

A Survey on Improving the Capacity of Hybrid Wireless Networks by Using Distributed Three-Hop Routing Protocol

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Abstract : A routing protocol is a critical component that affects the throughput capacity of a wireless network in data transmission. The routing protocols in hybrid wireless networks combine the cellular transmission mode (i.e. transmission mode) in infrastructure wireless networks and the ad-hoc transmission mode in mobile ad-hoc networks. The protocols use the multi-hop routing to forward a message to the mobile gateway nodes that are closest to the base station or have the highest bandwidth to the base stations. The widespread base station, the mobile nodes have a high probability of encountering a BS while moving. Existing Two-Hop Routing protocols are produce High overhead and Low Reliability. Taking advantage of this feature, we propose a Distributed Three-hop Data Routing protocol (DTR). In DTR a source node divides a message stream into a number of segments. The proposed DTR protocol compare to Two-Hop Routing protocol improve the Network Efficiency and reduce the Overhead.

Keywords: Hybrid wireless Network, Three-Hop, Distributing, Throughput, Overhead.

I. Introduction

With the increasing level of wireless communication in environment, people often required Quality of Services(QoS) for sharing their data between the nodes. For affording QoS to the user, the researchers proposed a very few methods to provide QoS guaranteed routing for hybrid networks, they strive to improve the network capacity and reliability but they evade constrain in QoS. Hybrid Wireless Communication (HWC) is one of the popular among the people for sharing the resources among the networks. The Hybrid approach is based on the combination of sensor, mobile adhoc, vehicular ad hoc network for sharing the resources in the distributed network. With the use of this communication people often needs the QOS while transferring the data. In mobile ad hoc networks (MANETs) expanded a great deal of concentration of considerable advantages brought about by multihop, infrastructure-less transmission. Due to the error prone wireless channel and the dynamic network topology, consistent data delivery in MANETs, the challenge environment with high mobility remains an issue. In the real world, a numerous applications need data delivery to multiple destination nodes which is defined as multicasting, where the access of multicast routing is an ideal approach to manage and reduce network traffic and cost of the network including bandwidth. The services are required over extremely in dynamic networks, which is Hybrid approach of above combination of ad hoc network. In an infrastructure network, nodes communicate with each other through base stations. Because of the long distance one-hop transmission between Base stations and mobile nodes, the infrastructure wireless networks can provide higher message transmission reliability and channel access efficiency, but suffer from higher power consumption on mobile nodes and the single point of failure problem.

In the absence of the central control infrastructure, in mobile adhoc network the data is routed to its destination through the intermediate nodes in a multi-hop manner. The multi-hop routing needs on-demand route discovery or route maintenance. The messages are transmitted in wireless channels and through dynamic routing paths, the mobile ad-hoc networks are not reliable as the infrastructure wireless networks. Because of the multi-hop transmission feature, mobile ad-hoc networks are only suitable for local area data transmission. The infrastructure wireless network (e.g. cellular network) is the major means of wireless communication in our daily lives. In the inter-cell communication (i.e., communication between nodes in different cells) and internet access. It makes the support of universal network connectivity and ubiquitous computing by integrating all kinds of wireless devices into the network. In an infrastructure network, nodes communicate with each other through base stations. Because of the long distance one-hop transmission between base stations and mobile nodes, the infrastructure wireless networks can provide higher message transmission reliability and channel access efficiency, but suffer from higher power consumption on mobile nodes and the single point of failure problem.

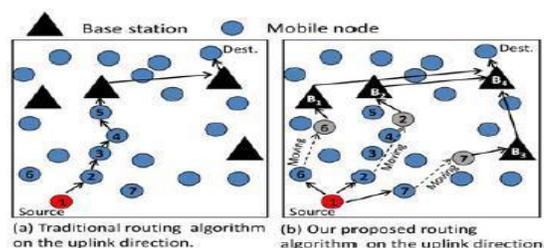


Fig. 1. Traditional and proposed routing algorithms on the uplink direction.

Infrastructure wireless networks and ad hoc networks are two popular types of wireless networks. In infrastructure wireless networks, mobile nodes communicate directly with an access point to the wired network. An ad hoc network, on the other hand, is comprised of mobile nodes that communicate solely over the wireless medium. One difficulty of installing infrastructure wireless networks is to avoid dead zones (areas without coverage). Additionally, unidirectional links, which are a common occurrence in wireless networks, can make direct communication with the access point impossible for mobile nodes if the access point has a greater transmission range than the mobile nodes. The limitation of ad hoc networks is that there is typically no connectivity between the fixed network and the mobile nodes, due to the lack of preexisting infrastructure. With the continued growth of interest in ad hoc networks, it is inevitable that global connectivity will be required for mobile wireless devices in the near future.

II. Related Work

2.1 A QOS-oriented distributed routing protocol for Hybrid Wireless Networks:

In wireless communication gains popularity, significant research has been devoted to supporting real-time transmission with stringent Quality of Service (QOS) requirements for wireless applications. A wireless hybrid network that integrates a mobile wireless ad hoc network (MANET) and a wireless infrastructure network has been proven to be a better alternative for the next generation wireless networks. By directly adopting resource reservation-based QOS routing for MANETs, hybrids networks inherit invalid reservation and race condition problems in MANETs. In this paper, proposed a QOS-Oriented Distributed routing protocol (QOD) to enhance the QOS support capability of hybrid networks. Taking advantage of fewer transmission hops and any cast transmission features of the hybrid networks, QOD transforms the packet routing problem to a resource scheduling problem. QOD incorporates five algorithms: 1) A QOS-guaranteed neighbor selection algorithm to meet the transmission delay requirement, 2) A distributed packet scheduling algorithm is used to reduce transmission delay, 3) A mobility-based segment resizing algorithm is used to adjust the segment size according to node in order to reduce transmission time, 4) A traffic redundant elimination algorithm to increase the transmission throughput, and 5) A data redundancy elimination-based transmission algorithm to eliminate the redundant data to further improve the transmission QOS. Analytical and simulation QOD protocol provide high QOS performance in terms of overhead, transmission delay, mobility-resilience, and scalability. In future this protocol implemented in real time tested.

2.2 A Highly adaptive distributed routing algorithm for mobile wireless networks:

In this paper a new distributed routing protocol for mobile, multihop wireless networks. The protocol is one of a family of protocols which we term "link reversal" algorithms. The protocol's reaction is structured as a temporally-ordered sequence of diffusing computations; each computation consisting of a sequence of directed link reversals. The protocol is highly adaptive, efficient and scalable; being best-suited for use in large, dense, mobile networks. In these networks, the protocol's reaction to link failures typically involves only a localized "single pass" of the distributed algorithm. This capability is unique among protocols which are stable in the face of network partitions, and results in the protocol's high degree of adaptivity. This desirable behavior is achieved through the novel use of a "physical or logical clock" to establish the "temporal order" of topological change events which is used to structure (or order) the algorithm's reaction to topological changes. We refer to the protocol as the Temporally-Ordered Routing Algorithm (TORA). In future to reduce the Performance overhead.

2.3. On the Capacity of Hybrid Wireless Networks:

A hybrid network is the transmission capacity is defined as the number of successful transmission taking place in the network per unit area, it formed by placing a sparse network of base stations in an ad hoc network. The base stations are assumed to be connected by a high-bandwidth wired network and act as relays for wireless nodes.

The wireless network consist of a number of nodes which communicate with each other over a wireless channel. They are not data sources or data receivers. Hybrid networks present a tradeoff between traditional cellular networks and pure ad hoc networks in that data may be forwarded in a multi-hop fashion or through the infrastructure. It has been shown that the capacity of a random ad hoc network does not scale well with the number of nodes in the system. In this work, we consider two different routing strategies and study the scaling behavior of the throughput capacity of a hybrid network. Analytical expressions of the throughput capacity are obtained. For a hybrid network of n nodes and m base stations, the results show that if m grows asymptotically slower than \sqrt{n} , the benefit of adding base stations on capacity is insignificant. However, if m grows faster than \sqrt{n} , the throughput capacity increases linearly with the number of base stations, providing an effective improvement over a pure ad hoc network. Therefore, in order to achieve non-negligible capacity gain, the investment in the wired infrastructure should be high enough. This protocol not support for adhoc networks. In future hybrid protocol support for adhoc networks.

III. Existing System

3.1 Two-Hop Routing Protocol:

In the Two-hop routing protocol the node transmission occurs with in a single cell. It takes only a single path transmission. Here the source node select the neighbor node the neighbor node have high bandwidth compare to source node otherwise the neighbor node have low bandwidth means source node directly transmit the message to the base station. In Two-hop, the source node adaptively chooses direct transmission (directly transmit packets to the AP) and forward transmission (transmit packets through a forwarding node) to forward packets to APs. As Two-hop and QOD only have two hops in the routing paths to APs, the short paths have lower probability to break down. Even if a link breaks down, the source node can quickly choose another forwarder. Therefore, node mobility does not greatly affect these two-hop protocols. Two-hop only concerns node bandwidth in packet forwarding rather than buffer usage, it may suffer severe buffer congestion in the selected node with high bandwidth. Two-hop in a low-mobility network.

Two-hop is mobility resilient due to its short path. Two-hop also slightly decreases as the node mobility increases. This is because faster mobility leads to higher frequency of link breakdown and hence more dropped packets on the fly. The overhead in Two-hop mainly resulted from channel information exchange for the dynamic packet forwarding and path reestablish overhead Two-hop only considers channel condition for the packet routing and ignores the buffer usage, making high-bandwidth nodes easily congested. In Two-hop, the packets are always forwarded to the nodes with higher transmission link rate. Without any buffer management strategy, the nodes with higher transmission links are very easily overloaded as the workload in the system increases. Two-hop always lets the source node forward the packets to the next hop node with high link rate without any resource.

3.2 Disadvantages of Two-Hop routing protocol:

The two hop routing protocol is a direct transmission of packets through the forwarding of the nodes and passes it over to the Access points and then to the destination it has got certain challenges:

- High overhead. Route discovery and maintenance incur high overhead. The wireless random access medium access control (MAC) required in mobile ad-hoc networks, which utilizes control handshaking and a back-off mechanism, further increases overhead.
- Hot spots. The mobile gateway nodes can easily become hot spots. The RTS-CTS random access, in which most traffic goes through the same gateway, and the flooding employed in mobile ad-hoc routing to discover routes may exacerbate the hot spot problem. In addition, mobile nodes only use the channel resources in their route direction, which may generate hot spots while leave resources in other directions under-utilized. Hot spots lead to low transmission rates, severe network congestion, and high data dropping rates.
- Low reliability. Dynamic and long routing paths lead to unreliable routing. Noise interference and neighbor interference during the multi-hop transmission process cause a high data drop rate.

Long routing paths increase the probability of the occurrence of path breakdown due to the highly dynamic nature of wireless ad-hoc networks.

IV. Proposed System

a. Distributed Three-Hop Routing Protocol (DTR) :

Distributed Three-hop Data Routing protocol (DTR), a source node divides a message stream into a number of segments. Each segment is sent to a neighbor mobile node. Based on the QoS requirement, these mobile relay nodes

choose between direct transmission or relay transmission to the BS. In relay transmission, a segment is forwarded to another mobile node with higher capacity to a BS than the current node. In direct transmission, a segment is directly forwarded to a BS. In the infrastructure, the segments are rearranged in their original order and sent to the destination. The number of routing hops in DTR is confined to three, including at most two hops in the ad-hoc transmission mode and one hop in the cellular transmission mode.

To overcome the aforementioned shortcomings, DTR tries to limit the number of hops. The first hop forwarding distributes the segments of a message in different directions to fully utilize the resources, and the possible second hop forwarding ensures the high capacity of the forwarder. DTR also has a congestion control algorithm to balance the traffic load between the nearby Basestaions in order to avoid traffic congestion at BSes. Using self-adaptive and distributed routing with high speed and short-path ad-hoc transmission, DTR significantly increases the throughput capacity and scalability of hybrid wireless ne networks by overcoming the three shortcomings of the previous routing algorithms. It has the following Features:

1. Low overhead: It eliminates overhead caused by route discovery and maintenance in the ad-hoc transmission mode, especially in a dynamic environment.
2. Hot spot reduction: It alleviates traffic congestion at mobile gateway nodes while makes full use of channel resources through a distributed multi-path relay.
3. High reliability: Because of its small hop path length with a short physical distance in each step, it alleviates noise and neighbor interference and avoids the adverse effect of route breakdown during data transmission. Thus, it reduces the packet drop rate and makes full use of special reuse, in which several source and destination nodes can communicate simultaneously without interference.

4.2 Distributed Three-Hop Routing Protocol

Algorithm:

- Step 1: The Message stream of source node divide the several segments.
- Step 2: Source node distribute the segments to the near(first) Base Station.
- Step 3: After a Base station receive the segments needs to forward the Destination node.
- Step 4: DTR select the neighbor node based on the Capacity(each node Periodically exchange their capacity level).
- Step 5: The neighbor node transmit the segments to Final Base station (near for Destination).
- Step 6: After the destination Base Station receives the segments of a message it and re-arrange the segments in to original message and the sends to Destination node.

V. Performance Evaluation

5.1 Network Simulator – NS-2:

NS-2 is an open-source simulation tool running on Unix-like operating systems. It is a discreet event simulator. It has many advantages that make it a useful tool, such as support for multiple protocols and the capability of graphically detailing network traffic.

5.2 Simulation setting:

We conducted the simulation experiments using network simulator-2 and considered the network with 10 mobile nodes. Here the base station transmit the packets randomly. The DTR algorithm will be running on background, it will measure the Performance of Packet delivery ratio, Delay, Average energy consumption, overhead and Throughput.

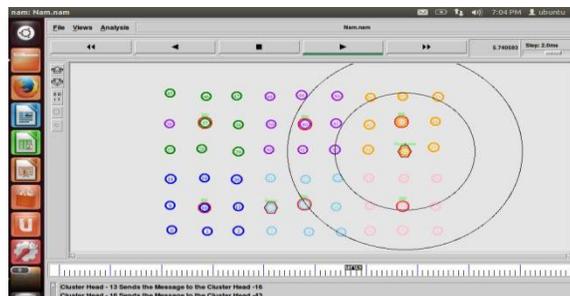


Fig.1Simulation setting

5.3 Data routing Process in DTR:

Data Routing Process in DTR divided Two steps:

1. Uplink Data Routing- Source node to First BS
2. Downlink data Routing and Data Reconstruction-Final BS to Destination node

5.4 Simulation results:

5.4.1 Simulation time Vs Packet delivery ratio:

In this graph shows the comparison of Packet delivery ratio against Simulation time. The simulation time is increased the packet delivery ratio increased 20% in Distributed Three-Hop Routing Protocol compare to Two-Hop Routing Protocol.

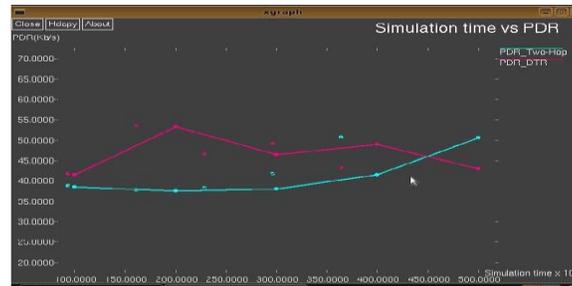


Fig 2. Simulation time Vs Packet Delivery Ratio

5.4.2 Simulation time Vs Delay:

In this graph shows the comparison of Delay against Simulation time. The simulation time is increased the Transmission delay also decreased 50% in Distributed Three-Hop Routing Protocol compare to Two-Hop Routing Protocol.

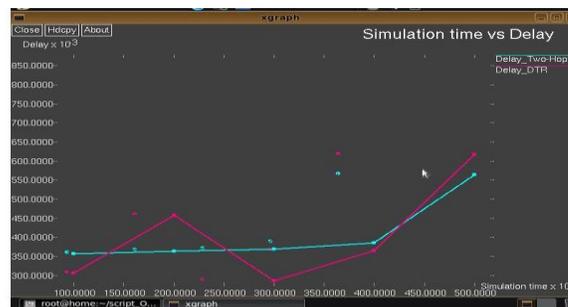


Fig 3. Simulation time Vs Delay

5.4.3 Simulation time Vs Average Energy Consumption:

In this graph shows the comparison of Average Energy Consumption against Simulation time. The simulation time is increased the Average Energy Consumption decreased 10% in Distributed Three-Hop Routing Protocol compare to Two-Hop Routing Protocol.

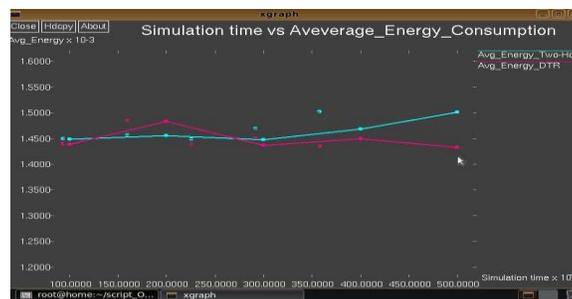


Fig 4. Simulation time Vs Average Energy Consumption

5.4.4 Mobility Vs Overhead:

In this graph shows the comparison of Mobility against Overhead. The Mobility is increased the Overhead is decreased 20% in Distributed Three-Hop Routing Protocol compare to Two-Hop Routing Protocol.



Fig 5. Mobility Vs Overhead

5.4.5 Mobility Vs Throughput:

In this graph shows the comparison of Mobility against Throughput. The Mobility is increased the Throughput is increased 20% in Distributed Three-Hop Routing Protocol compare to Two-Hop Routing Protocol.



Fig 6. Mobility Vs Throughput

VI. Conclusion

A hybrid wireless network combining an infrastructure wireless network and a mobile ad-hoc network leverages their advantages to increase the throughput capacity of the system. However, current hybrid wireless networks simply combine the routing protocols in the two types of networks for data transmission, which prevents them from achieving higher system capacity. In this paper, we propose a Distributed Three-hop Routing (DTR) data routing protocol that integrates the dual features of hybrid wireless networks in the data transmission process. In DTR, a source node divides a message stream into segments and transmits them to its mobile neighbors, which further forward the segments to their destination through an infrastructure network. DTR limits the routing path length to three, and always arranges for high-capacity nodes to forward data. Unlike most existing routing protocols, DTR produces significantly lower overhead by eliminating route discovery and maintenance. In addition, its distinguishing characteristics of short path length, short-distance transmission, and balanced load distribution provide high routing reliability and efficiency. DTR also has a congestion control algorithm to avoid load congestion in base stations in the case of unbalanced traffic distributions in networks. Theoretical analysis and simulation results show that DTR can dramatically improve the throughput capacity and scalability of hybrid wireless networks due to its high scalability, efficiency, and reliability and low overhead. In future any one good algorithm will be used for improve the hybrid network efficiency.

References:

- [1] H Luo, R. Ramjee, P. Sinha, L. Li, and S. Lu. Ucan: A unified cell and ad-hoc network architecture. In Proc. of MOBICOM, 2003. H. Wu, C. Qiao, S. De, and O. Tonguz, "Integrated cell and ad hoc relaying systems: iCAR," IEEE J. Sel. Areas Commun., vol. 19, no. 10, pp. 2105–2115, Oct. 2001.
- [2] Y. D. Lin and Y. C. Hsu, "Multi-hop cellular: A new architecture for wireless communications," in Proc. IEEE Conf. Comput. Commun., 2000, pp. 1273–1282.
- [3] P. Thiran, O. Dousse, and M. Hasler, "Connectivity in ad hoc and hybrid networks," in Proc. IEEE Conf. Comput. Commun., 2002, pp. 1079–1088
- [4] V. D. Park and M. Scott Corson, "A highly adaptive distributed routing algorithm for mobile wireless networks," in Proc. IEEE Conf. Comput. Commun., 1997, p. 1405
- [5] D. Johnson and D. Maltz, "Dynamic source routing in ad hoc wireless networks," T. Imielinski and H. Korth, eds. Mobile Computing, volume 353 of The Kluwer International Series in Engineering and Computer Science, Springer US, pp. 153–181, 1996.
- [6] R. S. Chang, W. Y. Chen, and Y. F. Wen, "Hybrid wireless network protocols," IEEE Trans. Veh. Technol., vol. 52, no. 4, pp. 1099–1109, Jul. 2003.
- [7] K. Akkarajitsakul, E. Hossain, and D. Niyato, "Cooperative packet delivery in hybrid wireless mobile networks: A coalitional game approach," IEEE Trans. Mobile Comput., vol. 12, no. 5, pp. 840–854, May 2013
- [8] B. Liu, P. Thiran, and D. Towsley, "Capacity of a wireless ad hoc network with infrastructure," in Proc. 8th ACM Int. Symp. Mobile Ad Hoc Netw. Comput., 2007, pp. 239–246.
- [9] P. Gupta and P. R. Kumar, "The capacity of wireless networks," IEEE Trans. Inf. Theory, vol. 46, no. 2, pp. 388–404, Mar. 2000.
- [10] Z. Li and H. Shen, "A distributed three-hop routing protocol to increase the capacity of hybrid networks," in Proc. Int. Conf. Parallel Process., 2009, pp. 277–284.
- [10] Haiying Shen, Senior Member, IEEE, Ze Li, and Chenxi Qiu "A Distributed Three-Hop Routing Protocol to Increase the Capacity of Hybrid Wireless Networks" VOL. 14, NO. 10, october 2015