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RESEARCH ARTICLE OPEN ACCESS

A New Paging Method Implementation in a Dynamic Cellular Network

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ABSTRACT—The challenge of location management in mobile cellular networks is significant and extremely critical. Mobility management, often known as location management, is the appropriate management of effectively locating a mobile device in a mobile computing environment. This management procedure was carried out via the location update and location inquiry, or paging, two ways. The mobile network uses a location query approach, and the mobile device uses a location update technique.Location inquiry and position update function together when a call is received from a user to determine the user's precise location. This research compares the suggested profile-based paging algorithm with the other various paging algorithms investigated by other authors in terms of bandwidth conservation and paging success rate. For the purpose of profiling mobile consumers, new genuine data from a service provider farm was used in this study, and the algorithm was validated using the user's original data. The suggested approach achieves a 2 to 8% better paging success rate and saves between 50% and 30% of the bandwidth when compared to traditional and sequential paging.

Keywords—Mobileterminal,Mobilitymanagement,Percallmanagement data (PCMD) or call data record (CDR) data, pagingtraffic,Profile-basedpaging.

I. INTRODUCTION

Locationmanagementisacrucialcomponent mobilecommunication. It means to the set of techniques that assistsin finding the exact location of the mobile device in a mobilecomputing environment. Location update and paging are thetwomainbasisoflocationmanagement.Locationupdateinforms the MSC about the current location of the device[1].PagingontheotherhandinformstheMobile Deviceregarding any incoming message. These two technologies areinter related and they share a tradeoff [2].With the decreasinglocation update frequency, the uncertainty in user's locationincreases which in turn increases the paging cost. And whenthelocationupdatefrequency increases(whichisdirectlyproportional to location update cost), there is a reduction inpaging cost as theprobability of user's location predictionincreases[3].

Location management utilizes bandwidth from the availablepool of bandwidth so although location management is verycrucial component lack of optimization of location will resultinlackofbandwidthforvoiceanddatacommunication[4].In the current scenario where service providers are strugglingto pack users into the limited amount of spectrum. Spectralefficiency is a deciding parameter. In this paperoptimizationof paging resource utilization is the matter of interest and thedifferent paging techniques in terms of spectral efficiency andpagingsuccessratearecompared[5-6].

II. CHARECTERISTIC OF PAGING CHANNEL

Paging usually managed by common control channels. Theoperation of paging channel is similar both for CDMA andGSM.All the mobile devices uses the same paging channel inthe same cell of a geographical area. The preserved power isreduced by the mobile device when monitoring the pagingchannelperiodically.Generallypagingchannel includes80ms slots out of which 32 to 64 slots present in each pagingcycle.Foraspecifiedmobile,thepagingistobroadcastinformationataparticulartimeslotinacycle[5].Identificationofthemobileisbasedonits IMSI(InternationalMobileSubscriberIdentifier)orTMSITemporary Mobile Subscriber Identifier it is provided by theBTS) or[6].

Performanceofapagingisjudgedbythreeimportantparameters

1. Pagingsuccessrate
2. Pagingdelay
3. Bandwidthrequirements

1. Paging success rate

It is determined as the ratio of successful pages to that of totalnumberofpages.Thehigherthepagingsuccessrate thebetteristhesystem.Foranoperationalvaluethepagingsuccess rate should be more than 80%. Paging is generallydone multiple times to locate the user. The value given here isthe cumulative sum of all the paging success rate. So if thepaging success rate of the 1st paging is 70% and that of thesecond paging is 20% then the net paging success rate at theend of second paging is 90%. A higher paging rate not onlyimplies a better algorithm to locate the user but also decreasesthepagingdelay[7].

2 Pagingdelay

This is another deciding factor of paging. It takes some timebetweentheinitiationofpagingrequestandthepagingrequestbeingacknowledgedbytheuser.Pagingdelayisgiven as the time difference between these two events. For abetter user experience and system stability improvement itshould be keptassmallaspossible [8].

3 Bandwidth requirements

Paging utilizestheavailablefrequency.Soan increaseinpaging load will reduce the bandwidth available for voice anddatacommunicationandwillultimatelyhamperthe GOS(Grade of service) of the system. Also considering the currentscenariowherethenumberofusersisincreasing inanexponentialmanner.Spectralefficiencyisanessential characteristic[9].

III. PAGING CLASSIFICATION

Inabroadsense,tolocateauserpagingcanbedividedintothreetypes.Thesearecategorizedasfollows:

1. Profilebasedpaging
2. Sequentialpaging
3. Blanketpaging

A. ProfileBased paging

Profile based paging is relatively a more younger idea. Likesuccessive paging it considers user probability of presencehowever alongside that it considers user behavioral examplefrom the previous. The outcome so got is a refined inquiryarea(pagingarea)thatfurtherlessensthebandwidthcapacitiesandenhancestheprobabilityofuser.Profileconstructpagingworksinlightofthewaythatclient's conduct is unsurprising in the event that we have the learningofuser'shistory.Thedifferentparametersmonitoredforprofiling the user are user movement pattern, call arrival rate,call arrival time etc. These parameters make the user behaviormore predictable. The advantage that we get out of this ismore bandwidth conservation. For instance if a user indicateslessdevelopmentinthepastthenitcanbesecurelyanticipatedthattheuser.Whereasauserwithveryhighdegree of movement indicates that the paging area need to belarge to reduce the paging delay. In this way profile basedpagingtriestooptimizethespectrumusedwhilenotcompromisingwiththepagingdelay.

B. Sequentialpaging

From the name it is understood that, in a sequential way thepaging or search of the mobile user is done one by one. In aparticularlocationareathecellsareclusteredofsmallergroups and accordingly these clusters are named as pagingareasorsearcharea.Thegatheringhavingthemostprobabilitylikelihoodoffindingtheuserispagedfirst. What's more, the consequent pages are done in a diminishingrequest of likelihood of finding the user. In this technique thebandwidthrequirementisconsiderablylesscomparedtoBlanketpagingaswearеonly paging asmall portionoflocationarea.Theonlyconcernofsequentialpagingispaging delay. As the LA is divided into small segments theprobability of finding the user comes into the picture. And thesizeofthepagingareaisdirectlyproportionaltotheprobability of locating the user. So the sequential paging hastotrade-offbetweenbandwidthconservationandpagingdelay. To lessen the paging delay the principal paging regionis made with high likelihood of finding the client. The run ofthe mill likelihood qualities are 0.90 to 0.95 for ideal pagingdeferralanddatatransmissionpreservation.Successivepaging breaks the paging load over various parts of the area.This lessens the system clogs and different issues that areconnected with show paging and makes the framework moresteady and strong.In terms of system requirements it requiresbetter computational resources to dynamically calculate theuser probability and design the Paging Area.The executionexpense is somewhat high contrasted with cover paging yetthefavorablecircumstancesitproducesare overpowering.Thisisthereasonthevastmajorityofthe administration suppliersarereceiving successivepaging slowly.Itoffers10%to20%oftheaggregate paging[10].

In this present work the described sequential paging is namedas Hypo-LA paging described in [11]. Hypo-LA paging usesthecellIDreportedinthelastknownlocationupdate todetermine the paging area. So the first paging area consists ofthe reported cell and cells in the vicinity of that cell. And theother cells are grouped into subsequent paging areas. The bestpossible dimension they found for paging region is one

BSCwhich comprises of 400 on a normal number of cells. Theperception refered to in the paper are utilized for correlationwiththe proposedpaging.

C. Blanketpaging

The most trditional and common type of paging is blanketpaging. In this type the paging is done for the total locationarea at once. This blanket paging is also commonly known asbroadcastpaging.Thepagingsuccessrateremainshighinnormalconditionbut,ahugeamountofbandwidthisconsumedinthistypeofpaging.Thereisareductioninavailablebandwidthforvoicecallsandothercontrolingactivitiesasaresult;thegradeofservice(GOS)ofthecellular system is hampered. The available channel reductionduring peak hours increasesthewaiting time and averagetime in the system for users. As the load on MSC increasescumulatively,itleadstosystemfailurefinally withhugenumberofcalldrops.So,duringpeakhoursthepagingsuccess rate is extremely low in this kind of paging.

Thesepgingsystemsarethecheapestasthesystemrequirementsareminimalintermsofimplementationcostandcomputationalrequirements.Butcurrentlyalmost80 %to90% of the paging is occurred as blanket paging or broadcastpagingdueto nonavailabilityofadvanced technology.

Inthisworkwehadproposedaprofilebasedpagingalgorithmandhadcontrasteditandcomparedwithotheralgorithms.The projected profile based calculation uses theclient's periodicity to lessen the paging load and advance theasset use. A large portion of the user carry on occasionallythat is whether you are an office laborer or an under studythen your day by day movement are very connected. Whichinfers if Friday at 11 am you are at area 'A', then there is ahigh likelihood that on the following Friday at 11 am you willbe at area'A'?Soif a call lands around10am on Mondaythentheproposedcalculationpagescell"A"firstthenalternatecells.Theproposedcalculationseparatestheseoccasional examples in user development and improves thepaging as needs be. The proposed calculation gains from theuserconductandbuildupadynamicpagingregionthatdependsonperiodicityinuser development.[12].

IV. PROPOSED ALGORITHM

A.PCMDTraces

Utilizing PCMD data the proposed paging profile the users.Here Per Call Measurement Data or PCMD also known asCDR. In MSC It is initiated for individual user and their callctivitiesarerecorded.

Abouttheuser'scallingpatternandmovementpatternis provided by this CDR data Such as Call time and date. Callednumber, Call type, Call duration, Number of events ,servedMSISDN,NetworkID ,cellIdentifieretc.

We have used these PCMD data to profile the user. Profilingwas to be able to extract the periodicity in user movement isthe main objective of the work.Here the calling tme anddate,Cell ID at the time of call and the location area are thethreemain fieldsconsidered for profiling.[12].

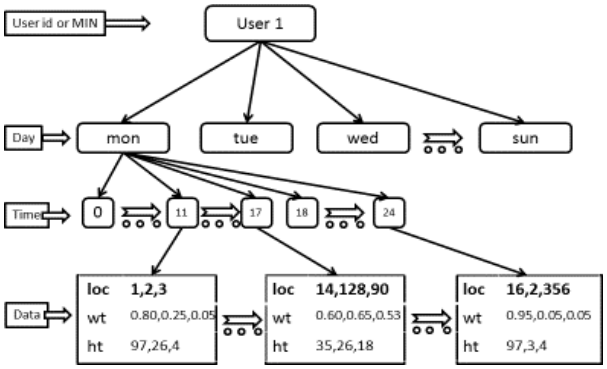

Fig1:UserProfile

The cell ID put in **Loc,** the user has moved in the past at thespecified time. **Wt**represents the weight or probability of theuser being available in that **cell ID** at that specific time. **Ht**remainsforhistory.Itrecordsthequantityoftimethe userhasbeenavailableatthesameareapreviously.Thisinformation base is upgraded at consistent interim of timewhere new cells if went to by the user are added to the locexhibit and old cells with less **Wt**qualities are expelled fromthe cell. The **Wt**vector likewise gets redesigned to portraytheadjustmentin userprobabilityafter some time

V. SIMULATION AND RESULT

A. Resultsofprofilebasedpaging algorithm

The suggested algorithm is simulated with MATLAB over aperiodof6weekswith320realdatasamples.Theobservationsthatweobtainedarerepresented below.

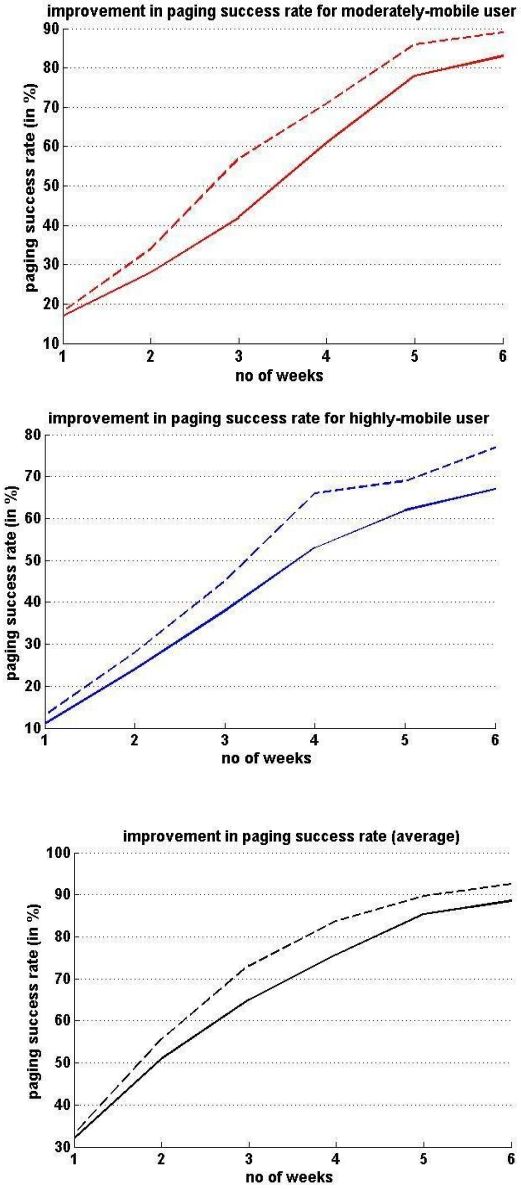

Fig2:DifferentusersPagingsuccessrate

These graph presents the paging success rate over differentweeks. The observations at the end of 6th week are presentedinthe table:

B. UserDatabaseorProfile

Theobtaineddata areplaced inaprofileasgivenbellow

Table1:PagingSuccessrateofnumberofcellspaged

Typeofuser	Numberofcellpaged		Pagingsuccessrate	
	Firstpaging	Secondpaging	Firstpaging	Secondpaging
Less-mobile	8 cells(Max)	35 cells(Max)	95%	97%
Moderately-mobile	19 cells(Max)	47 cells(Max)	83%	89%
Highly-mobile	36 cells(Max)	102 cells(Max)	67%	77%

Theobtainedresultsarecomparedwithcommonlyusedpaging techniques to show a comparative of improved pagingchracteristicsofthe proposedpagingscheme.

C. AnalysisofBlanketpagingcharecteristics

TheleadingtelecomproviderinIndiaprovidespagingcharacteristics(Blanketpaging)foracomparativestudy.Average paging success rate over different weeks are presentbelowintabularform[12].

Table2 :NumberofweeksPagingsuccessrate

Numberofweeks	Pagingsuccessrate
week1	77.13
week2	84.95
week3	80.58
week4	79.16
week5	80.75
week6	78.20

D. Paging characteristicsofHypo-LApaging

ThetablebelowsummarizestheobservationsregardingHypo-LApaging.

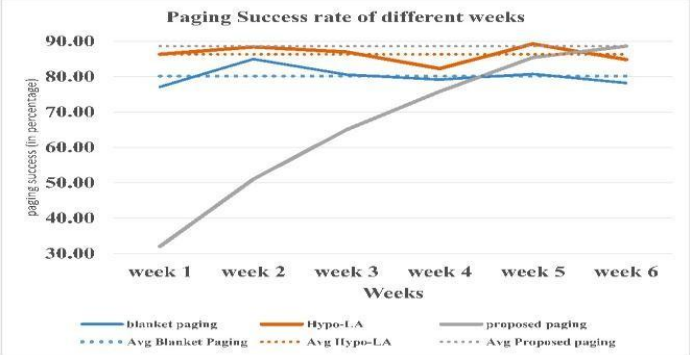

Fig3:Pagingsuccessrateofdifferentpagingindifferentweeks

Table3 :Firstand Second PagingofHypo-lapaging

	Hypo-lapaging
FirstPagingtype	TMSI
FirstPagingarea	BSC (300cellsonavg.)
1st pagingSuccessrate(in %)	85.15
Secondpagingtype	IMSI
Secondpagingarea	LA(600cells)
2nd pagingSuccessrate(in%)	91

It is conclude from the graph that higher paging success ratecomparedtoblanketpagingover6weeksachievedinsequential paging. Whereas acceptable paging success rateafterthe5th weekobtainedintheproposedpaging.Itisclearly observed that the paging success rate follows similartrendenenaftersecondpaging.

The average paging success rate is summarized in Table 4after endof6th week.

Table4:Comparisonofdifferentpaging

Typeofpaging	Paging success rateafter1st paging(Average)	Paging success rateafter2nd paging(Average)
BlanketPaging	80	85
SequentialPaging	87	91
ProfileBasedPaging	89	93

1. Intermsofbandwidthconservation

Theaccompanyingdiagrampicturestheevaluateddatatransfer capacity necessary for the distinctive sorts of pagingas bandwith requirement is specifically corresponding to thequantityofcellspaged.

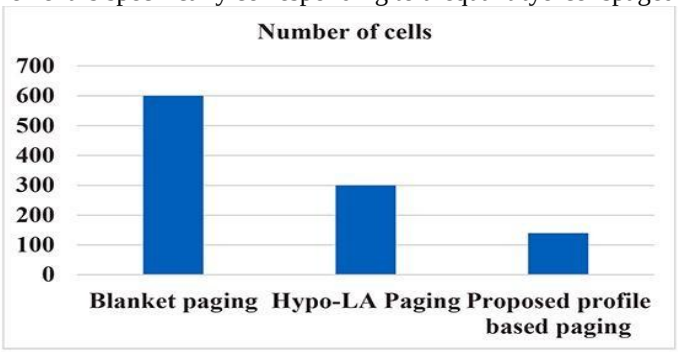

Fig4:Comparisionofpagingsuccessrateofdifferentpaging

This demonstrates the proposed paging is twice proficientwhen contrasted with the consecutive paging (Hypo-LApaging)andthreetimesmoreeffectivecontrastedwithBlanketpaging.

VI. CONCLUSION AND FUTURE WORK

The proposed profile based paging algorithm surpasses boththe blanket paging and sequential paging in all the aspects. Itgives a paging success rate that is 8% more than the blanketpaging and 2% more than sequential paging. The proposedalgorithm does so while using 50% of the bandwidth used bythesequentialpagingandusing33%bandwidthused byBlanket paging. So at the current scenario where bandwidthconservation is of utmost importance. The proposed profilebasedpagingcanbetheperfectsolution.Andthe delaygenerated is the same compared to the blanket paging. So theproposedpagingalgorithmcanbeimplementedwiththeexisting system for a period of 5 to 6 week and then thesystemcanworkalone.

In our future work we are attempting to build up a dynamicclient profile that will promote lessen the support expense ofthe profile and will facilitate improve the paging achievementrate. The future work likewise incorporates a cost estimationforthe usage oftheproposedalgorithm.

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