DENSITY DETERMINATION IN MOBILE NETWORK USING CLUSTERING CLASSIFICATION

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Abstract-**The quality service in the mobile network is achievable via expanding or sharing the existing mobile infrastructure. The expandability or share ability of the mobile network is to be determined through some valuable measures based on its utilization on cluster basis. Here the cluster denotes a specific region of the single base station of mobile network and based on the analysis and the adoptable optimal solution density level is to be calculated. The observed results are represented and critically evaluated, to achieve effective and quality service to the mobile users via, sharing or expanding the mobile infrastructure which includes the future enhancement and the limitations.**

I INTRODUCTION

This research is initiated to determine the share ability and expansion of Mobile network infrastructure according to the usage of the mobile users in a region. In the current system this decision is considered based on the geographical analysis method instead of utilization method. This research work is initiative to adopt the policy changes to share the infrastructure in mobile network .The mobile network service providers can expand their infrastructure to provide effective services for various mobile service providers in India to provide mobile service. Every service provider have invested huge amount to create infrastructures from their earnings. Therefore the service cost is more to the mobile users. To reduce the mobile service cost and to provide the quality mobile service to the users, the Government of India has initiated infrastructure sharing policy in the mobile network. To determine the expandability or creation of infrastructure facilities is based on geographical and utilization services.

Hypothesis provides the reachable target and its expected impact. The proposed research methodology is the guide line to carry over the research and determine the decision making tool for mobile network expandability or share ability.

Infrastructures can be expanded or shared to the efficiency of mobile network services. A tool is required to take decision on expansion or creation of new infrastructure integration of geographical location and mobile service utilization.

A. Objectives

The research is initiated with the following objectives.

a. Find out the number of users utilizing the specified network for their mobile services.
b. Determine the density level of the users in a selected cluster.
c. To determine mobile network utilization services and its efficiency for access ability and share ability using clustering and K- neighborhood concept
d. Evaluate the density level according to mobile number specification to suggest a decision support tool for expandability or share ability.

B. Hypothesis

The density determination will provide a tool for decision making on the expandability and share ability of the mobile network. The established mobile network infrastructure provides an effective and quality data service to the mobile users and will increase the business potentiality.

C. Methodology

In this research, the researcher adopts the scientific research methodology which contains the following steps:

a. The problem is described with its integrated factors.
b. Analysis the existing scientific technology which involves concepts, algorithms and derived solutions.
c. Design the density determination method using existing available scientific concepts and algorithms.

d. Develop the model according to the design.
e. Observe the results and the critical evaluation for the same.
f. Specification of its limitation and further enhancement.

D. View of Mobile Network

India is wide geographical land scale with huge population. The technology growth must be reachable and accessible to all the citizens of India. To make sure the mobile service access ability to the users the infrastructure facility to be created by the service providers. The service providers are establishing their infrastructure individually, to make sure the quality mobile service to the mobile users which includes data transmission, high density signal and mobile enabled services etc., the infrastructure expansion or creation involved in two factors

a. Use ability
b. Access ability

a) Use ability

It is a measure how the infrastructure is utilized towards the business. How many users are using or sharing the infrastructure will directly create an impact in the business revenue. The numbers of users are determined based on the technological availability. The new infrastructure establishment will determine depends on the number of users accessing the available infrastructure. The numbers of users are more the infrastructure access to be expanded or shared. If the number of users is less the infrastructure is not utilized at the maximum. To overcome such a issues this research is initiated.

b) Accessibility

The mobile user's quality services are measured through the mobile users Access ability of infrastructure. Access ability means that establishing high density connection with the mobile service network and the access able device. If the high density transformation signal occurs then the quality data transformation is enabled otherwise the quality services are uncertainty. The Access ability measures create an impact on quality data service. To provide effective access ability the cluster based analysis and K- neighborhood mathematical concepts are adopted in this research. It will provide an effective access able environment for the quality data service among mobile user and mobile network.

II. NETWORKING ALGORITHMS

The clustering algorithm and density determination methodology is specified and the mobile operations and its conceptual algorithms also represented. To understand the mobile communication system and its functionality the call processing methods and the operation pseudo code represented

The K-Neighborhood algorithm is also represented for the predicative move of the mobile device from one cluster to another cluster based on high density signal availability which leads to determine the density of the cluster.

A. K-Means Clustering

K-means (MacQueen, 1967) is one of the simplest unsupervised learning algorithms that solve the well known clustering problem. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters (assume k clusters) fixed a priori. The main idea is to define k centroids, one for each cluster. These centroids shoud be placed in a cunning way because of different location causes different result. So, the better choice is to place them as much as possible far away from each other. The next step is to take each point belonging to a given data set and associate it to the nearest centroid. When no point is pending, the first step is completed and an early groupage is done. At this point we need to re-calculate k new centroids as barycenters of the clusters resulting from the previous step. After we have these k new centroids, a new binding has to be done between the same data set points and the nearest new centroid. A loop has been generated. As a result of this loop we may notice that the k centroids change their location step by step until no more changes are done. In other words centroids do not move any more.

Finally, this algorithm aims at minimizing an *objective function*, in this case a squared error function. The objective function

$$J = \sum_{j=1}^{k} \sum_{i=1}^{n} \left\| x_i^{(j)} - c_j \right\|^2 ,$$

where $\left\| x_i^{(j)} - c_j \right\|^2$ is a chosen distance measure between a data point $x_i^{(j)}$ and the cluster centre c_j, is an indicator of the distance of the *n* data points from their respective cluster centres.

The algorithm is composed of the following steps:

1. *Place K points into the space represented by the objects that are being clustered. These points represent initial group centroids.*
2. *Assign each object to the group that has the closest centroid.*
3. *When all objects have been assigned, recalculate the positions of the K centroids.*
4. *Repeat Steps 2 and 3 until the centroids no longer move. This produces a separation of the objects into groups from which the metric to be minimized can be calculated.*

Although it can be proved that the procedure will always terminate, the k-means algorithm does not necessarily find the most optimal configuration, corresponding to the global objective function minimum. The algorithm is also significantly sensitive to the initial randomly selected cluster centres. The k-means algorithm can be run multiple times to reduce this effect.

K-means is a simple algorithm that has been adapted to many problem domains. As we are going to see, it is a good candidate for extension to work with fuzzy feature vectors.

B. Mobile Operational Algorithms

a) Call Processing Algorithms

The system supports unlimited number of agents groups and service access numbers that allow organization of any number of services in one system. Several types of call processing algorithms are implemented. One access number can be used to route calls to several agent groups. In this case, usually, all calls to dedicated access number are routed to a single virtual preliminary group, after which they can be readdressed to other groups (functional sectors) within the same service depend on predefined routing criteria and call conditions.

b) PSTN Incoming Call Processing Algorithm

After the incoming call is accepted by the system, the Automatic Call Distribution Subsystem processes this call according to the following scenarios: If there are agents available in the group, the call is routed directly to the workplace of the agent, using call distribution algorithm specified for this service; If there are no agents available in the group, the call is queued.

If an IVR configured for this service, call is transferred to the IVR subsystem. After a dialog with IVR, call can be switch immediately to the workplace of an agent (if necessary); if there are no free agents available in the group, call is transferred to the queue of agent group.

The caller can receive some information while waiting (advertisement information about company services as well as number in the queue and approximate waiting time).
Call routing to the desired group is based on the service access number dialed by the caller, on the information received from the dialog of the caller with the IVR system (by tone dialing), and/or on the Caller ID.

c) Call processing Algorithm for Telephone Switchboard Mode

PROTEI Call Center can operate as a telephone switchboard according to ex-USSR countries rules for long distance semi-automatic service providing:

- Order reception for long distance calls for immediate or for delayed execution;
- Long distance call order execution by an call center agents: manual number dialing, A- and B-party switching, speech quality control;
- Supporting wide range of order parameters: order execution time, call to one of the ordered numbers, serial calls to all ordered numbers, call with preliminary notification, calls with limited duration etc.;
- Providing information about the number of called party and about tariffs to the selected destination;
- Main difference between standard agent terminal software and switchboard agent terminal software is that switchboard agent has an opportunity simultaneously to serve up to 10 calls, to supervise any particular call state and speech path quality check after subscribers A and B are switched on.

If called party is unavailable at the time of order execution, order can be postponed and processed later. When receiving and processing orders, the system automatically logs information such as caller ID, request reception time, and the ID of the agent who received/serviced the request.

d) VoIP Call processing AlgorithmVoIP

Protei IP Call Center allows access to its services when accessed via Internet using VoIP technology.

e) Callback Features

Callback mode provides a powerful feature to accept incoming calls or any other call orders (e.g. E-mail) without necessity to queue them immediately, with subsequent callback to order originator by a free agent. This feature dramatically increases call processing service level and gives a unique possibility not to lose incoming call even when all agents are busy and group queue is overflowed.

There are three algorithms for accessing this feature: requesting a callback from a dialog with IVR, requesting a callback from the Web site or automatic callback order placement when group queue overflowed.

When requesting a callback from the Web site, the client fills out a form specifying the approximate time for callback, type of communication, and the contact phone number. This information can also be entered via IVR menu.

The callback order is queued and processed similar to outgoing call.

f) E-mail Requests Processing Algorithm

A quick response to large number of E-mails increases the overall efficiency of the company business and the quality of servicing its clients.

Access to resources of the contact center via E-mail can be obtained in two methods:

- Sending a letter to the company's E-mail address;
- Filling out a special form on the Web site.

g) Outgoing Call Processing Algorithm

One of the Protei Call Center features is a built-in predictive dialing subsystem. This subsystem is very useful when it is necessary to process large volumes of outbound traffic. List of numbers to be dialed can be generated automatically, by call center personnel, or by external information systems depending on the particular applications or business cases.

The system automatically initiates calls from the generated active lists, determines the state of the line (Busy, No Answer, Fax, or "Live" Answer). When the subscriber answers, the line is switched to a currently available agent (optionally to the IVR).

h) Queuing

To ensure the best quality of incoming calls servicing, Protei Call Center supports flexible call queuing. When there are no available agents in an agent group that should process the call according to call center configuration, the call is queued.

Each group of agents works with its own queue.

The system continuously monitors the length of each queue. If the length of the queue exceeds a threshold established for this group by maintenance personnel, the caller receives an IVR notification and then is disconnected.

i) Voice Prompts

A flexible system of voice prompts provides possibility to use its own prompt set for each queue. In the Protei Call Center the following prompts could be defined for agent group:

- Service Welcome message;
- Prompt before call queuing;
- Prompt during call is in the queue;
- Prompt before call will be distributed to an agent;
- Agent welcome message;
- Prompt that will be played when group queue is overflowed;
- Prompt that will be played when service access is restricted for this subscriber (in case of black list is used for particular service).

Prompts can depend on time of the day and day of the week. Average queue waiting time is calculated in Protei Call Center to inform calling subscribers.

This parameter is calculated on the base of the following parameters:

- Number of calls in the queue;
- Average answer handling rate;
- Waiting time of the earliest call;
- Number of current agents;
- Number of available agents.

j) Call Routing

To optimize call processing the Protei Call Center supports flexible routing algorithms. Specific algorithm being defined for a particular agent group depends on the analysis of the purposes of a particular contact center.

Depending on the parameters set by the system administrator, calls can be routed to different agent groups and different agents in the group; subscribers can listen to music, information, etc during waiting in the queue. The following criteria affect call routing:

- The number dialed (service access number);
- Time of day and day of the week;
- Caller ID;
- Digits dialed by the caller during the dialog with IVR;
- Number of agents in the agent group;
- Number of available agents in the agent group;
- Number of calls in the queue of the agent group;
- Number of high priority calls in the queue of the call center (if used);
- Calculated waiting time in the queue of the agent group.

Different combinations of these parameters allow to create very flexible call routing algorithms. For example, dedicated agents may process calls from VIP subscribers immediately.

k) Calls Distribution Algorithms

Three main call distribution algorithms are used:

- Round-robin call distribution (i.e. any available agent handles the call);
- The "longest available" agent will be chosen for next call (i.e. the agent that will handle the call from the queue is chosen depending on the time, during which this agent was free from servicing calls, based on the following two parameters: time free from servicing clients and the agent's qualification);
- Choice of the least busy agent (i.e. the call from the queue is handled by the agent, characterized by the least load level. Either the total conversation time or the total number of calls handled by the agent can function as the criterion for the choice. This algorithm can be modified to include the agent's qualification as another parameter.

In addition, calls from several subscribers can be addressed directly to a particular agent. Usually such scheme is used for high priority calls from VIP subscribers.

C. Agents Features

The system supports several agent groups. A group can include one or several agent workplaces. Each agent in the system is identified by a unique number (ID) and password. Special software is installed at the agent workplace and allows the call center agent to:

- Register in a desired group at any workplace under their unique ID;
- Accept incoming calls from PSTN and the Internet (VoIP);
- Make outgoing calls;
- Put calls on hold;
- Consult (second call);
- Transfer calls to another group/senior operator (supervisor)/external line;
- Make call recording;
- Exit the call servicing mode temporarily (console blocking);
- Force disconnect calls;
- Get access to the Call Center and CRM databases while processing calls.

During an incoming call, information about the caller is displayed on the agent's workplace. Flexible API is supported in Call Center agent terminal software for integration with external application (i.e. CRM systems).

G.711 and G.729 audio-codecs are supported in agent terminal software.
To provide high level of call processing quality a special feature is implemented in the Protei Call Center: Call forwarding When Agent Does Not Answer. This feature will forward the call from the console of the agent who does not answer it during specified time interval to the same group of agents (for example, this situation could happens if the agent leaves his workplace without terminal blocking that system still considers the agent available for receiving calls).

In order to avoid another "no answer" situation, the agent's workplace is blocked until the agent returns and unblocks his workplace. Call Center supervisor also will be notified about this event.

D. Call Forwarding

Call forwarding is an additional feature that could be used to change routing rules for particular agent group temporarily.

The following types of call forwarding are supported in Protei Call Center:

- Unconditional forwarding to a group/IVR;
- Forwarding when a group queue overflow;
- Forwarding if a group is administratively blocked;
- Forwarding if no agents are available in a group.

E. Call Monitoring and Recording

To provide an effective tool to control the call service quality and to save necessary voice information for further use a powerful call monitoring and call recording subsystem is implemented in Protei Call Center.

Special features of this subsystem allow the supervisor to perform effective control of the call accepting and servicing process. Two control modes are available:

- Participation in the conversation of the agent with the caller (only listening or listening with subsequent call interception);
- Recording the conversations of the selected operators with subsequent playback from the supervisor console. Conversations of up to 100% of the Call Center agents can be recorded simultaneously.

o) Statistics and Call Logging

The efficiency of a Call Center depends on the character of load, number of operators, tasks of the Call Center, and many other factors. Only continuous monitoring of the Call Center operation can provide detailed information about traffic parameters and Call Centers functioning efficiency. A powerful statistics and call logging subsystem implemented in Protei Call Center can ensure optimal distribution of the Call Center resources, and allows to provide the best service quality level for Call Center clients.

The system can form and store a large amount of statistical data and operation logs. It can also generate real-time reports and chronological long-time reports.

The system allows very flexible manipulations with accumulated statistical data, built-in report constructor is implemented, table and graphical report generation is available.

The following main statistical values are available:

(1) Number of calls:

- Incoming;
- Outgoing;
- Released from the queue before agent answers;
- Released from the queue before agent answers with queue waiting time that is more than specified threshold;
- Correctly serviced calls with queue waiting time that is more than specified threshold;
- Average queue waiting time for successfully services calls;
- Average queue waiting time for lost calls;
- Average call duration;
- Average IVR session duration etc.

(2) Agent work parameters:

- Number of call processes during selected time interval;
- Number of calls transferred to the supervisor or to an agent with higher qualification;
- Average call duration;
- Average “after-call-time” duration;
- Average load of agent (time in percent when this agent processed calls);
- Short breaks duration etc.

F. *Administration and Maintenance*

Protei Call Center software includes WEB based administration tools that allow efficient and comfortable configuration management. By using this software tools system Administrator can configure:

- Access numbers settings;
- Agent groups settings;
- System voice prompt list;
- Voice prompts for each agent groups;
- Agents terminal parameters;

- Agent settings (personal agent settings, list of terminals allowed for this agent, etc.);
- Call routing algorithms for each agent group;
- Call distribution algorithms for each agent group;
- Call queuing settings for each agent group;
- Call forwarding settings;
- IVR scenarios;
- Caller "black lists";
- PSTN interface settings.

G. Architecture, Scalability and Reliability

The solutions used in both the hardware and software design of Protei Call Center comply with the requirements for the carrier class real-time systems.

System has a horizontally scalable architecture that allow system capacity growing according to the operator needs. Each type of system modules could be reserved. Several modules of the same type could work in traffic sharing mode.

I. Calling Card System

a)Prepaid Calling Card System

Protei Prepaid Calling Card System is a powerful and flexible carrier class solution that gives a wide range of possibilities for prepaid services implementation to a service provider. System is intended for providing access to a range of telecommunication services (local, long-distance, and international telephone calls, VoIP Calls, dial-up access) by using prepaid calling cards. Any subscriber can get access to such services from any telephone with tone dialing.

Protei Prepaid Calling Card System may be used by:

- Fixed telecommunications operators for providing telecommunications services on prepaid basis and for organization of Points of Presence in a network;
- Fixed telecommunications operators for modernizing existing payphone networks;
- VoIP service providers.

Providing prepaid services solves the problem of debts, and allows for a convenient way of implementing additional value added telecommunications services.
The owner of the phone card gains access to the entire range of services, regardless of where he makes a call from: home, workplace, or a street payphone.

b) Accessing services

When purchasing a card, the subscriber receives a personal identification number (PIN). To access the services provided by the card, the subscriber should dial the service access number printed on the card, wait for system welcome and after that subscriber should dial a secret number and/or PIN according to IVR prompts and – called party number. Payphones working by prepaid calling cards may use a "hotline" service or specially programmed keypad. Upon accepting the number entered by the subscriber, the system establishes connection and switches the voice channel on. When the called party answers, the system begins billing the subscriber, and the balance of his card is updated according to the current fee for the service.

The number of digits in a PIN and Secret number can vary depend on operator needs and should be set before first card series generation. The maximum PIN entering attempts is set by the system Administrator and could be changed at any time.

The card security system provides protection from attempts of unauthorized access. Upon entering the wrong PIN, the system plays a special voice message. After several attempts to enter the wrong PIN, the system can block an access to the service from this calling party number or to block this card. All failed authorization attempts are logged.

Phone cards may be rechargeable or not, may have an unlimited validity period or a certain expiry date, after which they will be blocked. Cards with automatic balance update also supported (for such cards balance can be updated regularly or upon reaching a certain threshold).

c) Billing

Calls are billed in billing units. The "account" of every card contains the actual rest in billing units. The system administrator can update the balance of a card manually.
The system supports several card categories. A list of available destinations and a tariff plan can be assigned to each category separately. Tariff plan includes set of tariff zones. Each of tariff zones includes set of destinations (called party prefixes).

Billing of the Protei Prepaid Calling Card System supports recursive destinations (i.e. 7 and 7095) that allow flexible tariff configuration. Thus, separate tariff can be set even for dedicated telephone numbers.

Inside the category tariff for the call to the selected destination could depend on time of the day, day of the week and calling party number.

The following parameters can be set for each tariff zone:

- Charging interval;Cost of connection establishment;
- Cost per minute (could be defined in currency or in units);
- Set of coefficients and tariff schedule;
- "Free-of-charge" time;
- Number of seconds before billing begins.

The ratio between currency and billing unit is established by the system Administrator and can automatically be corrected on the basis of the information from external sources.
Only successful (answered) calls are billed. Billing begins when the called party answers and ends when one of the callers hangs up, or when the number of billing units on the card of the calling party reaches zero. In the latter event, the system disconnects the call automatically.
The statistic subsystem collects the necessary information for the traffic analysis.

d) Additional features

In addition to making a call after the authorization in the Protei Prepaid Calling Card System, the card owner gets access to the system additional features. The subscriber can:

- To redial last number;
- To request Information about card balance;
- To receive information about the maximum duration of call in chosen path;
- To request directions for card use.

The system supports RADIUS protocol as an open interface for access to the prepaid card service from external applications (i.e. VoIP gateways or dial-up remote access servers).

e) Administration maintenance

The easy-to-use WEB based application provides the following features to the system Administrator:

i**) call processing scenarios management**

ii) Voice Prompts management

iii) Card management:

- Card Series Generation with required parameters (category, card volume, number of card in the series, expiry date);
- Automatic PINs generation, or their loading from preliminary generated files;
- Blocking/unblocking of card series, cards, or card sets;
- Updating cards balance;
- Changing categories for selected sets of cards;
- Generating card usage reports.

iv) Tariff management

- Setting up parameters of tariff zones;
- Viewing existing tariff zones and parameters;
- Creating/deleting/modifying tariff zones;
- Blocking/unblocking tariff zones;
- Adding schedules for tariff zones;
- Adding/removing destinations to/from selected tariff zone.

v) Destinations management

- Prefix list management;
- Viewing existing destinations;
- Creating/deleting/modifying destinations;
- Blocking/unblocking selected destinations.

vi) Statistical information viewing

- Number of incoming call attempts;
- Number of successfully entered PIN codes;
- Number of invalid PIN inputs;
- Number of outgoing call attempts;
- Number of successful outgoing calls;
- Number of successful call attempts to the selected destination;

- Total cost and total duration of calls to the selected destination during specified time interval;

Number of calls disconnected upon card credit reaching zero

After the analysis of various available clustering algorithms, the hierarchal and k-means algorithms are used for density determination process of mobile network The functionalities adopted from the protei systems mobile operations who provides the Business Processing support to mobile service provider.

III DENSITY DETERMINATION FACTORS

It describes about the problem to calculate the density level of a mobile network using clustering concept. All the technical keywords and its functionalities also represented. The mobile network concept which is related to density determination factors such as Home location register, Visitor Location register and its functional relationship is specified.

A. Decision Support System

This is the tool to determine the share ability and extend ability of mobile network infrastructure based on the mobile network utilization in a specific region using cluster based analysis which leads to provide effective quality data service from the mobile network service provider to mobile user services. To obtain this support system the density level to be observed in a specific cluster over a period of time. The density ratio to be calculated according to the observed and collected mobile network utilization data for a particular cluster.

B. Density Determination

It is a process to find out mobile infrastructure utilization level of a specific region. The density determination involves the registered user and the non-registered user. The users are classified as follows:

a. Home User: The user belongs to the same cluster.

b. Visitor: The user belonging to other clusters but utilizing the specified clustered area.

c. Registered: The users registered with the service provider and utilizing the same service provider's network.

d. Non-registered: The users are utilizing service from other than their registered service provider.

e. Others - Home: They are not the registered users of mobile network but getting the services from the specified clusters.

f. Others – Visitors: They are not the registered users of mobile network but getting the service from the clusters other than the specified cluster.

According to the above classification the users are classified as follows:

a. Home-user-registered: registered and utilizing the same network. Example: Aircel Chennai registered user communicating to the same Aircel Chennai mobile.

b. Visitor-user: registered and utilizing the same network in different clusters. Example Aircel Chennai registered user communicating Aircel network while he is traveling other than Chennai Aircel network. This is normally called as roaming.

c. Home-user-non registered: They are registered with other network and utilizing different network services. Example: An Aircel mobile communicating with non Aircel mobile in Chennai city itself.

d. Visitor–non registered: They are registered with other network and utilizing networks other than their specified cluster. Example: A Chennai based registered Aircel mobile user communicating to other users through service providers other than Aircel.

e. Home others: They are not receiving any mobile network services but connected with network through other communication system from the same cluster. Example: Aircel mobile user communicating to any land line in Chennai itself.

f. Visitor - others: They are not receiving any mobile network services but connected with network through other communicating systems from different clusters. Example: Chennai based registered Aircel user communicating to any land line other than Chennai.

g. Non – registered – visitor: Other network registered users accessing the mobile infrastructure while visiting the specified cluster. Example: non Chennai based other mobile network users communicating to the Aircel mobile network via Aircel network at Chennai.

h. Non – registered- others: Other mobile network non registered users accessing the mobile network infrastructure while visiting the specified cluster. Example: non Chennai based other mobile network users communicating to the any mobile network via Aircel network at Chennai.

In this research work the mobile users are observed based on their call transformation via, base station. Whenever the call is routed from the same network or from other network and passed through this network; it is encountered as a network utilization system. The initiated call, on going call and passing calls are taken into the account for the density determination. For this process various registers are used to determine the originality of

the call. The basic concept of mobile network system and various registers and its functionalities are described as follows:

C. Mobile Station

The mobile station (MS) consists of the mobile equipment (the terminal) and a smart card called the Subscriber Identity Module (SIM). The SIM provides personal mobility, so that the user can have access to subscribed services irrespective of a specific terminal. By inserting the SIM card into another GSM terminal, the user is able to receive calls at that terminal, make calls from that terminal, and receive other subscribed services.

The mobile equipment is uniquely identified by the International Mobile Equipment Identity (IMEI). The SIM card contains the International Mobile Subscriber Identity (IMSI) used to identify the subscriber to the system, a secret key for authentication, and other information. The IMEI and the IMSI are independent, thereby allowing personal mobility. The SIM card may be protected against unauthorized use by a password or personal identity number.

D. Base Station Subsystem

The Base Station Subsystem is composed of two parts, the Base Transceiver Station (BTS) and the Base Station Controller (BSC). These communicate across the standardized Abis interface, allowing (as in the rest of the system) operation between components made by different suppliers.

The Base Transceiver Station houses the radio transceivers that define a cell and handles the radio-link protocols with the Mobile Station. In a large urban area, there will potentially be a large number of BTSs deployed, thus the requirements for a BTS are ruggedness, reliability, portability, and minimum cost.

The Base Station Controller manages the radio resources for one or more BTSs. It handles radio-channel setup, frequency hopping, and handovers, as described below. The BSC is the connection between the mobile station and the Mobile service Switching Center (MSC).

E. Network Subsystem

The central component of the Network Subsystem is the Mobile services Switching Center (MSC). It acts like a normal switching node of the PSTN or ISDN, and additionally provides all the functionality needed to handle a mobile subscriber, such as registration, authentication, location updating, handovers, and call routing to a roaming subscriber. These services are provided in conjunction with several functional entities, which together form the Network Subsystem. The MSC provides the connection to the fixed networks (such as the PSTN or ISDN). Signaling between functional entities in the Network Subsystem uses Signaling System Number 7 (SS7), used for trunk signaling in ISDN and widely used in current public networks.

The Home Location Register (HLR) and Visitor Location Register (VLR), together with the MSC, provide the call-routing and roaming capabilities of GSM. The HLR contains all the administrative information of each subscriber registered in the corresponding GSM network, along with the current location of the mobile. The location of the mobile is typically in the form of the signaling address of the VLR associated with the mobile station. The actual routing procedure will be described later. There is logically one HLR per GSM network, although it may be implemented as a distributed database.

The Visitor Location Register (VLR) contains selected administrative information from the HLR, necessary for call control and provision of the subscribed services, for each mobile currently located in the geographical area controlled by the VLR. Although each functional entity can be implemented as an independent unit, all manufacturers of switching equipment to date implement the VLR together with the MSC, so that the geographical area controlled by the MSC corresponds to that controlled by the VLR, thus simplifying the signaling required. Note that the MSC contains no information about particular mobile stations --- this information is stored in the location registers.

The other two registers are used for authentication and security purposes. The Equipment Identity Register (EIR) is a database that contains a list of all valid mobile equipment on the network, where each mobile station is identified by its International Mobile Equipment Identity (IMEI). An IMEI is marked as invalid if it has been reported stolen or is not type approved. The Authentication Center (AuC) is a protected database that stores a copy of the secret key stored in each subscriber's SIM card, which is used for authentication and encryption over the radio channel.

IV. NUMBERING SYSTEM AND DENSITY DETEMINATION

This mobile number system is represented for the mobile architecture accesability and the mobile device Mobile Telephone numbering in India

The functionality of density determination of a base station. Have four functional areas such as Data Capturing, Representation, Classification and Analysis for density determination. The concept and the functional classification and its process are discussed

The Telecom Regulatory Authority of India (TRAI) has divided India into various cellular *zones* such that within each zone, the call is treated as a local call, while across zones, it becomes a long-distance call. A cellular zone (or cellular circle) is normally the entire state, with a few exceptions like Mumbai (which is a different zone), Goa (which is a part of the Maharashtra zone) or Uttar Pradesh (which is so big it was divided into multiple zones)

The dialing procedure for calls within a State for these States would also be simplified i.e. dialing of mobile-to mobile subscribers and fixed-to-mobile subscribers would be without prefixing '0'.

All mobile numbers in India have the prefix **9** (This includes pager services, but the use of pagers is on the decline). Each zone is allowed to have multiple private operators (earlier it was 2 private + BSNL, subsequently it was changed to 3 private + BSNL in GSM 900/1800, now it also includes 2 private + BSNL in CDMA). All cell phone numbers are 10 digits long, (normally) split up as **OO-AA-NNNNNN** where **OO** is the operator code, **AA** is the zone code assigned to the operator, and **NNNNNN** is the subscriber number.

A.) Numbering plan

92-xx-y - TATA Indicom Numbers
93-xx-y - Reliance Mobile Numbers (CDMA)
94-xx-y - BSNL Mobile Numbers
97-xx-y - Various operators except Tata, Reliance (CDMA) & BSNL
98-xx-y - Various operators except Tata, Reliance (CDMA) & BSNL
99-xx-y - Various operators except Tata, Reliance (CDMA) & BSNL

B) Mobile Phone numbers, Operator and Circle

9200	MP	9300	MP	9400	--	9700	-	--	9800	-	--	9900	A	KN
9201	MP	9301	MP	9401	--	9701	-	--	9801	-	--	9901	A	KN
9202	MP	9302	MP	9402	--	9702	-	--	9802	-	--	9902	-	--
9203	MP	9303	MP	9403	--	9703	-	--	9803	-	--	9903	A	KO
9204	--	9304	BR	9404	--	9704	-	--	9804	-	--	9904	I	GJ
9205	--	9305	UE	9405	--	9705	-	--	9805	-	--	9905	R	BR
9206	--	9306	JK	9406	MP	9706	-	--	9806	-	--	9906	A	JK
9207	--	9307	--	9407	--	9707	-	--	9807	-	--	9907	R	MP
9208	--	9308	--	9408	--	9708	-	--	9808	-	--	9908	A	AP
9209	--	9309	--	9409	--	9709	-	--	9809	-	--	9909	H	GJ
9210	DL	9310	DL	9410	UW	9710	-	--	9810	A	DL	9910	A	DL
9211	DL	9311	DL	9411	UW	9711	-	--	9811	H	DL	9911	I	DL
9212	DL	9312	DL	9412	UW	9712	-	--	9812	I	HR	9912	I	AP
9213	DL	9313	DL	9413	RJ	9713	-	--	9813	H	HR	9913	H	GJ
9214	RJ	9314	RJ	9414	RJ	9714	-	--	9814	S	PB	9914	S	PB
9215	HR	9315	HR	9415	UE	9715	-	--	9815	A	PB	9915	A	PB
9216	PB	9316	PB	9416	HR	9716	-	--	9816	A	HP	9916	H	KN
9217	PB	9317	PB	9417	PB	9717	-	--	9817	R	HP	9917	I	UW
9218	HP	9318	HP	9418	HP	9718	-	--	9818	A	DL	9918	H	UE
9219	UW	9319	UW	9419	JK	9719	H	UW	9819	H	MU	9919	H	UE

9220	MU	9320	MU	9420	MH	9720	-	--	9820	H	MU	9920	H	MU
9221	MU	9321	MU	9421	MH	9721	-	--	9821	B	MU	9921	I	MH
9222	MU	9322	MU	9422	MH	9722	-	--	9822	I	MH	9922	I	MH
9223	MU	9323	MU	9423	MH	9723	-	--	9823	H	MH	9923	H	MH
9224	MU	9324	MU	9424	MP	9724	-	--	9824	I	GJ	9924	I	GJ
9225	MH	9325	MH	9425	MP	9725	-	--	9825	H	GJ	9925	H	GJ
9226	MH	9326	MH	9426	GJ	9726	-	--	9826	I	MP	9926	I	MP
9227	GJ	9327	GJ	9427	GJ	9727	-	--	9827	R	MP	9927	I	UW
9228	GJ	9328	GJ	9428	GJ	9728	-	--	9828	H	RJ	9928	A	RJ
9229	MP	9329	MP	9429	--	9729	-	--	9829	A	RJ	9929	A	RJ
9230	KO	9330	KO	9430	BR	9730	-	--	9830	H	KO	9930	-	--
9231	KO	9331	KO	9431	BR	9731	-	--	9831	A	KO	9931	A	BR
9232	WB	9332	WB	9432	WB	9732	H	WB	9832	R	WB	9932	A	WB
9233	WB	9333	WB	9433	KO	9733	H	WB	9833	H	MU	9933	A	WB
9234	BR	9334	BR	9434	WB	9734	-	--	9834	-	--	9934	A	BR
9235	UE	9335	UE	9435	AS	9735	-	--	9835	R	BR	9935	A	UE
9236	UE	9336	UE	9436	NE	9736	-	--	9836	H	KO	9936	A	UE
9237	OR	9337	OR	9437	OR	9737	-	--	9837	I	UW	9937	A	OR

9238	OR	9338	OR	9438	OR	9738	-	--	9838	H	UE	9938	A	OR
9239	KO	9339	KO	9439	--	9739	-	--	9839	H	UE	9939	A	BR
9240	CH	9340	CH	9440	AP	9740	-	--	9840	A	CH	9940	A	CH
9241	KN	9341	KN	9441	AP	9741	-	--	9841	a	CH	9941	a	CH
9242	KN	9342	KN	9442	TN	9742	-	--	9842	a	TN	9942	a	TN
9243	KN	9343	KN	9443	TN	9743	-	--	9843	H	TN	9943	H	TN
9244	TN	9344	KN	9444	CH	9744	-	--	9844	S	KN	9944	A	TN
9245	TN	9345	TN	9445	CH	9745	-	--	9845	A	KN	9945	A	KN
9246	AP	9346	AP	9446	KL	9746	-	--	9846	H	KL	9946	H	KL
9247	AP	9347	AP	9447	KL	9747	-	--	9847	I	KL	9947	I	KL
9248	AP	9348	AP	9448	KN	9748	-	--	9848	I	AP	9948	I	AP
9249	KL	9349	KL	9449	KN	9749	-	--	9849	A	AP	9949	A	AP
9250	DL	9350	DL	9450	UE	9750	-	--	9850	I	MH	9950	-	--
9251	RJ	9351	RJ	9451	UE	9751	-	--	9851	D	WB	9951	-	--
9252	RJ	9352	RJ	9452	UE	9752	-	--	9852	D	BR	9952	-	--
9253	RJ	9353	RJ	9453	--	9753	-	--	9853	D	OR	9953	-	--
9254	HR	9354	HR	9454	--	9754	-	--	9854	D	AS	9954	A	AS
9255	HR	9355	HR	9455	--	9755	-	--	9855	S	PB	9955	A	BR
9256	PB	9356	PB	9456	--	9756	-	--	9856	D	NE	9956	A	UE
9257	PB	9357	PB	9457	--	9757	-	--	9857	D	HP	9957	-	--

9258	UW	9358	UW	9458	--	9758	H	UW	9858	D	JK	9958	-	--
9259	UW	9359	UW	9459	--	9759	H	UW	9859	-	--	9959	-	--
9260	TN	9360	TN	9460	RJ	9760	-	--	9860	A	MH	9960	A	MH
9261	TN	9361	TN	9461	--	9761	-	--	9861	R	OR	9961	I	KL
9262	TN	9362	TN	9462	--	9762	-	--	9862	A	NE	9962	H	CH
9263	TN	9363	TN	9463	PB	9763	-	--	9863	R	NE	9963	A	AP
9264	TN	9364	TN	9464	--	9764	-	--	9864	R	AS	9964	S	TN
9265	TN	9365	TN	9465	--	9765	-	--	9865	a	TN	9965	a	TN
9266	TN	9366	TN	9466	JK	9766	-	--	9866	A	AP	9966	H	AP
9267	TN	9367	TN	9467	--	9767	-	--	9867	A	MU	9967	A	MU
9268	--	9368	--	9468	--	9768	-	--	9868	M	DL	9968	M	DL
9269	--	9369	--	9469	--	9769	-	--	9869	M	MU	9969	M	MU
9270	MH	9370	MH	9470	--	9770	-	--	9870	B	MU	9970	A	MH
9271	MH	9371	MH	9471	--	9771	-	--	9871	A	DL	9971	A	DL
9272	MH	9372	MH	9472	--	9772	-	--	9872	A	PB	9972	A	KN
9273	MH	9373	MH	9473	--	9773	-	--	9873	H	DL	9973	-	--
9274	GJ	9374	GJ	9474	WB	9774	-	--	9874	*	**	9974	A	GJ
9275	GJ	9375	GJ	9475	--	9775	-	--	9875	r	RJ	9975	-	--
9276	GJ	9376	GJ	9476	--	9776	-	--	9876	A	PB	9976	-	--
9277	GJ	9377	GJ	9477	--	9777	-	--	9877	-	--	9977	I	MP
9278	--	9378	--	9478	--	9778	-	--	9878	-	--	9978	-	--
9279	--	9379	--	9479	--	9779	-	--	9879	H	GJ	9979	H	GJ
9280	CH	9380	CH	9480	KN	9780	-	--	9880	A	KN	9980	A	KN
9281	CH	9381	CH	9481	--	9781	-	--	9881	I	MH	9981	-	--
9282	CH	9382	CH	9482	--	9782	-	--	9882	I	HP	9982	H	RJ
9283	CH	9383	CH	9483	--	9783	-	--	9883	R	KO	9983	-	--
9284	CH	9384	CH	9484	--	9784	-	--	9884	H	CH	9984	H	UE
9285	CH	9385	CH	9485	--	9785	-	--	9885	H	AP	9985	H	AP
9286	--	9386	--	9486	TN	9786	-	--	9886	H	KN	9986	H	KN
9287	KL	9387	KL	9487	--	9787	-	--	9887	I	RJ	9987	-	--
9288	KL	9388	KL	9488	--	9788	-	--	9888	H	PB	9988	H	PB
9289	--	9389	--	9489	--	9789	-	--	9889	I	UE	9989	A	AP
9290	AP	9390	AP	9490	AP	9790	-	--	9890	A	MH	9990	I	DL
9291	AP	9391	AP	9491	--	9791	-	--	9891	I	DL	9991	H	HR
9292	AP	9392	AP	9492	--	9792	-	--	9892	A	MU	9992	I	HR
9293	AP	9393	AP	9493	--	9793	-	--	9893	A	MP	9993	A	MP
9294	AP	9394	AP	9494	--	9794	-	--	9894	A	TN	9994	A	TN
9295	AP	9395	AP	9495	KL	9795	-	--	9895	A	KL	9995	A	KL
9296	AP	9396	AP	9496	--	9796	-	--	9896	A	HR	9996	A	HR
9297	AP	9397	AP	9497	--	9797	-	--	9897	A	UW	9997	A	UW

Table 4.1 Mobile Phone numbers, Operator and Circle

A	AIRTEL (GSM)
a	AIRCEL (GSM)
B	BPL Mobile (GSM)
D	DISHNET WIRELESS LTD. (GSM)
M	DOLPHIN (MTNL) (GSM)
H	HUTCH (GSM)
I	IDEA (GSM)
R	RELIANCE (GSM)
r	RAINBOW (SHYAM TELELINK) (CDMA)
S	SPICE (GSM)
-	NOT ALLOTTED
*	NOT KNOWN

Table 4.2 Cellular Operator

AP	ANDHRA PRADESH
AS	ASSAM
BR	BIHAR & JHARKHAND
CH	CHENNAI
DL	DELHI
GJ	GUJRAT
HP	HIMACHAL PRADESH
HR	HARYANA
JK	JAMMU & KASHMIR
KL	KERALA
KN	KARNATAKA
KO	KOLKATA
MH	MAHARASHTRA
MP	MADHYA PRADESH & CHHATTISGARH
MU	MUMBAI
NE	NORTH EAST
OR	ORISSA
PB	PUNJAB
RJ	RAJASTHAN
TN	TAMILNADU
UE	UTTAR PRADESH(EAST)
UW	UTTAR PRADESH(WEST) & UTTARANCHAL
WB	WEST BENGAL & ANDAMAN NIKOBAR
--	NOT ALLOTTED
**	NOT KNOWN

Table 4.3 Telecom Circles

identification. The Indian number system and its classification described.

E. Concepts for density determination

The density level is calculated according to mobile users for a particular instance. A instance refers to a time factor. At particular instance how many mobile users are accessing their prescribed and assigned infrastructure, at the same time how many unassigned users are accessing the same infrastructure. The number of accessible users are treated as the total number of users in a particular infrastructure. For that particular

instance if the total accessor is greater than predefined infrastructure user capacity then the expansion is required. To provide the effective service the specified infrastructure can be isolated from other service providers. If the total number of accessor is less in comparison with the predefined infrastructure capacity then the specified infrastructure is open for share ability of other service providers user. The accessible user includes non-registered, visitor and other data transferring devices using this infrastructure for communication.

Data capturing module

Objective : Capture the specified data from the server and classify into corresponding table for the analysis purpose
Functionality : Data Capturing and classification
Users: Administrator, Data reviewer
Input : The dialer id, receiver id, call duration, type , scheme, call cost, status
Output : Classified data to be updated in the corresponding table using JDBC and SQL processing .

b) Classification of Mobile users

Objective: Determine the mobile user's utilization
Functionality: from the classified tables calculate the region, registered, non registered users summary
Users: Administrator, Data classifier
Input: The dialer id, receiver id, call duration, type, scheme, call cost, status
Output: Text based report

c) Density computation
Objective: Calculate the mobile user's utilization of particular transmitter
Functionality: from the classified tables analysis the periodical call flow, utilization time of the transmitter by the registered users, non – registered users and their summary in graphical and non graphical format
Input: transaction id, Time start, time till, number of calls from Registered users to Registered user, Registered users to Non-Registered users, Non- Registered users to Registered user, Non-Registered users to Non-Registered user, like others.
Output: Graphical and Non- graphical reports

d) Decisions Support System with various ratio analysis:
Objective: Provide Suggestion to the management with reports
Functionality: As per the report calculate the ratio for existing mobile users
Input: Frequency data, ratio values
Output: Recommendation as a Text message

Based on the above mentioned functional models the software is developed with the following specifications.

a. The mobile user's identity, call duration and related information is captured from base station server.
b. The gathered data is represented according to clustering concepts.
c. The clustered data is used to calculate the mean, mode of the base station utilization.
d. The standard utilization for the particular instance aid to determine the base station accessibility using user accessibility and capacity ratio. The graphical representation is also generated for classified users.
e. According to the ratio for different instance the decision support tool system aid for expansion or share ability of mobile network infrastructure.

V. PERFORMANCE ANALYSIS

The designed algorithms evaluated with the available data from the mobile service providers. The network optimization process involves the observation of mobile user utilization of particular base station and the utilization of the mobile network. The number of users used and access the network for the network for the particular instance of time. The density determination process achieved through the observation of mobile utilization of particular base station. The observation is a part of Mobile network optimization. Various possible optimizations, the observed result and the comets are discussed.

A. Optimization

The established network utilization is called as optimization. The maximum utilization is not applicable then we can share the infrastructure with other service providers. If the existing infrastructure not able t provide the service to all required mobile devises then the expansion is required.

Networking process will be optimized the basic utilization of network and its effective service to the users from the service providers. The network service will be optimized not only the signal availability and also the utilization of network How the network optimization is achievable through with its different stages are described below.

Comparison of different network optimization strategies

Network Stage	Network Features	Proper Network Optimization Mode
Early stage of network construction (Build stage)	Generally it refers to the first two years of network construction. (If the construction goes slowly, the period could last three to four years) In this stage, there are a small number of base transceiver stations (BTSs), but the deployment range is large. The network structure is relatively simple. Occurrence of network problems is characterized as time-based.	Before each phase of network construction or in the mid-late stage of network construction, reuse the same manpower by time to improve the manpower utilization rate. If a large number of BTSs are to be constructed in a short period, centralized network optimization is recommended.
Mid stage of development (Development stage)	In this stage, the traffic and the number of BTSs grow very fast. The network structure is the most complicated among all stages. Numerous network problems emerge. Customers are posing more and higher requirements on the network. Network quality becomes the bottleneck of development.	Concentrate the efforts on the network optimization in selected areas. The duration cannot be too long. Otherwise, the investment will be huge.
Late stage of development (Mature stage)	Network development comes to the stable stage. The network development may slow down because of the threats from new networks and new technologies. Network construction and expansion investment slow down. Network problems are large in quantity and disperse in distribution. Problem occurrence is characterized by continuity in time.	A lot of problems occur and the areas and time of occurrence are dispersive. It is recommended to balance the manpower distribution in the long term. Moderate centralized optimization is also needed owing to concentration of problems in some areas.

Table 5.1 Network Strategy

The above stages are identified as part the optimization factors.

B. Utilization level

As per the observation of available data which is provided by the ISP, the utilization percentage of a base station represented here. The base station is selected in the border of metro city which is mostly adapted to share for the visitors and where shadow density occurs.

C. Total call and Base station Service Observation

Two base station utilization data gathers and observed. Four base station data gathers and observed according to the classification. The four classifications gathered from the available data and its utilization across the network and transformation of call through data transformation. The call transfer contains the identification of ISP and the basic infrastructure with mobile device identification. The classification data as follows

Base Station	Location	Duration (days)	Total Call Observed	Home %	Visitor -reg %	Visitor -Non-reg%	others
B1	Urban	30	769875878	82	8	4	6
B2	Metro Border	30	667543687	71.67	14	7.3	7.03
B3	Rural	30	347656899	64	21	11.6	3.4
B4	Rural Border	30	387459346	68	18.67	11.4	1.93

Table 5.2 Classified Data Summary

As per the observation, the urban base station utilized at the maximum level to their register user. The rural stations are used mostly by the registered users and shared with the registered visitors.

D. Call Service and Percentage

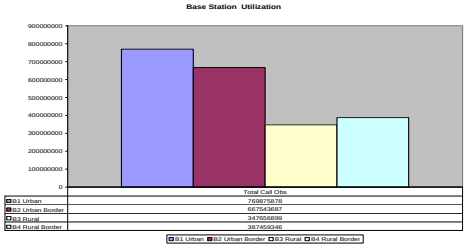


Figure5.3 Base Station Utilization Vs Total Calls

The above graph represents the base station and number of calls passed in the duration of 30 days. The calls are observed with the initiation and closing of calls and counted as a as a single call. The duration is not considered for this observation. The majority of the calls are initiated and utilized with the registered clusters. Maximum numbers of urban users are utilized effectively in the available urban base station. The urban border and the rural base stations are used in an moderate level. The rural base station used is less when compared with other urban, urban border and rural border base station. The visitors and unregistered users also observed from the data for 30 days duration. The observation is as follows:

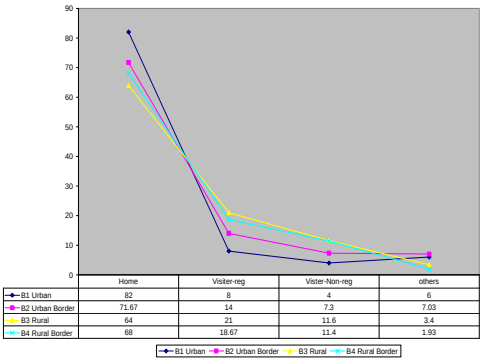


Figure 5.4 Base Station Utilization Percentages

The above graph shows the utilization of base stations which is located one at urban, urban border, rural and rural border. From the above table the total number of calls and their attributes are manipulated using clustering algorithm and determine their originality of base station utilization and it is represented in it's percentage. Out of total number of calls which is accessed from the particular base station, the classification method drives on the differentiation of home registered users, visitor registered users , home non-registered users, visited non registered and others. As per the observation all the home registered users are utilizing their service from their own service providers. In the registered area they are not accessing other service provider's support to provide any mobile service based on infrastructure but they are sharing the accessible technology on with another. Therefore in the above represented table home non-registered users are eliminated all the registered users are treated as home users and they had the privilege to access their own base station and supporting services from the registered service providers.

The above table represents the percentage utilization of visitors and their attributes. Mostly, the users are right to access the same service provider's base station while they are moving from one cluster to another cluster. Therefore, the visitor- registered users percentage is more compared with other mobile service accessors like visitor-non-registered and others. While they are moving from one cluster to another cluster the base station identifies the registered users initially then it moves to the associated registered users or collaborators. Therefore the number of users from the non-registered group and others accessing for the service station is less.

E. Density determination of the base stations

A base station has the capacity to handle specified number of mobile users at the instance of time. Over the 30 days observation the server has faced the critical service situation twice due to the following reasons

a. natural disaster
b. local festival

This observed data is gathered in the month of January .During this month local festival is celebrated at Tamil Nadu during these days the server managed with above its capacity level data transmission.

Base Station	Location	capacity	calls(1)	calls (2)
B1	Urban	1048576	1677722	1593836
B2	urban Border	1048576	1468006	1426063
B3	Rural	1048576	838861	754974.7
B4	Rural Border	1048576	796918	713031.7

Table 5.5 Critical Situation Calls

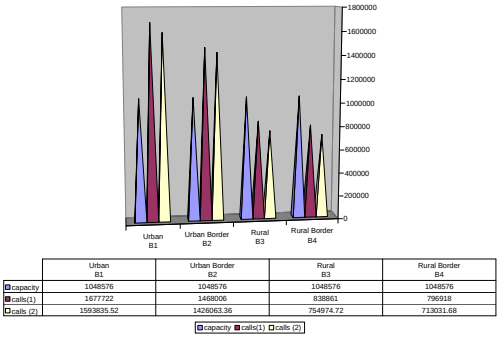
The above table represents the number of calls handled at two different occasions by the urban, urban border, rural and rural border base stations. The call (1) represents the observation of 24 hour duration during the natural disaster flood occurred in Chennai. The call (2) is the 24 hour observation of local festival (pongal).

F. Critical Situation Observation

These two occasions the server faced the critical situation towards the data transmission between the mobile users. This critical situation occurs with the following factors:

a. The numbers of mobile users try to access the servers above the capacity level.

b. More number of non-registered and outside users demands the service from the base station.
c. The queue capacity is overloaded with the request of mobile devices.



	Urban B1	Urban Border B2	Rural B3	Rural Border B4
capacity	1048576	1048576	1048576	1048576
calls(1)	1677722	1468006	838861	796918
calls (2)	1593835.52	1426063.36	754974.72	713031.68

Figure 5.6 Base Station Capacity Vs Calls

This chart shows about the based station capacity and number of calls handled during the critical position. The base station can manageable to the specified capacity. The daily routine of mobile service users are increased day by day, the number of new users also increased every day according to the cluster. The number of users is increased but corresponding infrastructure is not expanded or added. Therefore the work load of the based station capacity level is increasing. The users are demanded the services, if the bases station able to management then we can provide the effective services otherwise the service efficiency will be reduce.

G. Ratio calculation

The base station capacity and the service capacity compared. The ratio of base station utilization has to be calculated as follows

Base station Utilization ratio = Number of calls /
Base station Capacity
Base Station capacity = 1048576
Number of calls at the instance = 1677722
Base Station utilization ration = 1677722 / 1048576 = 1.6

The ratio is used to calculate to determine density and predicate the share ability and expandability of mobile base station.

Base Station	Location	Ratio calls(1)	Ratio calls (2)
B1	Urban	1.6	1.52
B2	Urban Border	1.4	1.36
B3	Rural	0.8	0.72
B4	Rural Border	0.76	0.68

Table 5.7 Call Ratio

The above table represents the ratio of call service provided by different base station on the critical situation occurs.

H. Density Determination

The ratio vales are observed over the period of time and calculated according to the data represented in the server. Where the ratio level is above one then the base station required some attention to increase the capacity. Hence the frequent ratio variance occurrence due to the demand of service from other mobile service request. The service providers register users also increased day by day the specific service efficiency also expected to be increased. But the service providers are not necessary to expand or share to specify the clustering area of the users. The ratio value indicates that the urban and urban border base station only expected to be increased. The rural and rural border base station can be shared with other service providers. These scientific approaches of calculation lead the business infrastructure utilization and increase the efficiency according t6he mobile user's utilization instead of Geographical specification.

VI. FUTURE ENHANCEMENT

A. Automation of Base station Capacity

This research work extends to determine the base station operational capacity and send the notification to the administrator to fix or share ability of service capacity to the mobile users. The number of users allotted and access and expand the service and regional based clustering can be used for further decision making tool. The base station indication used to fix the Queue handling process and fix the traffic control on the service request.

B. Determination of Operational Share ability

This research work initiated the thrust area to determine the new tool to share the assigned operations with other or near base station to provide the service to demanded mobile device. The routing process automatically divert by the controlling system to divert the unmanageable load to the near available service station with the automated software. This will provide the uninterrupted continuous standard quality service to the mobile users

C. Determination and Success of the research

This research work, the researcher observed the mobile station data flow and its operation based on the services. The gathered information represented based on the clustering model. The data classified and the cumulative result obtained for the calculation for determination ratio and density level. It is used to determine the decision for the management towards the expansion or Sharability of mobile infrastructure to the mobile users from the mobile service providers.

D. Learning's

The researcher learned the concept of Mobile network architecture and its functionality. The researcher interacted with the mobile service providers and identified the demands of the mobile service users and services of mobile service providers. The research work leads to learn the technology and its real time implementation.

CONCLUSION

In this paper we highlight on mobile network concept which is related to density determination factors. This covers the concepts of GSM mobile network and its architecture which involves in determining the usage of mobile network cluster.

The determined factors are observed from the factors and the utilization of the data which leads the management to guide for the expansion or share ability of infrastructure integrated with available users and their service utilization. Thus, the Research Analysis aid as decision supporting tool for the management and initiated the interest towards the scientific approach of visualizing the real time day to day application. This is the starting point of the research to procure research method and its implementation. The technology learning and its application process will be the continuous process that leads the research activity to the next level determining the usage of mobile network cluster.

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