit. Figure 2 shows a processor with some specifications that is used in SIM card. Processors used in various generations of SIM card are given in table 2.
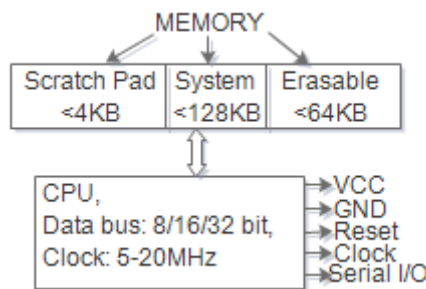

Figure 2: Generic block diagram of microcontroller/ processor of SIM card

Table 2: Type of processors in SIM card

Generation of SIM	Speed kbps	Technology	Type of processor
1	2.4	Analog	8 bit/CISC
2	9.6/14.4	TDMA	8 bit/CISC
3	500/700	CDMA	16 bit/CISC
4	3000/5000	WiMAX LTE	32 bit/RISC

The processor is a small integrated circuit which is read by the mobile which it is inserted in. Memory of it contains the unique identification number, phone number and other data that is specific to the subscriber. The modern processor contains all the units that are required for execution of SIM operating system (OS). They contain ALU, three types of memories and input output ports. To execute the OS program three types of memories, i.e. system, scratch-pad and erasable memories are required. System memory stores the OS program and constants; scratch-pad memory is required for storing intermediate results and for the implementation of stack. Erasable memory is used to store information of subscriber such as mobile number, phone directory, etc.

IV. MICROCONTROLLER BASED SIM CARDS

The most important part of the SIM card is its microcontroller. It is a paper sized system on chip (SoC) which has peripherals necessary for executing the code required for providing the services to the subscriber. Peripherals include ROM with size between 64 KB to 512 KB, RAM size ranges between 1KB to 8KB while the EEPROM size is in between 16KB to 512 KB. The ROM contains the operating system for the card, while the EEPROM contains data called personalization that includes international mobile subscriber identity, contact table, SMS management, etc. The operating voltage of SIM may be either, 1.8V, 3V or 5V and the maximum clock frequency is upto 20MHz.

SIM card is used in a mobile handset which is a battery operated device. Optimum use of battery is necessary for longer duration use of mobile phone. Same battery supplies current to the SIM card through two pins of flat connector.SIM card should draw less amount of current from battery when the card is idle or not in use. Card has provision for this by use of power management unit for the functions: detection of idle state, to activate standby and sleep mode. Figure 3 shows a typical block diagram of complete electronic system used inside the SIM card.
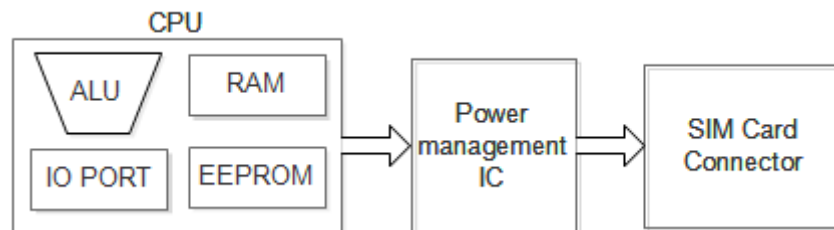

Figure 3: Typical block diagram of system unit of SIM card

V. COMMUNICATION BETWEEN SIM AND HANDSET

SIM card is a removable part of mobile handset and it is independent of type of handset. Connection between them is established by serial communication technique. Only one I/O pin is available on flat connector of SIM. Both input and output data transfer take place through this pin. This two way communication is called duplex but since it is through one wire it is commonly called half duplex. The rate of data transfer is either 9.6or 500 kbps for old and modern SIM cards respectively

VI. SOFTWARE IN SIM CARD

The OS program in either C, assembly or JAVA is written and stored in the system memory of SIM for following purpose.
1. Manage subscriber's data: identity, phone number, network authorization data, contact list, text messages.
2. To secure the subscriber's data by authentication by encryption techniques.
3. Monitor activities like authentication, call management, etc.
4. Control activities like power management.
5. Memory management.
6. Data communication.

VII. CONCLUSION

SIM card is very complex device, so the beginners find it difficult. Here, we have tried to explain it in a simple language with the help of some illustrative diagrams. Authors have attempted to explain meaning, purpose and

application of SIM in lucid language. The inside of SIM that is microcontroller chip and its peripherals are discussed with their typical range of values. The article is for beginners and it covers some basic introductory parts. Authors have plan to present advances and future of SIM in the next article.

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