ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 3, Special Issue 3, April 2016

A Mutual Inducement Detection Approach Against Blockhole Attack In Mobile Adhoc Networks

Jeeva.G
M.Efinalyear ComputerScience and Engineering,Mahendra Engineering College (Autonomous)

Mr.A.Sureshkumar
Asst.professor
Department of Computer Science & Engineering
Mahendra Engineering College(Autonomous)

***Abstract*—In a typicalwirelessmobileadhoc network (MANET)usingasharedcommunication medium,everynode receivesoroverhearseverydata transmissionoccurringtime of attacking.However,thistechniqueisnotapplicablewhenapower saving mechanism (PSM) such as the one specified in IEEE802.11 is employed, where a packet advertisement period is separatedfromtheactualdatatransmissionperiod.Whenanodereceives an advertised packetthatisnotdestined toit,itswitches toalow-powerstateduringthedata transmissionperiod,and thus, conserves power. However, sincesome MANET routing protocolssuchas DynamicSourceRouting(DSR)collectroute information from attack nodeviaoverhearing,theywouldsufferifthey are used with the IEEE 802.11PSM. Allowing no overhearing may criticallydeterioratetheperformanceofthe underlyingrouting protocol, while unconditional overhearing may offset the advantage of using PSM.This paper proposes a new communicationmechanism,calledRandomCastor Rcast,via whichasendercanspecifythedesiredlevel ofoverhearingin addition to the intended receiver by using(AdhocOn-demand DistanceVector)AODV protocol.Therefore,itispossiblethatonly a random set of nodes overhear and collect route informationforfutureuse at time of attacking.Rcastimprovesnot onlytheenergy efficiency,butalsotheenergybalanceamongthenodes,without significantlyaffectingthe routingefficiency.**

Keywords-Energy balance, energy efficiency, mobile ad hoc networks,networklifetime,overhearing, power savingmechanism.

I. INTRODUCTION

Adhocnetworksareinfrastructure less wireless networks.Here,mobilenodes communicatedirectlywitheach other.Iftwonodesarenotwithinradiorange ofeach other, theycanusetheforwarding functionality of anothernodeto establishaconnection,i.e.,themessagetravelsfrom onenode toanotheruntilitreachesits destination.Allnodesneedto implement atleast simple medium access mechanisms and needtodetectcollisionsthemselves.Therefore,nodesofad hocnetworksaremuch morecomplexthanthose of infrastructurebasednetworks. However, adhocnetworksare easytomanageandestablish.Sincethey donot requirean infrastructurenetwork,they aremuchmoreflexibleandtheir useis possibleinabroader rangeofscenarios,e.g.fordisaster relief.Dependingonthefrequencyofstructuralchangesinthe network, adhocnetworkscanbesubdividedintomobileadhoc networks,orMANETs,andsensornetworks.

Oneof themostcriticalissuesin mobileadhoc networks(MANETs)is energyconservation.Sincemobile nodes usuallyoperateonbatteries,a prudentpower saving mechanism(PSM)isrequired toguaranteeacertain amount of devicelifetime.Italsodirectly affectsthenetwork lifetime becausemobilenodesthemselvescollectivelyformanetwork infrastructureforroutinginaMANET.Energyefficiencycan beimprovedin twodifferent ways:Reducingtheenergyused foractivecommunicationactivities andreducingtheenergy spentduringaninactiveperiod.

IEEE802.11standard,whichisthemost popular wirelessLANstandard,exploits this hardwarecapabilityto supportthepowermanagementfunctioninitsmedium access control(MAC)layerspecification.Eachmobiledevicecan be in oneofthe two power management modes:active mode (AM)orpowersave(PS)mode.A deviceinthe PSmode periodicallywakesupduring thepacketadvertisementperiod, calledAdhoc(orAnnouncement)TrafficIndication Message (ATIM)windowto seeifit hasanydata to receive.Itputsitself intothelow-powerstateif itisnotaddressed, butstaysawaken toreceiveanyadvertisedpacket otherwise.However, thisIEEE 802.11 PSMisdifficult to employ in a multihopMANET because of routingcomplexity notalonethedifficulty in synchronizationandpacketadvertisementin a dynamic distributedenvironment

Themain goalofthispaper isto make the IEEE 802.11 PSMapplicable in multihopMANETs when the popular(AdhocOn-demandDistanceVector)AODVisused asthenetworklayerprotocol.Amajorconcernin integrating theAODVprotocolwiththeIEEE802.11 PSMis overhearing. Overhearingimprovestheroutingefficiencyin AODVby eavesdroppingother communicationsandgatheringroute information.Itincursnoextracostifallmobilenodesoperate intheAMmode becausethey arealwaysawakeandidle listeninganyway.However,ifmobile nodes operateinthePS mode,itbrings onahighenergycostbecausethey shouldnot sleepbut receivealltheroutingand datapacketstransmittedin theirvicinity.

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 3, Special Issue 3, April 2016

Inshort, overhearingplaysanessentialrolein disseminatingroute informationin AODV butitshould becarefully re-designedif energyisaprimaryconcern.

This paper proposes a message overhearing mechanism,calledRandom Cast orRcast,viawhichasender canspecifythedesiredlevelofoverhearingwhenitadvertises a packet.Uponreceivingapacketadvertisement duringan ATIMwindow,anodemakesits decisionwhetherornotto overhearitbasedon thespecified overhearinglevel.If no overhearingisspecified,everynode decidesnotto overhear except theintendedreceiver andif unconditionaloverhearingis specified,every nodeshould decideto overhear.Randomized overhearingachievesabalancesomewherein between,where each nodemakes its decision probabilistically based on networkparameters such asnodedensity andnetworktraffic. Rcasthelpsnodes conserveenergywhilemaintaininga comparableset ofrouteinformationineachnode.Since route information ismaintained by sequence number in AODV, Rcasteffectivelyavoidsunnecessary efforttogatherredundant routeinformationandthussavesenergy.Thekey ideabehind theRcastschemeis toexplorethetemporalandspatiallocality ofrouteinformation,asis doneintheCPUcache.Overheard routeinformationwillprobably beoverheardagaininthenear futureandthusitis possibletomaintainthesamequality of routeinformation,whileoverhearingonly asmallfraction of packets. Eventhougha nodemisses particular route information, itis highlyprobable that oneof its neighbors overhearsitandcan offertheinformationwhenthenodeasks forit.NotethatwehavechosenAODVin this paper because otherMANETrouting algorithmsusually employ periodic broadcasts of routingrelatedcontrolmessages,and thustendto consumemoreenergywithIEEE802.11PSM.

Key contributionsofthis paperarethreefold: 1)ItpresentstheRandom Castprotocolthatis designedtoemploy theIEEE 802.11PSMinmultihopMANETs.Unlike previous approaches,wherenodesneedtoswitchbetweenAMand PS mode,theyconsistentlyoperateinthePSmodeinRandom Cast2)InRandom Cast,atransmittercanspecifythedesired levelof overhearingtostrikeabalancebetweenenergy and throughput.Moreimportantly,ithelps avoidthesemantic discrepancyfoundin mostofMANETrouting protocols. 3) Comparedtoourearlierwork[15],this papershowsthat the problem ofunconditional orunnecessary forwardingof broadcast packetscanalso betakencare of in theRandomCast framework.

Therestofthepaperisstructuredasfollows:Section IIpresentsthebackgroundinformation ontheAODV routing protocolandIEEE802.11PSM.SectionIII presentsthe proposed RandomCast protocol and its integration with AODV.SectionIVdrawsthesimulationprogressofthisstudy.

II.BACKGROUND

WeassumethatmobilenodesoperateastheIEEE 802.11PSMforenergy-efficientmedium accessanduse AODVfordiscoveringandmaintaining routing paths.Section AsummarizestheAODVroutingprotocol.Italsodiscusses the stale route and loadunbalanceproblemin AODVand argues that unconditional overhearing is the main reason behindthem. SectionBexplainsthe IEEE 802.11PSM.

A. AODV ProtocolOverview

TheAODV routingprotocol isareactiverouting protocol;therefore,routesare determinedonly when needed. Hellomessagesmay beusedtodetectandmonitorlinksto neighbors.IfHellomessagesareused,each activenode periodically broadcasts aHellomessagethat allitsneighbors receive.Becausenodes periodicallysendHellomessages,if a nodefailstoreceiveseveralHellomessagesfrom aneighbor,a linkbreakisdetected. When asourcehasdatatotransmittoan unknowndestination,itbroadcastsaRouteRequest(RREQ) forthatdestination.Ateachintermediatenode,whenaRREQ is receivedaroutetothe source iscreated.Ifthereceivingnode hasnotreceivedthisRREQ before,isnotthedestinationand doesnothaveacurrentroutetothedestination,it rebroadcasts theRREQ.

If the receivingnode isthedestinationor hasacurrent routetothedestination,itgeneratesaRouteReply(RREP). TheRREPisunicastinahop-by-hopfashiontothesource. As theRREP propagates,eachintermediatenodecreates a routeto thedestination.When thesourcereceivestheRREP,itrecords the routeto the destinationand canbeginsendingdata.If multipleRREPs arereceivedbythesource,the routewiththe shortesthopcountis chosen.Asdataflowsfromthesourceto thedestination,eachnodealongthe routeupdatesthe timers associatedwiththe routes tothesourceanddestination, maintainingthe routesin the routingtable.Ifa route isnotused forsomeperiodoftime,anodecannotbesurewhetherthe routeis stillvalid;consequently,thenoderemovestheroute fromitsroutingtable.

Ifdata isflowingandalinkbreakisdetected,a Route Error (RERR)issenttothesource of the datain ahop-by-hop fashion.AstheRERR propagatestowardsthesource,each intermediatenodeinvalidates routes toany unreachable destinations.When thesource of the data receives theRERR, it invalidates the route and reinitiates route discovery if necessary.

B. IEEE 802.11 PSM

IntheIEEE802.11PSM,anodecanbein oneof two differentpower modes,i.e., activemodewhena nodecan receiveframesatanytimeandpower-savemode (PS)when a nodeismainly inlow-powerstateandtransitstofullpowered state subject tothe rules describednext.Thelow-powerstate usually consumesatleastanorderofmagnitudelesspower thaninthe active state.

Inthepower-savemode,all nodesin thenetworkare synchronizedtowakeupperiodically tolistentobeacon messages.Broadcast/multicastmessagesorunicastmessages

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 3, Special Issue 3, April 2016

toa power-savingnodearefirstbufferedatthetransmitterand announcedduring theperiodwhen all nodes areawake.The announcement ismade via an ad hoc traffic indication message (ATIM)insideasmallintervalatthebeginning of the beaconintervalcalledtheATIMwindow.Ifanodereceives a directedATIMframeintheATIMwindow (i.e.itisthe designatedreceiver),itsendsan acknowledgmentandstays awakefor the entire beaconintervalwaitingfor data packetsto betransmitted.Immediately aftertheATIM window, a node can transmit buffered broadcast/multicastframes, data packets andmanagementframes addressedtonodes thatareknownto beactive(by receptionofacknowledgmenttoATIMframes). Otherwise,thenodecanswitch to thelow-powerstateto conserve energy. In IEEE 802.11, a node's power managementmodeisindicatedintheframe controlfield of the MACheaderforeach packet.IntheIEEE802.11PSM,the lengthof abeacon intervalandthesizeof anATIMwindow areconfigured by thefirstnodethatinitiates thenetworkin IBSS.Amobilestationcan choosetowakeupeverymultiples ofthe beaconintervalsfor further energysaving.

.

III. RandomCastImplementationWith AODV

A. No,Unconditional,and Randomized Overhearing

Theunicastpacketisdeliveredonly toanintended receiveriftheIEEE802.11PSM isemployed.Considerthata nodeStransmits packets toanodeDviaa pre-computed routingpathwiththreeintermediatenodesasshowninFig. 1(a).Onlyfivenodesareinvolvedinthecommunicationand therestwouldnotoverhearit(*nooverhearing*).However,if each neighboris required to overhear as in AODV, each sendershouldbeableto"broadcast"aunicastmessage.i.e.,it specifiesaparticularreceiverbutatthesametimeasksothers to overhear it as shown in Fig. 1(b) (*unconditional overhearing*).*Randomized overhearing* adds one more possibilityinbetweenunconditionalandnooverhearing.As showninFig.1(c),someoftheneighborsoverhear,butothers donotandthesenodesswitchtothelow-powerstateduring thedatatransmissionperiod.Randomizedoverhearingsaves substantial amountof energy compared to unconditional overhearing.Withrespecttorouteinformation,itdoesnot deterioratethequalityofrouteinformationbyexploitingthe spatial and temporal locality of route information disseminationasexplainedintheintroduction.Consideran example inFig. 1(c), in which nodes X and Y are two neighbors of the communicating nodes A and B. Their communicationand overhearingactivitiesare drawnin Fig. 3. WhennodeAreceivesaRREPfromnodeB,itobtainsanew route(S D)andstoresitinitsroutecache.NodesXandY donotoverheartheRREPasshowninthefigurebut,since therewillbeanumberof datapacketstransferredfromnodeA toB,theywillobtaintherouteinformation(S D).Inthis figure,nodeXoverhearsthesecondDatapacketandnodeY overhearsthesecondfromthelastpacket.Fig.1alsoshows whentheroutebecomesstaleandgetseliminatedfromthe routecache.

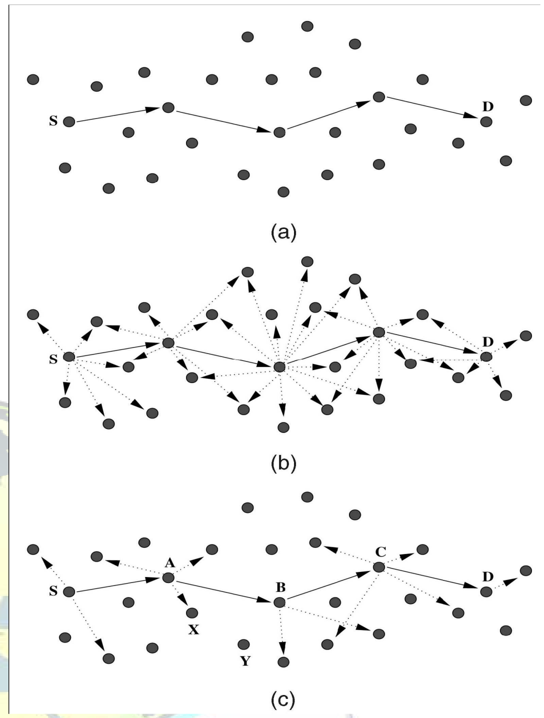

Fig.1 Deliveryofaunicastmessagewithdifferentoverhearingmechanisms.(a) no overhearing, (b) unconditional overhearing, and (c) randomized overhearing.

B. RcastImplementation

TheRcastmechanismenablesanodetochooseno, unconditional, orrandomized overhearing when it has a unicast packetto send. Itsdecisioncanbe specifiedinthe ATIMframesothatitisavailabletoitsneighboringnodes duringtheATIMwindow.Forpracticality,implementationin the contextof IEEE 802.11 specification is considered by slightlymodifying theATIMframeformatasshowninFig.4. AnATIMframeisamanagementframetypeanditssubtype ID is10012. The Rcastmechanism utilizes two reserved subtypeIDs,11012and11112,tospecifyrandomizedand unconditional overhearing, respectively frame with subtype 10012is recognizedas nooverhearing,andthus,conformsto thestandard.

Consider anexamplewhenanode (itsMACaddress MA) wakes up at the beginning of a beacon interval and receivesanATIMframe.Itdecideswhetherornottoreceive oroverhearthepacketbasedonthedestinationaddress(DA) and subtypeID. It wouldremain awaken if one of the followingconditionsis satisfied.

1.The node isthe intended destination(DA= MA).

2. Thenodeisnot thedestination butthesenderwants unconditional overhearing(DA 6= MA but subtype ID = 11112).

3. Thenodeisnotthedestination,butthesenderwants randomizedoverhearing,andthenoderandomlydecidesto

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 3, Special Issue 3, April 2016

overhearthepacket(DA 6=MA, subtypeID=11012and decides to overhear).

Akey designissuein theRcastimplementationis the mechanismofoverhearingwhenthesenderspecifies node maintains a probability, PR, determinedusingthe factorslisted below andprobabilisticallymakes theoverhearingdecision basedonPR.Inotherwords,ifarandomlygeneratednumber is >PR, thenanode decidesto overhear.

• *SenderID*: Themain objectiveofRcastisto minimizeredundantoverhearingasmuch as possible.Sincea nodeusuallyrepeatsthe sameroute informationinconsecutive packets, a neighbor can easily identify the potential redundancy basedonthesenderID.Forinstance,whenanode receivesanATIMframewith subtype11012,it determinesto overhearitif thesenderhasnotbeenheardoroverheardfora while.Theformerconditionmeansthatthetrafficfrom the senderhappensrarely orthepacketisforanew traffic.The latterconditionholdswhen thenodeskipstoomany packets fromthe sender.

•*Mobility*:Whennodemobility ishigh,linkerrors occur frequentlyand route information stored in the route cache becomesstale. Therefore, itisrecommendedto overhear moreconservativelyin thiscase.Each nodeisnot knowledgeableaboutmobility ofevery othernode,butitcan estimateitsownmobility basedontheconnectivity changes withits neighbors.

Remainingbatteryenergy:Thisis oneof themost obviouscriteriathathelpsextendthenetworklifetime:Less overhearingifremainingbatteryenergyislow.However,itis necessarytoconsiderothernodes' remaining batteryenergyin ordertomakea better balance.

Number ofneighbors: When anodehasalarge numberofneighbors,itis possible that oneof them offersa routingpathto thenodewhenitasksfor itbysending a RREQ.Therefore, the overhearing decision is related inverselytothenumberofneighbors.Overhearingdecision can bemade basedon theabovefourcriteria, butin this paper, weadoptasimpleschemeusingonly thenumberofneighbors (P_R=1/numberof neighbors)toshowthepotentialbenefitof Rcast.Inotherwords,if anodehasfiveneighborsinitsradio transmission range,it overhears randomlywith theprobability $P_R$of0.2.

C. RCASTWITHAODV

AODV employs threecontrol packets,RREQ,RREP andRERR,in additiontodatapackets.RREQis abroadcast andRREP,RERR anddataareunicastpackets.Foreach of theseunicast packets,AODVusesthefollowing overhearing mechanism.

RandomizedoverhearingforRREP packets: A RREPincludesthediscoveredrouteandissentfrom the destination tothe originator of the corresponding RREQ packet.Forexample,inFig.1(c),nodeDsendsaRREPto nodeS.IntermediatenodesaswellasnodeDwillRcastthis messageto allowrandomized overhearing.

Unconditional overhearingof RREP is not a good idea becauseAODV generatesalargenumberofRREPpacketsas discussedinSection2.1.

Randomized overhearingfor data packets: In AODV,every datapacketincludes theentireroutefromthe sourcetothedestination.Each intermediatenode(e.g.,nodes A,B,andCin Fig.1(c))as wellas thesourcenode(e.g.,node Sin Fig. 1(c))will demand randomizedoverhearingforthese packetssothatneighboringnodes(e.g.,nodesXandYinFig. 1(c)) canoverhear themrandomly.

Unconditional overhearingfor RERR packets: Whena brokenlinkisdetected, anupstreamnode (e.g., node BinFig.1(c))transmitsaRERRtothesource.Nodeswill overhearthismessageunconditionally becausethestaleroute informationmust be invalidatedas soon as possiblefrom nodes'route caches.

NotethatabroadcastpacketsuchasRREQcanalso beRcastedtoallow randomizedreceivingasmentionedinthe introduction. This is toavoidredundantrebroadcasts of the samepacketin densemobile networks.In this case, the overhearingdecisionmustbemadeconservativelytomake surethatthebroadcastpacketsuchas RREQis propagated correctlyuntilitreachesthefinaldestination.Notealsothat the randomizationapproachdescribed above canavoid the occurrenceofpreferentialattachment,discussedinSection III (B), and leadto a morebalanced network withrespect to packet forwardingresponsibilityandenergyconsumption.

IV. SIMULATIONPROGRESS

Fig.2 NAMwindowfor implementing AODV with50 nodes.

IntheaboveNAMwindow,theAODV routing protocolis simulatedby usingfiftynodes andtheworking progress ofprotocolisanalyzed.

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 3, Special Issue 3, April 2016

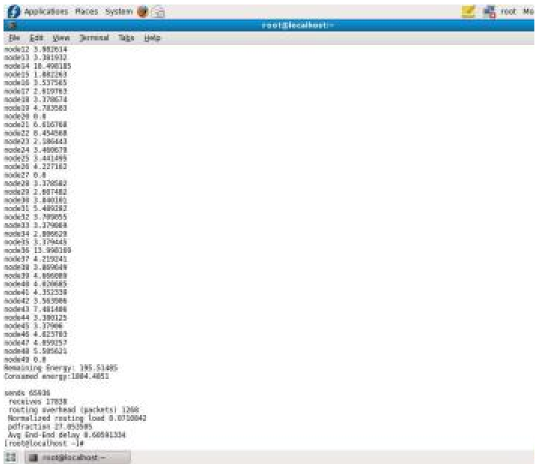

Fig.3 Tracefilecalculation for energyconsumedinAODV

Fig.3showsthetracefileforcalculating energy consumedinAODVroutingprotocol withscenariogenerated for fiftynodes. The increasednetwork structure and node createthe overhead. The simulatedgraphforthe routing overheadisshownbelow.

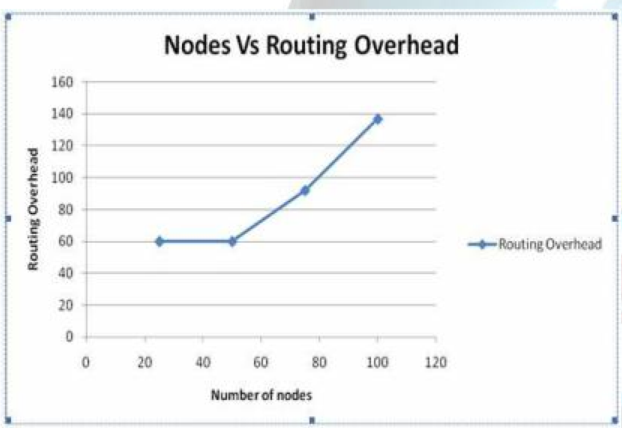

Fig.4 Graph betweennumberof nodesvsrouting overhead.

Inthegraphitisclear thataftercertain extentthe overheadincreasesexponentiallywith increasein numberof nodes.

REFERENCES

[1] NS-2,The nsManual(formallyknownasNS Documentation) available at*http://www.isi.edu/nsnam/ns/doc*.

[2] SamyakShah,AmitKhandre,MaheshShiroleandGirish Bhole,"PerformanceEvaluationofAdHoc RoutingProtocols UsingNS2Simulation" InternationalConferenceonMobile and PervasiveComputing(CoMPC–2008),pp167-171.

[3] Z.J. Hass, J.Y. Halpern, andL. Li, "Gossip-Based AdHoc Routing,"Proc. IEEE INFOCOM, pp. 1707-1716,2002.

[4] D.B.JohnsonandD.A.Maltz,"DynamicSource RoutinginAd Hoc Wireless Networks," Mobile Computing, pp. 153-181, Kluwer, 1996.

[5] S. Lim, C. Yu, and C. Das, "Rcast: A Randomized CommunicationSchemeforImproving EnergyEfficiencyin Mobile Ad Hoc Networks," Proc. 25th IEEEInt'l Conf. Distributed Computing Systems (ICDCS '05), pp. 123-132, 2005.

[6] S. Singh, M. Woo, andC.S. Raghavendra, "Power-Aware RoutinginMobileAdHocNetworks,"Proc.ACMMobiCom, pp. 181-190,Oct. 1998.

[7] J.-H.ChangandL.Tassiulas.EnergyConserving Routingin WirelessAd-hocNetworks.InProc.IEEE INFOCOM,pages 22–31, 2000.

[8] S. R. Das, C. E. Perkins, andE. M. Royer. Performance ComparisonofTwoOn-demand RoutingProtocolsforAdHoc Networks.InProc.IEEE INFOCOM,pages3–12, 2000.

[9] Y.HuandD.B.Johnson.CachingStrategiesinOn-Demand RoutingProtocolsforWirelessAdHocNetworks.InProc. ACM MOBICOM, pages231–242,2000.

[10] D.B.JohnsonandD.A.Maltz.DynamicSource Routingin Ad HocWireless Networks.In Mobile Computing,pages153–181, Kluwer1996.

[11] C. PerkinsandE. M. Royer. Ad-hoc On-Demand Distance VectorRouting.In 2nd IEEE workshopon MobileComputing Systemsand Applications,pages90–100,1999.

[12] Y.-C. Tseng, C.-S. Hsu andT.-Y. Hsieh.Power-Saving ProtocolforIEEE802.11-BasedMulti-HopAdHocNetworks.InProc.IEEE INFOCOM, pages200–209,2002.

[13] H. Woesner,J.Ebert, M. Schlager,andA.Wolisz.Power- Saving Mechanismsin Emerging Standards for Wireless LANs: The MAC Level Perspective. IEEE Personal Communications, 5(3):40–48,Jun 1998.

[14] R.ZhengandR.Kravets.On-DemandPowerManagementfor Ad HocNetworks.In Proc.IEEE INFOCOM,pages481–491, 2003.

[15] SunhoLim, ChansuYu, Chita R.Das. "Random Cast: An Energy-EfficientCommunication Scheme forMobileAdHoc Networks," Proc.IEEETransaction on Mobile Computing, Vol.8,No.8,August2009.

[16] RendongBaiandMukeshSinghal.,"DOA:DSRoverAODV Routing for Mobile Ad-Hoc Networks," Proc.*IEEE TransactiononMobileComputing*,Vol.5,No .10, October 2006.