International Journal of Computer Network and Security(IJCNS)
Vol 4. No 1. Jan-Mar 2012 ISSN: 0975-8283
www.ijcns.com

Dynamic Time Slot Partitioning For a Mobile Multihop Relay In Cellular Network

K.Praveen kumar[#1], J.Geetharamani [#2]
[#1]M.E (Communication Systems),[#2] Assistant Professor/(ECE)
SNS College of Technology,Coimbatore, Tamilnadu
praveeneee04@gmail.com ,geetharamanij@yahoo.co.in

Abstract

The wireless industry is experiencing a great revolution in order to meet the expectations of the end users. In mobile multi-hop DTSP algorithm, the available bandwidth resources are increased by partitioning each time slot into several minislots wherein different numbers of minislots are allocated to different users. The mobile multi-hop DTSP algorithm is based on asynchronous time-division multiplexing, wherein users with variable number of packets in their buffers can transmit data sequentially without any loss in the overall available resources. In mobile multi-hop, the gateway nodes are in mobility. The base station periodically updates the location information of the gateway nodes. If any of the gateway node gets failed in the network means it gives the information to the base station as well as to their mobile stations. The Base station finds the next gateway node which is nearer to the failed gateway node and moves that node to the failure location in order to transmit and receive the information from the cluster. This will reduce the data transmission distance and the overall communication distance between the mobile station and the base station in the network. The key advantage of DTSP is that it can flexibly adapt to different quality of service requirements. It achieves much higher system capacity through the data transmission distance is reduced. It also achieves the packet delivery ratio performance, end-end delay performance, wider service range, throughput, packet drop, routing overhead and energy consumption in the network on the basis of time and plot the graphs.

Index Terms— mobile multihop, gateway, mobility, dynamic time slot partition, base station, mobile station.

1. INTRODUCTION ON PROBLEM OF TWO HOP CELLULAR NETWORK

Two-hop time slot allocation does not always deliver high data rates, especially when there is high number of users. The time slot allocation method is based on synchronous TDM and is not efficient for next generation all- IP-based packet-oriented services, especially when the different packets are of varying length. In a traditional two-hop cellular network, the distance between the base station (BS) and the mobile station (MS) is in the range of several kilometres (km). Wireless terminals are energy-constrained devices. Hence, the transmitter power cannot be increased indiscriminately in order to support very good quality high data rate. Therefore, an efficient alternative method for high data rate communication involving battery-constrained wireless devices is to use a multihop network.

In cellular communications, the source and destination nodes are communicate with each other over multihops.Fig. 1 shows an example of a next generation multihop cellular network. The BS communicates with the end-users in either single-hop or in multi-hop. Different algorithms and architectures have been proposed over the recent years for efficient spectrum and resource utilization in multi-hop cellular networks. An integrated cellular ad hoc relay network has been proposed in that diverts the traffic from highly loaded cells to lightly loaded cells. In a practical situation, 84 percent of multi-hop communication takes place within four hops, with 62 percent of the communication happening in two hops. In two-hop cellular network, gateways are in fixed position. In two-hop DTSP algorithm is that have cross-time-slot regions, as there is random simultaneous transmission of packets by different users in the same minislot. This results lower system performance in cellular network.

A novel cluster-based design has been recently proposed for multi-hop cellular architectures.The cluster-based design results in a frequency reuse of one and is found to be superior in achieving higher system capacity in comparison with the state of two-hop networks.Higher time taken for data transmission in the two-hop time slot partitioning techniques.

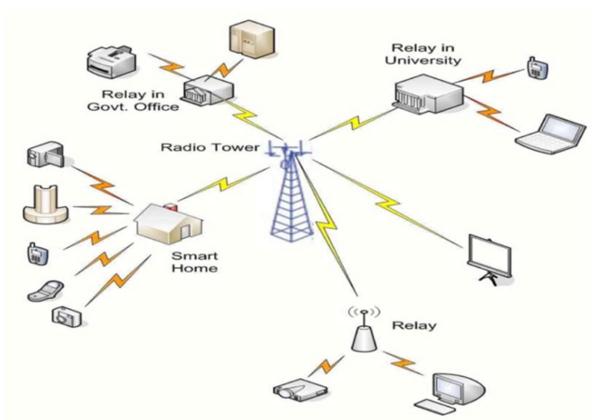

Figure1. An example of next generation multihop cellular network.

2. RELATED WORKS ON MULTICELLULAR NETWORK

In multihop networks for cellular communications, the source and destination nodes are communicate each other. Different algorithms and architectures have been proposed over the recent years for efficient spectrum and resource utilization in multi-hop cellular networks. A novel cluster-based design has been recently proposed for two-hop cellular networks. The cluster-based design results in a frequency reuse of one and is found to be superior in achieving higher system capacity in comparison with the state-of-the-art two-hop algorithms. A multi-hop dynamic channel assignment (MDCA) scheme has been recently proposed for clustered multi-hop cellular networks, which works by assigning channels based on information about interference in surrounding cells.

In multihop cellular network models as a method to extend the communication coverage and provide higher data rate for an infrastructure based cellular network. Whereas cellular systems have traditionally adopted single-hop transmissions between the mobile station (MS) and the base station (BS), researchers expect multihop transmission to be utilised in the future.Multihop cellular networks is an exciting and a fledgling area of wireless communication which offers huge potential in terms of coverage enhancement, data-rates, power reduction, and various other quality of service improvements.

A fixed station in a cellular wireless network, used for communicating with mobile terminals (phones). A base station is what links mobile phones to a wireless carrier's network.A base station provides local coverage (an area where mobile phones will work) for a wireless network. The area of coverage may be many miles or just a few city blocks. A single location often hosts multiple base stations, each owned by a different carrier. Significantly, there has been considerable research in the cross-layer domain for multihop cellular networks.

A gateway is a network point that acts as an entrance to another network. On the Internet, a node or stopping point can be either a gateway node or a host (end-point) node. Both the computers of Internet users and the computers that serve pages to users are host nodes, while the nodes that connect the networks in between are gateways.

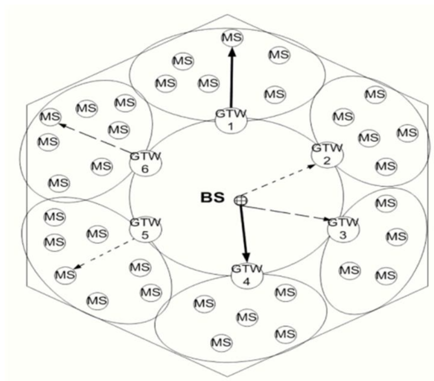

Figure. 2. Multicellular network with all gateways in the cell located equidistantly from the BS

3. MOBILE MULTIHOP RELAY (MMR) BASED DTSP IN CELLULAR NETWORK

Types of relays is Fixed and Mobile relays (Mobile Bus,Train,Aeroplane) Data transmission distance is reduced using MMR.Signal strength loss is reduced using MMR.The mobile station (MS) comprises all user equipment and software needed for communication with a mobile network. The mobile station refers to global system connected to the mobile network, i.e. mobile phone or mobile computer connected using a mobile broadband adapter. A user's wireless device, which can be a cell phone or a system in a vehicle. Station in the mobile service intended to be used while in motion or during halts at unspecified points. One or more transmitters that are capable of transmission while in motion.

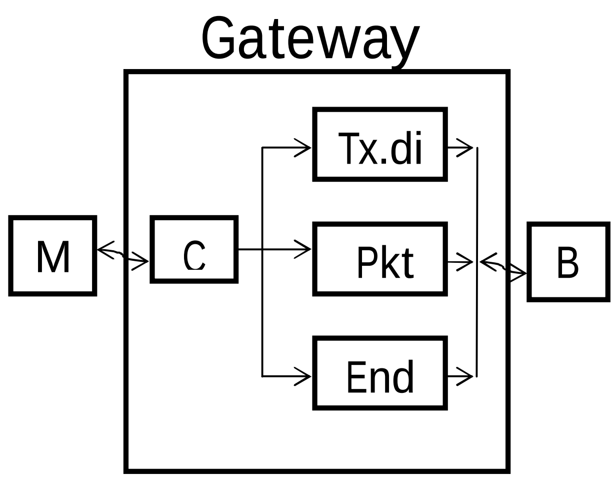

Figure.3.Mobile multihop relay(MMR) based dtsp in cellular network

A. Summary of multihop relay networks

Relay concept applies to Cellular Networks and to Wireless access. Relays can help overcome obstacles. Relays help improve the capacity by decreasing the distance. Relays help decrease the cost since they are much cheaper than base stations. Routing with fixed relays is simple. Relays are low-cost low transmit power and have no connection to wired infrastructure. More capacity due to shorter distances and frequency reuse. Goal is high capacity and wide coverage.

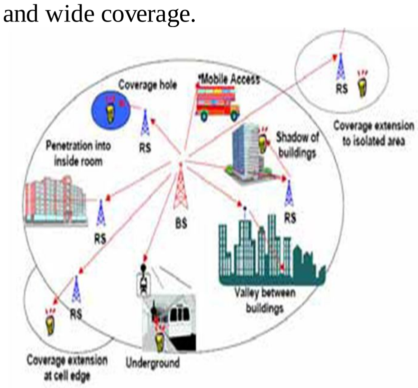

Figure 4. Various mobile relays network

4. DYNAMIC TIME SLOT PARTITIONING ALGORITHM

A. DTSP Overview

This section introduces the novel DTSP algorithm which combines the benefits of dynamic TDD/TDMA and that of the OFDM design, for efficient communication in multihopcellular networks. In the DTSP algorithm, any time slot could be partitioned into up to a maximum of N minislots which are given to the same or to different users. User data are transmitted in the mini time slots in a burst format. The number of bits transmitted per mini slot depends on the selected modulation technique.

The DTSP algorithm takes advantage of several attributes of shared networks:
1. All users are typically not connected to the network at any point of time.
2. Even when connected, the users do not transmit data all the time.
3. Most traffic in a packet radio network is "bursty."Hence, there are gaps between packets of information
that can be filled with other users' traffic.

The BS considers the MSs in the inner region and the GTWs at the boundary of the inner and out erregions to be a single group of entity. The MSs in the clustered outer layer constitute the second group. The MSsin the clusters are selected for transmitting data in a round-robinfashion according to their ID number.

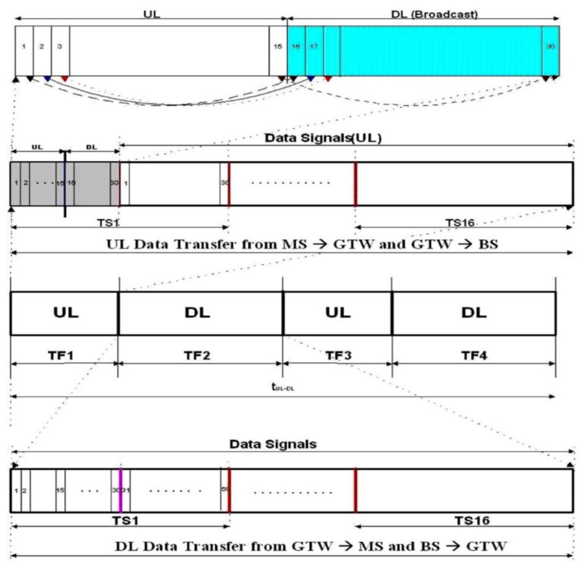

Figure.5. Time slot allocation in uplink (UL) and downlink (DL)

B. Time Slot Allocation in DTSP

Fig. 5 presents the frame structure and the time slot allocation according to the DTSP algorithm. The uplink and downlink time frames are independent of each other. The first one is divided into two equal parts: control section and data section. The control section is further divided into two equal parts: uplink control section and downlink control section, as shown in Fig. 5.There are N=4 minislots each for uplink and downlink control section. The N=4 minislots in the uplink controlsection are used by different wireless devices to sendcontrol signals to the GTW node. The next N=4 minislots inthe uplink frame are for downlink control section, wherein,the GTW broadcasts information to the MSs.

There is only one transmitter and many receivers,unlike the case of uplink where there are severaltransmitters and one receiver.The transmitter (BS or GTW) knows the buffer sizethat is to be transmitted to the different receivers.

TABLE 1
List of Parameters and Their Description

Parameter	Description of Parameter
F	Number of time frames in a superframe.
S	Number of time slots per frame.
N	Maximum number of minislots per time slot.
GTW′ and GTW″	Diametrically opposite gateways in a cell.
n	Number of MSs under GTW′.
b_{U_n}	Buffer size of mobile node, n, for transmitting to GTW′.
$b_{U_{\text{GTW}''}}$	Buffer size of GTW″ for transmitting to BS.
γ_{D_n}	C/I ratio of GTW′ → MS$_n$ in previous frame.
$\gamma_{D_{\text{GTW}''}}$	C/I ratio of BS → GTW″ in previous frame.
γ_{U_n}	γ ratio of MS$_n$ → GTW′ in current frame.
$\gamma_{U_{\text{GTW}''}}$	γ ratio of GTW″ → BS in current frame.
ζ_{U_n}	Modulation scheme of data packet from MS$_n$ → GTW′.
$\zeta_{U_{\text{GTW}''}}$	Modulation scheme of data packet from GTW″ → BS.
$t_{U_{\text{GTW}''}}$	Time required by GTW″ to transmit packets to BS.
t_{U_n}	Time required by MS$_n$ to transmit packets to GTW′.
$\zeta_{D_{\text{GTW}''}}$	Modulation scheme of data packet from BS → GTW″.
$\zeta_{D_{\text{MS}_p}}$	Modulation scheme of data packet from GTW′ → MS$_p$.
t_{D_n}	Time required by GTW′ to transmit packets to MS$_n$.
$t_{D_{\text{GTW}''}}$	Time required by BS to transmit packets to GTW″.

Algorithm: Dynamic Time Slot Partitioning

1: for i ¼ 1 to F do
2: if i=2 ¼ 0 then
3: for j ¼ 1 to S do
4: Divide time slot j into N minislots
5: if j ¼¼ 1 then
6: for k ¼ 1 to N=2 do
7: MSk transmits bUk and _Dk to GTW'.
8: GTW" transmits bUGTW00 and _DGTW to BS.
9: GTW' calculates _Uk .
10: BS calculates _UGTW00 .
11: GTW' determines _Uk from _Uk .
12: BS determines _UGTW00 from _UGTW00 .
13: BS determines time, tUGTW00 , required by GTW".
14: GTW' determines tUk required by MSk.
15: end for
16: All MSs in the cluster switch to the "ON" state.
17: for k ¼ ðN=2Þ þ 1 to N do
18: GTW' broadcasts _Uk and tUk .
19: BS broadcasts _UGTW00 and tUGTW00 .
20: end for
21: end if
22: if j not equal 1 then
23: for p ¼ 1 to n do
24: MSp transmits data packets to GTW'.
25: GTW" transmits data packets to BS.
26: end for
27: end if
28: end for
29: else
30: BS determines _DGTW00 from _UGTW00 .

31: GTW' determines _DMSp from _Un .
32: BS computes time, tDGTW00 .
33: GTW' computes time, tDn .
34: j ¼ 1.
35: while j <¼ S do
36: Divide time slot j into N minislots
37: BS transmits data packets to GTW".
38: GTW' transmits data packets to MSp.
39: Compute the increase in number of time slots, j
40: end while
41: end if
42: end for

5. SIMULATION AND ANALYSIS

A. Simulation configuration

We use NS-2 2.33 to evaluate simulation models. The radio model is similar to that of WaveLAN, with radio transmission range of 250 meters and tx rate 2Mbps. As comparison, implementation of Dynamic Source Routing (DSR) model is also evaluated. Both DSR and our CBSR protocols have interface queue of size 50 packets. Interface queue is the queue between link layer and media access layer, where packets already contain complete route and waiting for media access layer to deliver it into physical medium packets size is fixed to 512 byte.

B. Simulation results

In order to compare the performance of two routing algorithms. We measured end user perceived performance metrics, i.e., packet delivery ratio and transmission delay as well as network perceived performance metrics i.e routing overhead. They are plotted in graph Pkt delivery ratio, end to end delay, energy consumption,throughput, packet drop and routing overhead. Routing overhead is measured in total number of routing packets. Most obvious observation is that CBSR is able to deliver more data packets than DSR. This leads to less packet drops. In addition, CBSR added very little overhead to network traffic comparing to DSR.

In addition to more packets delivered, CBSR also deliver packets significantly faster. DSR always has to broadcast route request and wait for route reply before sending out a data packet. Therefore they suffer from long route establishment delay. Secondly although routing packets have high priority in node's interface queue, they still have to compete with other kinds of packets in other nodes to get medium access. This renders itself vulnerable to interference or collision, which further increases delay in routing information transmission. Also we observed that CBSR is more robust in stressful situations.

Its performance drops in terms of packet delivery ratio, delay and routing overhead is very limited compare to DSR. It suggests that CBSR should scale well with respect to network site, network and node mobility. Thus confirms our previous observation that by ensuring accurate and on time delivery of control packets, we are able to maintain proper network operation under big network, high traffic load and high mobility situation.

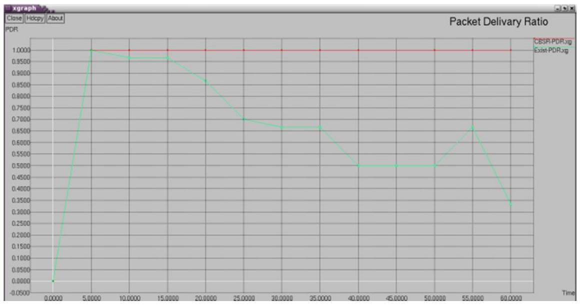

Figure. 6. Packet delivery ratio

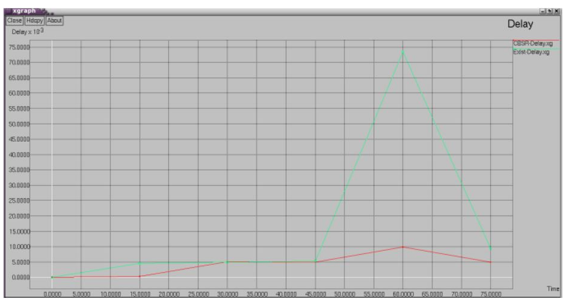

Figure 7. End to end delay performance

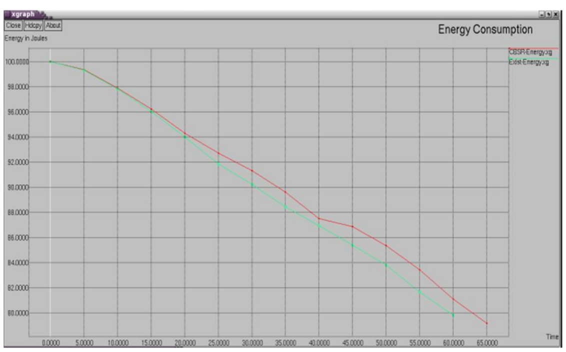

Figure. 8. Energy consumption

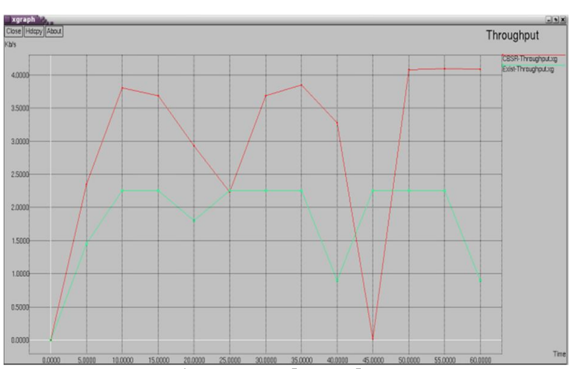

Figure. 9. Throughput

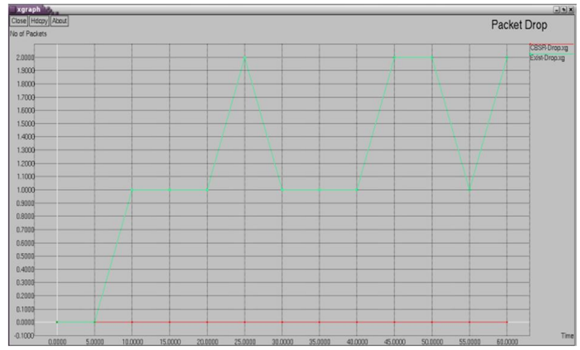

Figure.10. Packet drop

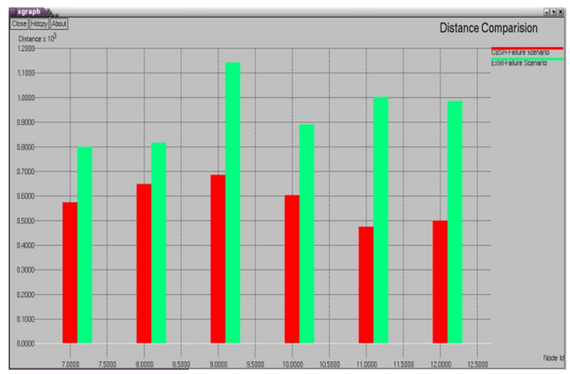

Figure.11. Distance reduced comparison

6. CONCLUSION

In enhancement, using the mobile multihop relay instead of two-hop cellular networks. If any of the gateway node get failed in the network means, it will give the information to the base station as well as to their mobile stations. The Base station finds the next gateway node and it transmit the data to that gateway node. Through the next gateway node the information's are transreceive from the cluster. So the data transmission distance is increased.

In proposed system, the gateway nodes are in mobility. So the base station periodically update the location information of the moving gateway nodes. This will reduce the data transmission distance. Thus the future broadband mobile communication techniques can be developed with an wider service range. DTSP algorithm works well for any kind of traffic, asymmetry ratio between uplink and downlink mode in the cellular network. Mobile multi-hop DTSP are limited by interference comprised of inner and co-channel interference.

Finally, analyzed the performance of the proposed approach with the existing approach in terms of the time taken to transfer the data packets from the source to destination. It achieves much higher system capacity through the data transmission distance is reduced. It also achieves the packet delivery ratio, end-end delay performance, energy consumption, throughput, packet drop, routing overhead and wider service range. And finally the simulation results shows that proposed approach is much worthier than the existing system.

REFERENCES

1. D. Cavalcanti, D. Agrawal, C. Cordeiro, B. Xie, and A. Kumar, "Issues in Integrating Cellular Networks, WLANs, and MANETS: A Futuristic Heterogeneous Wireless Network," IEEE Comm. Magazine, vol. 12, no. 3, pp. 30-41, June 2005.
2. M. Grossglauser and D.N.C. Tse, "Mobility Increases the Capacity of Ad Hoc Wireless Networks," IEEE/ACM Trans. Networking, vol. 10, no. 4, pp. 477-486, Aug. 2002.
3. D.G. Jeong and W.S. Jeon, "CDMA/TDD System for Wireless Multimedia Services with Traffic Unbalance between Uplink and Downlink," IEEE J. Selected Areas in Comm., vol. 17, no. 5, pp. 939-946, May 1999.
4. H. Li, D. Yu, and H. Chen, "New Approach to Multihop-Cellular Based Multihop Network," Proc. IEEE Symp. Personal Indoor Mobile Radio Comm. (PIMRC), vol. 2, pp. 1629-1633, Sept. 2003.
5. X.J. Li and P.H.J. Chong, "A Dynamic Channel Assignment Scheme for Clustered Multihop Cellular Networks," Wireless Comm. and Mobile Computing, vol. 8, no. 7, pp. 845-856, Sept. 2008.
6. Y. Liu, R. Hoshyar, X. Yang, and R. Tafazolli, "Integrated Radio Resource Allocation for Multihop Cellular Networks with Fixed Relay Stations," IEEE J. Selected Areas in Comm., vol. 24, no. 11, pp. 2137-2146, Nov. 2006.
7. R. Pabst et al., "Relay-Based Deployment Concepts for Wireless and Mobile Broadband Radio," IEEE Comm. Magazine, vol. 42, no. 9, pp. 80-89, Sept. 2004.
8. H. Venkataraman, S. Sinanovic, and H. Haas, "Cluster-Based Design for Two-Hop Cellular Networks," Int'l J. Comm., Networks and Systems, vol. 1, no. 4, pp. 370-385, Nov. 2008.
9. H. Vishwanathan and S. Mukherjee, "Performance of Cellular Networks with Relays and Centralized Scheduling," IEEE Trans. Wireless Comm., vol. 4, no. 5, pp. 2318-2328, Sept. 2005.
10. H. Wu, C. Qao, S. De, and O. Tonguz, "Integrated Cellular and Ad Hoc Relaying Systems," IEEE J. Selected Areas in Comm., vol. 19, no. 10, pp. 2105-2115, Oct. 2001.