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A Novel Framework for Reducing Total Cost through Reporting Cell Optimization in Mobile Computing

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Abstract

Objective: In this paper, we proposed a framework called "Reporting Cell based Scheme" where the reporting cell arrangement is a capable location management plan wherein couple of cells in the system as doled out as reporting cells, which assume the accountability of dealing with the location updating and paging methods in the system. **Method/Analysis:** The intention of dexterous exploitation of the inhibited accessible data transmission and to fabricate the limit of the network, repetition of re-use idea is established in cellular systems which encouraged in expanding the number of cells in the system. This prompted trouble in finding the position of a moveable client in the network and expansion in the signaling expense. In addition, Location management manages monitoring a dynamic movable terminal in a particular zone whereas decreasing the cost brought about in finding the movable terminal. The present position management is completed by congregating the phones in light of endorser density. The Location management measures depend on customer portability and impends the incoming call rate to a resourceful terminal, which recommends that the location management cost encloses of paging cost and location upgrade cost. Genetic Algorithm and Reporting Cell is used to reduce the total cost. **Findings**: By using the proposed framework, the requirement of enormous value is to decide an ideal reporting cell setup where the location management expense is decreased and accordingly it is keeping up an exchange off between area upgrade and paging cost. **Applications/Improvements:** The routing protocol can make of this framework in order to reduce the total cost. Genetic Algorithm is used in this framework to optimize the selection of reporting cell than the existing reporting cell methods.

Keywords: Genetic Algorithm, History Based Scheme, Location Management, Paging Cost, Reporting Cell

1. Introduction

In our day to day life the deployment of Wireless Communication has turned vital in the field of technology. At present there is no world without remote correspondence. Especially, maintaining our hub to mobile communication, cellular telephones have bowed into an unavoidable piece of man. Due to the huge development of cellular phones, the world has turned out to be so little and it is associated with each corner and alcove. The cutting edge innovation has made spontaneous cellular communication as far as affordability, excellence of service, portability, various services and reliability[1]. Along these lines, wireless cellular systems have been adjusted to portability. There is a fast exponential development in cell correspondence since years and will keep on proceeding later on. This advancement in user based communication

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frameworks is specifically identified with misuse of radio range.

Location Management[2] manages to monitor a dynamic portable terminal inside of the phone system. A specific measure of expense is brought about on finding the location of a client, as they move naturally with the location region. This expense is known as location management cost and it is exclusively qualified to the progress repetition of a portable terminal inside of a given range and the quantity of call entries to that mobile terminal. The management of system assets or creating methodologies to lessen this expense is known as Location Management[3]. There are two essential operations included with the area administration i.e. Paging and Location Update.

Location Update[4] is significant to monitor the portable client in the network scope zone and it is executed by the moveable terminal. At whatever point a portable client moves starting with one cell then onto the next cell in a specific scope region, the mobile terminal consequently sends an area redesign and demand sign to the MSC[5]. Accordingly, the mobile location is upgraded to the current dwelling cell and from that point all the strategies are made by the current living cell base station until the mobile moves to another cell.

In a situation when we receive an incoming call from a cell phone client, where the MSC routes the call to the base station wherein the portable terminal is dwelling as of now. Subsequently, the base station sends a broadcast sign to the entire mobile terminals inside of its range territory and routes the call to that portable terminal which reacts to the show signal. Thus, the ring is set between the two mobile terminals. This marvel of television is a sign to the transportable terminals inside of the scope of the base station is known as Paging (Figure 1).

2. Background Study

In Pointer Forwarding based Location Area (POFLA)[6], a portable terminal performs area renovate to the Home Area Register (HLR) every time the client traverses a Registration Area (RA) limit, in addition to that it reschedules at the past Visitor Location Register (VLR). Anyway, the numerous clients are distant from their HLRs, overwhelming the network traffic take place. The mobile anchor plan diminishes the downside by picking a nearby stay for every client. In such point the client moves starting with one RA subsequently onto the next, the mobile terminal will perform area overhaul to the nearby stay. The disadvantage of this strategy is that when the client prolongs the moving always without accepting all calls, the upgrades to nearby stay might turn out to be expensive as well.

In User Profile Based Location Area strategy (UPBLA)[7] a profile has fabricated to hoard the client's everyday data regularly. On the off vision that the customer acquires after the summary well, the passage in renovate rate is pointed. In this situation, when a call arrives to a client the paging can be actualized in each Registration Area (RA)

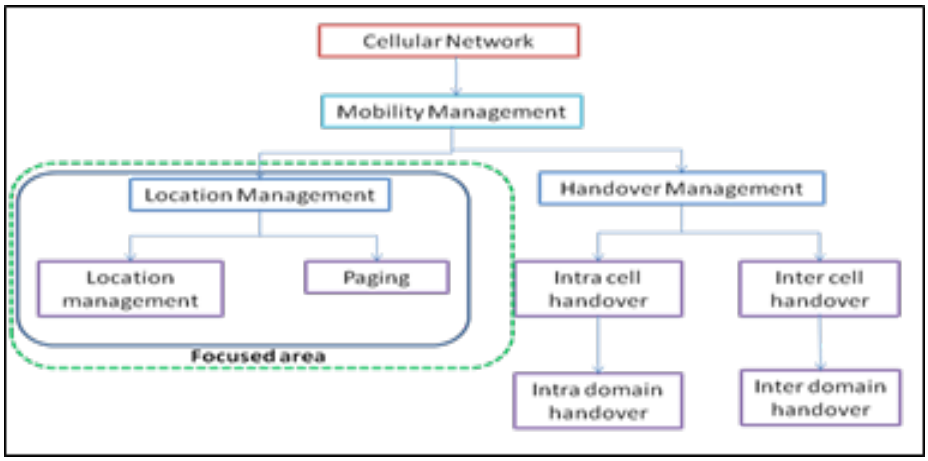

Figure 1. Cellular Network Mobility Management Model.

meanwhile, the location updating expense is reduced. On the off chance that there is any deviation from the schedule, the versatile terminal is required to answer to the new VLR each time.

In the User Mobility Pattern (UMP)[8] an example is considered and recovered call delivery and location update techniques. Here the paging deferral and traffic is additionally less. This framework can anticipate a client's future location well ahead of time if the client needs to take part in some vital applications. This can enhance the QoS extraordinarily.

In the Mobile IP Network (MIPN)[9], portable terminals that are able to modify their location in different subnets are known as Mobile Hosts (MHs). A MH has an eternal address registered in its domestic system and this IP address hangs about unchanged and able of utilized for individualizing the map-reading and classification, which consume in a Home Agent (HA). A HA is a switch in a mobile node domestic structure which is able to confine and passage the packets for the mobile node. Furthermore, it keeps up the current position of data for the mobile node. Portable IP is not a decent answer for clients with high portability. Here the area redesign expense can be over the pinnacle within the main long distance and high mobility from their HAs.

The Call-to-Mobility pRoportion (CMR)[10] is the section of the quantity of calls for finding cell phone clients over the quantity of cell limit crossing. On the off chance that CMR is less, i.e., comparatively a small number of positioning the calls to a mobile customer for each phone limit crossing, the era of a location update from a mobile customer won't bring about much sparing in the expense for finding the mobile customer. As a result of era in an location overhaul should be conceded for this case, if CMR is vast, i.e., there are countless in a cell phone clients for each cell limit crossing, the epoch of an position updating is able to diminish the position cost necessarily.

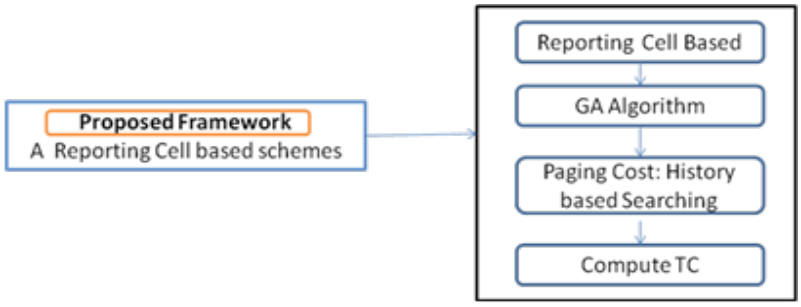

Figure 2. A Proposed Framework for Location Management for Network.

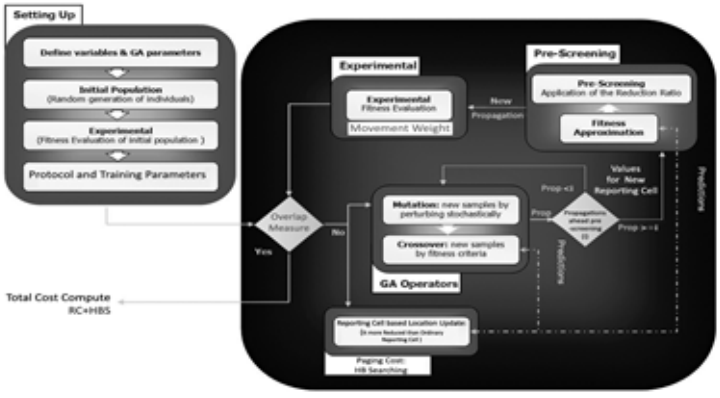

Figure 3. A proposed Framework setup using Genetic Algorithm and History based Selection

3. Proposed Framework

The Figure 2 represents the proposed framework for Location Management for Network, whereas Figure 3 gives the framework setup using Genetic Algorithm and History Based Selection. This framework is intended to beat the issues in the dynamic location management in mobile environment i.e to minimize the aggregate cost and paging expense is basically considered. The supplementary strides are included in this system.

3.1 Reporting Cell based System

Reporting cell: In Cellular system absolute system is isolated into cells. In this existing design a small number of cells are distributed in the engineering as a reporting cell and some other are non reporting cell. Finding of a best amount of reporting cells of the known design is a huge reporting the cell organizing issue. The problem is a hard optimization issue. For given cell design with N cells, the amount of feasible measures is 2N. For improvement we utilize genetic algorithm, it was produced to discover ideal solution for some optimizing issues. In this investigation, we deploy the genetic algorithm to position the best and ultimate answer for the reporting cell arranging issue. We show the outcomes got to reporting mobile arranging deploy the genetic algorithm[11]. In the previous researches, differential development, particle swarm optimization, replicated annealing and ant colony optimization were exploited for arrangement.

3.2 Genetic Algorithm

Genetic Algorithm (GA)[11] is a versatile heuristic search algorithm taking into account the organic developmental instrument of genetics and natural selection. GA is a evolutionary calculation which can discover great, conceivably ideal arrangements, to improvement issues with tremendous state spaces to be sought. It is globally probabilistic investigation method. GA is enlivened by Darwin's hypothesis about evolution - "survival of the fittest". The accompanying approaches are included in the genetic algorithm[12].

Objective Function/Fitness Function: It is likewise called as fitness capacity, is the issue for which the best/ideal arrangement is to be found. Here, our fitness function is the expense per call arriving function of reporting cell arranging issue. We will likely minimize cost per call entry and decide the ideal reporting cell set comparing to least cost.

Search Space: is the arrangement of every conceivable answer for the goal function[13]. Every arrangement has a "fitness" esteem given by the fitness/target function. In our issue articulation, for a cellular system containing N cells has an inquiry space of 2N arrangements. Every arrangement speaks to a reporting cell setup which is a binary vector of size N. A cell is represented by each bit. Bit esteem "1" alludes to a reporting cell and "0" infers a non-reporting cell.

Selection: Selection is the procedure of picking people with solid fitness esteem. Here we pick RCC arrangements which have less cost esteem. Genetic algorithm begins with a starting irregular populace, say n arrangements. Out of these arrangements, we select two in number people arbitrarily, called as parent people. The selection technique utilized is Roulette Wheel Selection.

Crossover: consolidates the two parent people to shape another off-spring. Crossover of particular point is deployed as a part of the computation here. It substitutes a division of the parent collection from an arbitrary position in the chromosomes and hence delivers two new arrangements.

Mutation changes the estimation of an arbitrary gene in the chromosomes of the new off-springs created after crossover. Changing the gene worth alludes to changing the estimation of an irregular piece in the new arrangements delivered.

Survival The fitness of the innovative genetic materials in this way created are assessed and contrasted and the wellness of the parent person. Parent people are replaced with the off-springs if the fitness of parent people is weaker than the posterity's fitness.

3.3 Algorithm Outline for Cost Minimization using Genetic Algorithm

Step 1: Random n number of RCC arrangements is created.

Step 2: The aggregate Location managements cost per call entry of each RCC arrangement is assessed.

Step 3: New RCC arrangements are made by rehashing the accompanying steps for n (number of arrangements) times:

Selection – Using Roulette Wheel selection, the RCC arrangements are chosen.

Crossover – Two RCC arrangements are chosen utilizing roulette wheel to frame new RCC arrangements.

Mutation - Mutation is performed if an arbitrary number created is more noteworthy than the characterized transformation likelihood. With a change likelihood, (taken as 0.8) the new arrangements at arbitrary cell positions are transformed in the binary RCC arrangement vector.

Step 4: Updating the RCC arrangements – If the expense of the new RCC arrangement is lesser than the expense of the past RCC arrangement, the past RCC arrangement is supplanted with the new RCC arrangement.

Step 5: If the end condition is fulfilled i.e. most extreme number of cycles, the procedure is ended and the best RCC arrangement in the updated RCC arrangement vector set with the updated cost worth is returned.

Step 6: Loop – The procedure is rehashed from step 2.

3.1 Total Cost Computation by History Based System

Here we have kept up mobility or history example of the last went by reporting cell. The renovation does not taken place as the client wanders inside of the reporting cells. The data position is renovated when the customer penetrates to a different reporting cell, which is not in the example. In this situation as the quantity of reporting cells in the history is expanded, the location upgrade expense is similarly reduced. The cost of arithmetical report can be distorted as it takes after:

NW_{mi} - The new development weight and number of reporting cells

h - Reporting cells

N_{LU} - the no of location overhauls

N_{P1} - the no of paging performed

W_{mi} - the development wt for cell i;

W_{cj} - the call arriving weight for cell j,

v(j) - the vicinity estimation of cell j;

N - the aggregate no of cells in the network, and

S - the arrangement of reporting cells in the system

$$N_{LU} = \sum_{ies} NW_{mi} \quad (2)$$

$$NW_{mi} = W_{mi} * \frac{(S-h)}{(S-1)} \quad (3)$$

$$NW_{cj} = W_{cj} * \left[\frac{NW_{mi}}{W_{mi}}\right] \quad (4)$$

$$N_{Pi} = \sum_{i=0}^{N-!} (NW_{cj}) * V(j) \quad (5)$$

$$N_{P2} = \sum_{j=0}^{N-1} (W_{cj} - NW_{cj}) * V(j) * \frac{1}{S} \quad (6)$$

$$N_{P3} = \sum_{j=0}^{N=1} \frac{(W_{cj} - NW_{cj}) * (S-1)/S * V(j) * h/2}{Call\ Factor} \quad (7)$$

$$N_{P4} = \sum_{j=0}^{N=1} (W_{cj} - NW_{cj}) * (S-1)/S * \left(1 - 1/callfactor\right) * V(j) \quad (8)$$

If $\left(W_{cj}/W_{mi}\right) < 1$ then call factor = 1

Else call factor = $\left(W_{cj}/W_{mi}\right)$ (9)

$$N_{P'} = N_{P1} + N_{P2} + + N_{P4} \quad (10)$$

Total Cost = $C.N_{LU} + N_{P'}$ (11)

In this HBS methods, the following equation numbers gives:

(4) - New paging cost is obtained from the weights of new call arrival.

(5) – Search cost for location updated Users

(6) – Search cost for the non-updated user from the same reporting cell

(7) – Search cost for the non-updated users from the different reporting cell

(8) – Subsequent calls are given by this equation.

(10) – Total paging cost

(11) – Total cost

Here on the off chance that we keep h=1, the NWmi/ Wmi. Through mounting the h appreciate the NWmi will be lessened, subsequently the overhauling expense is diminished and the paging charge gets expanded proportionately to the h esteem.

At whatever point the client goes into the reporting cells, the versatility example is altered and does not prompt the area redesign.

At whatever point a call arrives to the client, the client might be accessible inside of the region of any of the reporting cells in the example, which builds the quantity of cells to be sought. In any case, it is just surprisingly call. The following call to the client doesn't take much number of ventures.

Table 1. Dataset For 4×4 Networks

Cell No	Movement Weight	Call arrival weight
1	452	484
2	767	377
3	360	284
4	548	518
5	591	365
6	1451	1355
7	816	438
8	574	415
9	647	366
10	989	435
11	1105	510
12	736	501
13	529	470
14	423	376
15	1058	569
16	434	361

Table 2. Input Dataset For 8×8 Networks

Cell No	Movement Weight	Call arrival weight	Cell No	Movement Weight	Call arrival weight
1	452	484	33	1357	1596
2	767	377	34	842	628
3	360	284	35	753	591
4	548	518	36	684	524
5	591	365	37	1068	486
6	1451	1355	38	951	573
7	816	438	39	519	357
8	574	415	40	624	842
9	647	366	41	245	652
10	989	435	42	584	685
11	1105	510	43	369	147
12	736	501	44	1234	987
13	529	470	45	379	816
14	423	376	46	618	937
15	1058	569	47	856	458
16	434	361	48	785	589
17	514	301	49	452	256
18	689	421	50	412	632
19	780	650	51	1047	1258
20	1205	854	52	1452	1236
21	1003	751	53	893	782
22	874	512	54	486	248
23	542	500	55	321	789
24	701	384	56	654	1032
25	321	789	57	879	1087
26	693	471	58	805	406
27	245	100	59	980	570
28	1478	369	60	740	684
29	552	348	61	654	450
30	987	1023	62	599	320
31	852	417	63	868	470
32	963	741	64	1010	585

Table 3. A Novel Framework the GA Selects Reporting Cell in Dataset Of 4 X 4 Networks

Cell No	Movement Weight	Call arrival weight
3	360	284
14	423	376
8	574	415
6	1451	1355

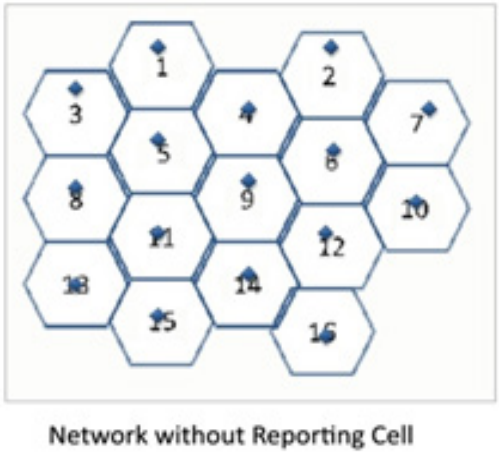

Figure 4. Network with Reporting Cell of pre-network and proposed network using RC-HBS.

Table 4. Selection of Reporting Cells for 8 X 8 Networks

Cell Number	Movement Weight	Call Arrival Weight
9	647	366
18	689	421
37	1068	486
51	1047	1258
44	1234	987
26	693	471
61	654	450

3.5 Input Dataset

The following Tables are used to feed the input represented by (Table 1 and 2):

4. Results and Discussions

The Table 3 gives the selection of reporting cell in the dataset of 4×4 network using Genetic algorithm whereas

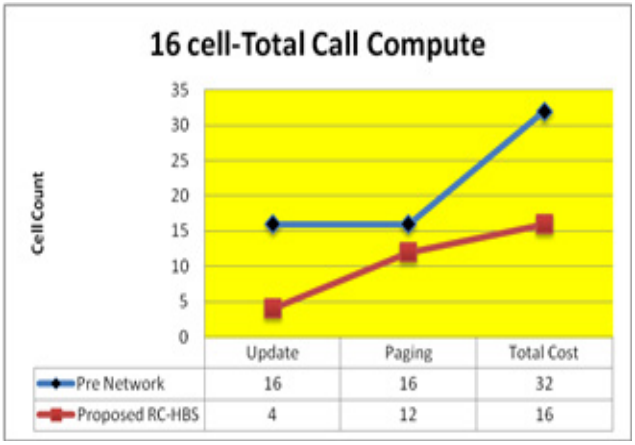

Figure 5. Total Cost Computation for 16-Cell of Pre-Network and Proposed RC-HBS.

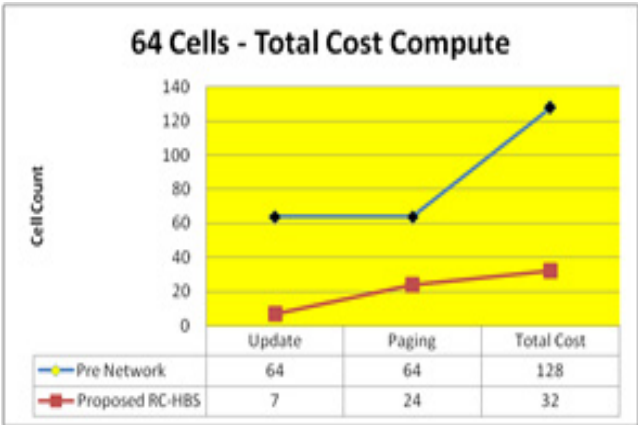

Figure 6. Total Cost Computation for 64-Cells of Pre-network and proposed RC-HBS.

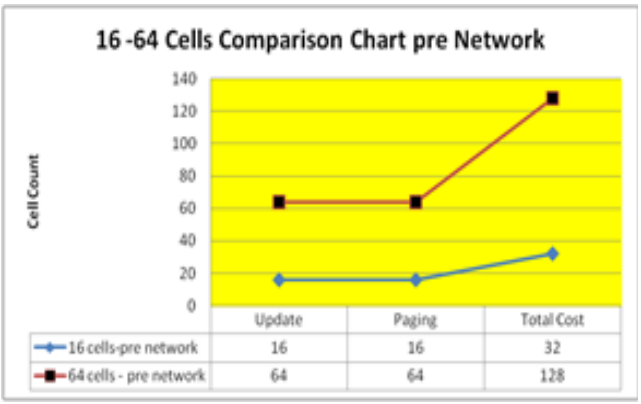

Figure 7. 16 cells and 64 cells comparison of updating, paging and total cost of pre-network.

Table 4 represents the selection of reporting cell in the dataset 8×8 networks.

The Figure 4 represents the network without reporting cell and network with reporting cell. In the Figure 5 total cost, the proposed RC-HBS requires less updating and paging than the other pre-networks, therefore, the total cost using proposed methods will be much less than the others.

The Figure 6 total cost represents the updating cost and paging cost is decreased than the pre-networks, thereby the total cost for computing will also be reduced for network with proposed RC-HBS.

From the given Figure 7 pre network and Figure 8 proposed RC-HBS represents the cost comparisons of the

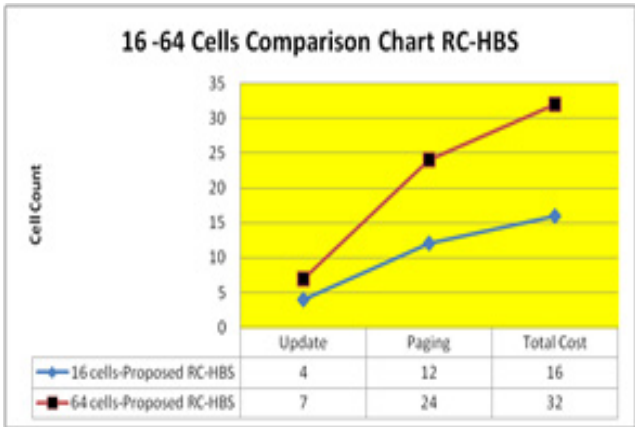

Figure 8. 16 and 64 cells updating, paging and total cost comparison of proposed RC-HBS.

network that are constructed using other already existing methods and proposed RC-HBS (Reporting Cell-History Based Schemes). In the already existing methods, the cells involved in the network is considered every cells as reporting cell, therefore the expenditure of the pre network are 16 and 64 cells. But in the proposed RC-HBS, only 4 cells from 8 cells are taken as reporting cost thereby the total cost is drastically reduced than the pre-network, where for 64 cells, only 7 cells are considered as reporting cell, so the total cost for network with proposed method is reduced than the other methods. Table 5 presents the result and discussion of the proposed framework with existing location management schemes.

5. Conclusion

From the Figure 7 pre network and Figure 8 proposed RC-HBS, it is concluded that the projected technique RC+HBS (Reporting Cell + History Based Scheme) performs well in the strategy like paging cost, updating cost and total cost than the other methods used for network construction. In the forthcoming we have proposals to widen the network range up to 32X32, the quantity of productions up to 2,000 in addition to that the arbitrary figure of data sets up to 16 cells to enhance the production. By employing the new structure in appropriate style, unquestionably it will be very functional to real time productions and able to receive the best possible outcome. The reputation of wireless system is rising gradually

Table 5. The Result and Discussion of the Proposed Framework With Existing Location Management Schemes

Methods	Result Discussion	Paging Cost
Pointer Forwarding based Location Area (POFLA)	Every time the client shifts from one Registration Area (RA) to the other, the transportable terminal will execute position update to the local anchor. The disadvantage is that while the client keeps affecting constantly without receiving any call, it keeps posting to local anchor may become expensive too[14].	The system performance has semi-fixed association with the client's call to-mobility ratio. The outcome suggest that POFLA scheme only works well for large call-to-mobility ratio and the total cost increases incessantly with the paging cost[14].
User profile based Location Area strategy (UPBLA)	In this method, the structure preserves the records of each clients mainly expected in itinerary. The prospect circulation of a client's location is known already. It can be afforded by the transportable terminal or predictable by the classification using the client's previous call history[14].	It has tight relationship with the user's call to-mobility ratio. The results suggest that UPBLA scheme only works well for very small call-to-mobility ratio and the total cost increases quickly with the paging cost[14].
Mobile IP Network (MIPN)	MPBS method could produce further updated posts than the PBS method does, it will decrease the total paging expenditure considerably and accomplish total expenditure saving significantly.	The total cost of MPBS is significantly less than PBS and the MPBS scheme is not very sensitive to the increase of paging cost.
Proposed framework model Reporting Cell Scheme	In this type of network, genetic algorithm is used to generate the cells for construction. And it generates only particular cells as reporting cell in the total number. Whenever the client is operated again in the same location then the already used reporting cell is considered. So thereby it reduces the updating cost of the client location as well paging cost.	Compared to other schemes our proposed framework model result will reduce the total cost because the number of Reporting cells is reduced and it can perform both large and small networks, it gives better performance in large networks.

because of bandwidth and mobility support. Therefore, the mobility administration is a significant feature for wireless network. In addition to that, it is not a monotonous process, but it is very simple to execute. The Location management is an essential element of mobility management and ensues to be one of the aspects that establish the recital of wireless networks. Through the incorporation of understanding with the mobility it is used to attain the fame indisputably. And also it will accomplish the future generation. In the prospect, the structure could require to administer a great deal of instantaneous data besides the positions of mobile clients. This composition could not be capable to congregate the synchronized necessities of the methods from the time when the quantity of mobile customers surrounded by a cell can be extremely energetic. The entire interruption in reclaiming the real-time data will be extremely impulsive.

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