Predictive Multi-Path Routing For Heterogeneous Wireless Network In High-Speed Vehicles

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Abstract:*Wireless networking is becoming more popular and widespread in recent computing era. Network consumers are rapidly increasing in count which also increases the count of mobile nodes and networks range. The people also need speeder and reliable network communication for current financial and commercial purposes. To solve this problem we introduce Predictive Multi-Path Routing (PMPR), which can decide Top Priority Scheduling basedrouting path from source to the destination. To take full advantage of the widespread base stations, PMPR divides a message data stream into segments and transmits the segments in a distributed manner. It makes full spatial reuse of a system via its high speed ad-hoc interface and alleviates mobile gateway congestion via its cellular interface. Furthermore, sending segments to a number of base stations simultaneously increases throughput and makes full use of widespread base stations. The paths are prevented from overlapping each other to prevent from congestion and also node selection in taken with security and latency in mind. So this Predictive Multi-Path Routing can adapt wireless networking to improve throughput of the transmission.*

Keywords:*Multipath routing, Top Priority Scheduling, Multi-Path Prediction*

I. INTRODUCTION

A. Multi-Path Network Communications

Throughput capacity is a key characteristic of wireless networks. It represents the long-term achievable data transmission rate that a network can support. The throughput capacity of a wireless network depends on many aspects of the network: network architecture, power and bandwidth constraints, routing strategy, radio interference, etc. A good understanding of the capacities of different network architectures allows a designer to choose architecture appropriate for his or her specific purpose. Several network models are available for wireless data networks. In a wireless cellular network or a wireless LAN, nodes communicate with each other through base stations or access points. A node first connects to the nearest base station or access point in order to communicate with other nodes. A base station serves as a communication gateway for all the nodes in its cell.

B. Wireless Ad Hoc Communications

In situations where there is no fixed infrastructure, for example, battle fields, catastrophe control, and wireless ad hoc networks become valuable alternatives to wireless cellular networks or wireless LANs for nodes to communicate with each other. An ad hoc network is a communication network formed by a collection of nodes without the aid of any fixed infrastructure. In an ad hoc network, due to the lack of infrastructure and the limited transmission range of each node, data needs to be routed to the destination by the nodes in a multi-hop fashion. The capacity of large hybrid wireless networks is considered in this project. The hybrid network is based on an ad-hoc network with an embedded wired infrastructure. Both types of wireless transmissions are allowed in hybrid networks: peer-to-peer and through infrastructure. The report focuses on the case when the number of base stations in the hybrid network grows sub-linearly with the network size. Previous results suggest that there exists a protocol that provides an improvement in capacity as compared to a pure ad- hoc network if the infrastructure growth is at least as fast as square root of the size of the network.

C. Throughput capacities

The success in the development of wireless communications in late 90s has resulted in the installation of commercial cellular networks. The ease of use and importance of mobility has led to the exploded use of cell phones. In many cases such systems are limited in the number of mobile users they can simultaneously handle. Market competition drives the costs lower which results in the increased number of users willing to pay for the wireless service. While the capacity performance of cellular networks has been well studied, researchers have started to investigate the capacity of wireless ad hoc networks only recently. The throughput capacity of a random wireless network, where fixed nodes are randomly placed in the network and each node sends data to a randomly chosen destination. There is only one active source and destination pair, while all other nodes serve as relay, assisting the transmission between the source and destination nodes.

D. Predictive Multi-Path Routing

The above studies all focus on the capacities of pure ad hoc network models. It is not clear how much capacity gain a network can achieve by adding a certain number of base stations to an ad hoc network and forming a hybrid network. Intuitively, on one hand, the infrastructure helps to reduce the wireless transmissions, resulting in less interference and a higher capacity. On the other hand, too much use of the infrastructure may cause hot spots around base stations and inefficient use of spatial concurrency, leading to a sub-optimal capacity. It is the purpose of this work to study the capacity of hybrid networks. In particular, we are interested in the following questions:

- How does the throughput capacity scale with the number of nodes and the number of base stations?
- How does the capacity of a hybrid network model compare to that of a pure ad hoc network?

In this project we proposed a hybrid network model with Predictive Multi-Path Routing (PMPR)to improve network connectivity and the . In the model, a sparse network of base stations connected by a wired network is placed within an ad hoc network. The resulting network consists of normal nodes and some well-connected base stations. It is called a hybrid network since it presents a tradeoff between traditional cellular networks and pure ad hoc networks. In ad hoc networks, there is no infrastructure, data can only be forwarded by the nodes in a multi-hop fashion. In cellular networks, data are always forwarded through the infrastructure. While in a hybrid network, data may be forwarded in a multihop fashion or through the infrastructure. Communications using multi-hop forwarding and communications using the infrastructure coexist in the network. It is of great interest to understand what performance gains can be achieved by the hybrid networks.

II. Related Work

Vehicular ad hoc networks (VANETs) have attracted many researchers' attention in recent years. Due to the highly dynamic nature of these networks, providing guaranteed quality-of-service (QoS) video-on-demand (VOD) [1] sessions is a challenging problem. In this paper, a new adaptive geographic routing scheme is proposed for establishing a simplex VOD transmission in urban environments. In this scheme, rather than one route, a number of independent routes are discovered between source and destination vehicles whose number of routes depends on the volume of the requested video and lifetime (span of time in which a route is almost fixed) for each route. A closed-form equation is derived for estimating the connectivity probability of a route, which is used to select best connected routes. Simulation results show the QoS parameters: packet loss ratio is decreased by 40.79% and freezing delay is significantly improved by 25 ms compared with those of junction-based multipath source routing at the cost of 2-ms degradation in the end-to-end delay.

Social behavior plays a more and more important role in delay tolerant networks (DTNs) [2]. In this paper, we present an analytical model for a hypercube-based social feature multipath routing protocol in DTNs. In this routing protocol, we use the internal social features of each node (individual) in the network for routing guidance. This approach is motivated from several real social contact networks, which show that people contact each other more when they have more social features in common. This routing scheme converts a routing problem in a highly mobile and unstructured contact space (M-space) [3] to a static and structured feature space (F-space) [3]. The multipath routing process is a hypercube-based feature matching process where the social feature differences are resolved step-by-step. A feature matching shortcut algorithm for fast searching is presented where more than one feature difference is resolved at one time. The multiple paths for the routing process are node-disjoint.

Traffic in optical backbone networks is increasing and becoming more heterogeneous with respect to bandwidth and QoS requirements due to the popularity of high-bandwidth services (such as cloud computing, e-science, telemedicine, etc.), which need to coexist with traditional services (HTTP, etc.). Mixed-line-rate (MLR) [4] networks that support lightpaths of different rates such as 10, 40, 100 Gb/s, etc., are being studied to better support the heterogeneous traffic demands.

Most routing protocols for delay tolerant networks resort to the sufficient state information, including trajectory and contact information, to ensure routing efficiency. However, state information tends to be dynamic and hard to obtain without a global and/or long-term collection process. In this paper, we use the internal social features of each node in the network to perform the routing process. In this way, feature-based routing converts a routing problem in a highly mobile and unstructured contact space to a static and structured feature space. This approach is motivated from several human contact networks, such as the Infocom 2006 trace and MIT reality mining data, where people contact each other more frequently if they have more social features in common.

The routing of packets is based on the destination address and the input interface over which the packet was received. If the trees are employed exclusively for multipath routing, then no packet overhead is required. If the trees are employed for failure recovery, then the overhead bits will range from 0 to 2 bits depending on the flexibility sought in routing. We evaluate the performance of the trees in fast recovery by comparing the path lengths provided under single- and dual-link failures with an earlier approach based on tunneling. We also evaluate the performance of the trees when used for multipath routing and compare it to equal-cost multipaths (ECMP) [5].

Hybrid wireless networks combining the advantages of both mobile ad-hoc networks and infrastructure wireless networks have been receiving increased attention due to their ultra-high performance. An efficient data routing protocol is important in such networks for high network capacity and scalability. However, most routing protocols for these networks simply combine the ad-hoc transmission mode with the cellular transmission mode, which inherits the drawbacks of ad-hoc transmission. This paper presents a Distributed Three-hop Routing protocol (DTR) [6] for hybrid wireless networks. To take full advantage of the widespread base stations, DTR divides a message data stream into segments and transmits the segments in a distributed manner. It makes full spatial reuse of a system via its high speed ad-hoc interface and alleviates mobile gateway congestion via its cellular interface.

III. PROBLEM IDENTIFICATION

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 HWN 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 generatehot 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.

A. Existing Methodology

In existing system the proposed algorithm can provide better onboard Internet services with lower cache requirements than the Earliest Delivery Path First (EDPF) and Weighted Round Robin (WRR) scheduling algorithms, in terms of bandwidth improvement and packet disorder reduction. some practical measurements of the existing 3G and 4G mobile networks have been performed in a typical high-speed environment on an HST. Then, a concurrent multipath transmission scheme, together with a network adaptive scheduling algorithm, has been proposed, which provides transparent and effective Internet services for the onboard users by multiple available wireless networks. Some of the superior properties of our algorithm have been analyzed, in terms of the length of sending queues, the buffer size for reordering, and the ability to aggregate bandwidth. Simulations and experiments have shown that the scheme can improve the QoS of Internet services on board by increasing the available bandwidth and avoiding the disorder of packets.

B. Proposed Model

To provide better network throughput, security traffic avoidance this project proposes Predictive Mulitpath Routing. This algorithm could be implemented on Heterogenious wireless network which can perform the following action. Unlike the existing system PMPR will not divide the data into several segments, it will first calculate available routes via available base stations. Then based on the paths available on the network the data is divided into N Segments. Then the sender will made N Threads to transmit data to N base stations and waits for positive feedback. The second part of the algorithm which runs on the Base Station will has the responsible to avoid congestion and traffic on the network and also to choose proper node for data transmission.

IV. PROPOSED METHODOLOGY AND PROCEDURES

A. Wireless Network Setup

Basically, there are two types of wireless network systems - base-station (BS) oriented networks and ad hoc wireless networks. In the first type, the mobile hosts communicate with base stations, while, in ad hoc networks, the mobile hosts communicate with one another directly. The BS-oriented wireless network has better performance and is more reliable. However, the ad hoc network topology is desirable because of its low cost, plug-and-play convenience, and flexibility. Its usage of bandwidth and battery power is more efficient, but route and communication connectivity is fairly weak; any migration by a host participating in one or more routes could make the route invalid. Much cost is incurred in maintaining communication. Thus, the ad hoc wireless network is only suitable for applications in a small geographical area.

B. Base Station Selection

Ping is a network diagnostic tool that's used to check if a host in a network is alive and responding. We are using this ping signal to detect available network base stations. The ping program sets an sequence identifier which gets incremented with each echo-request message. If the host is alive and responding, it sends an echo-reply message back to the source. The whole of the data is calculated to summarize the number of nodes and other such information and the summarized data is then displayed, showing the number of packets transmitted, received, percentage of packet loss, total time taken, the minimum, average and maximum round-trip time.

C. Predictive Multi-Path Route Calculation

Depending on the point where a network is sourced, there are various types of routes that could be present in hybrid wireless networks. The type of the route influences the route that is selected and installed by the router in the routing table. The available path calculated based on the available base station on the network. One of the intriguing aspects of routing selection, especially for those new to Hybrid network, is how the Base Station chooses which route is the best among those presented by routing protocols.

D. Data Segmentation

The data segmentation is done for the purpose to transmitting the data much faster in multiple paths. The segments count is equal to the number of available path on the network. The data is divided into several path and submitted to the available base station on the networks. Then it is responsible of the base station to send the data to the receiver nodes.

E. Transmission Thread Creation

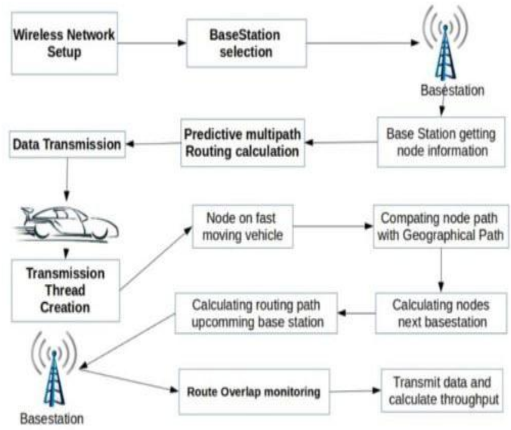
It is to create network connections and communicate through them, the fact that network communication is asynchronous. From the point of view of a program on one end of a network connection, messages can arrive from the other side of the connection at any time; the arrival of a message is an *event* that is not under the control of the program that is receiving the message. A program that wants to read data from a socket's input stream calls one of that input stream's input methods. It is possible that the data has already arrived before the input method is called; in that case, the input method retrieves the data and returns immediately. More likely, however, the input method will have to wait for data to arrive from the other side of the connection.

F. Route Overlap Monitoring

Its aim is to detect and monitor the route overlapping in the network to avoid congestion. Congestion, in the context of networks, refers to a network state where a node or link carries so much data that it may deteriorate network service quality, resulting in queuing delay loss and the blocking of new connections. In a congested network, response time slows with reduced network throughput. Congestion occurs when bandwidth is insufficient and network data traffic exceeds capacity. Data packet loss from, frame or data packet congestion is partially countered by aggressive network protocol retransmission, which maintains a network congestion state after reducing the initial data load.

G. Secure Node Selection

In the proposed model the system is implemented in the selection of network nodes. The network node has to be selected in the secured way. The node with the less traffic and with less buffer level is taken in consideration. With uniform node distribution and continuous traffic model without data fusion, no routing strategy, in general, can avoid the creation of an energy hole around the sink. However, nearly balanced energy consumption can be achieved by using non- uniform deterministic node distribution where nodes are placed in predetermined positions.



Base station selection:

Start

While ping
Send response
Get response
If response and retrieval
Get response time
Sort response time
End if
Select base station from list

Data segmentation

Start
Get data
Convert data into byte array
Get count N<-no of base station
Segment data into N parts
Create transmission thread
Send data
end data

Node_idetification

Start the program
Gather node information
And then gather node position Select node bufferrabe
Node buffer<-buffer If node buffer>traffic
Reject node
Else
Add node in list
End

Congestion detection

Start
Get path N
Monitor path
For node in path
If node transmits two data
Alert path overlap
End if
End for
End

Node Location Prediction

measure the interference μ n (t).

compute the best response set Δ n (t).
if Δ n (t) = ∅ then
contend for the decision update

opportunity.

if win the decision update contention then
choose the decision a n (t + 1) ∈ Δ n
(t) for next slot.
broadcast the RTU message to other users.

else choose the original decision a n (t + 1) =a
n (t) for next slot.

end if

else choose the original decision a n (t+1) = a n

(t) for next slot.
end if
until no RTU messages are broadcasted for M consecutive slots

I. Experimental Evaluation

We have proposed a highly adaptive distributed Predictive Multi-Path routing algorithm that is well-suited for operation in mobile wireless networks. It quickly creates and maintains loop- free multipath routing to destinations for which routing is required, while minimizing communication overhead. It rapidly adapts to topological changes, and has the ability to detect network partitions and erase all invalid routes within a finite time. As mentioned earlier, the protocol is designed to decouple the generation of far-reaching control message propagation from the dynamics of the network topology. Consequently, there is no distance estimate or link-state information propagation. A negative effect of this design choice is clear. Over time, as the link reversal process proceeds, the destination oriented Congestion control performing may become less optimally directed than it was upon creation

I. Conclusion

In this project, we studied the throughput capacity of hybrid wireless networks. A hybrid network consists of an ad hoc network and a sparse network of base stations. The base stations are connected by a wired network and placed in the ad hoc network in a regular pattern. Data may be forwarded in a multi-hop fashion as in ad hoc networks or forwarded through the infrastructure as in cellular networks. The goal of this paper is to investigate the benefit of the infrastructure to the throughput capacity and derive the asymptotic capacity of hybrid networks.

7. Future Enhancement

The current methods for topology discovery used in ad-hoc networks are typically based on the use of hello beacons which are transmitted periodically. But this method does not scale very well, especially when the density of nodes 1 is very high. When a large number of stations fall within the capture area of a given station, the possibility of the hello beacons themselves colliding and getting lost becomes very high. This can have serious consequences because routing cannot be made robust or efficient without up-to-date information about the location of nodes. Thus, there is a trade-off between the frequency at which neighbors can be notified of the nodes' presence and the bandwidth that is taken up by these hello packets.

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