General Article

Multipath Extension to DSR Protocol for Mobile Ad-hoc Network using Active Packets

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Abstract

In this paper we consider a multipath extension to the dynamic source routing DSR protocol an on demand routing protocol for ad hoc wireless networks. This extension keeps two node disjoint paths between the source and destination of a routing process without introducing extra overhead Unlike other multipath extensions where node disjoint paths are selected at the destination or at the reply phase our approach generates two node disjoint paths during the query phase of the route discovery process by restricting the way the query packet is flooded Several optimization options are also considered Simulation is Conducted to determine the success rate of finding node disjoint paths

Keywords: Ad-hoc, MANET, Caching, Routing

Introduction

Recent advances in technology have provided portable computers with wireless interfaces that allow networked communication among mobile users The resulting computing environment which is often referred to as mobile computing no longer requires users to maintain a fixed and universally known position in the network and enables almost unrestricted mobility. An ad hoc wireless network is a special type of wireless mobile network in which a collection of mobile hosts with wireless network interfaces may form a temporary network without the aid of any established infrastructure or centralized administration. The applications of ad hoc wireless networks range from civilian e.g. distributed computing sensor networks to disaster recovery search and rescue and military battled.

An ad hoc wireless network can be represented as a simple directed graph where V is the vertex set representing a set of wireless mobile hosts also called nodes and E is a set of edges representing a set of links channels. An edge v, u from v to u indicates that host u is within the wireless transmitter range of host v such a graph is also called unit disk graph or simply unit graph.

Routing is a process of sending a message from one mobile host in the network to another it is also called unicast Routing protocols for ad hoc wireless networks normally call for mobility management and scalable design Mobility management is done through information exchanges between moving hosts in the ad hoc wireless network. In general when information exchanges occur frequently the network maintains accurate information of host locations and other relevant information. However frequent information exchanges can be costly because they consume communication resources including bandwidth and power. With less frequent information exchanges these costs diminish but there is more uncertainty about the hosts location Scalable design one that works for large size networks requires both routing protocols and resource consumptions to be scalable.

Routing in the ad hoc wireless network poses special challenges because of its infrastructure less network and its dynamic topology. The tunnel based triangle routing of mobile IP works well if there is a fixed infrastructure to support the concept of the home agent. However when all hosts move including the home agent such a strategy cannot be directly applied. Traditional routing protocols for wired networks that generally use either link state or distance vector are no longer suitable for ad hoc wireless networks. In an environment with mobile hosts as routers convergence to new stable routes after dynamic changes in network topology may be slow and this process could be expensive due to low bandwidth. Routing information has to be localized to adapt quickly to changes such as hosts movement.

Routing protocols for ad hoc wireless networks can be roughly divided into proactive and reactive. In proactive routing each host continuously maintains complete routing information of the network. Both link state and distance vector belong to proactive routing. The reactive scheme on the other hand invokes a route determination procedure only on demand through a query reply approach. Dynamic source routing DSR protocol is a reactive routing protocol. The source determines the complete path for each routing process. The approach consists of route discovery and route maintenance. Route discovery allows any host to dynamically discover a route to a destination host. Each host also maintains a route cache in which it caches source

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routes that it has learned. Unlike regular routing table based approaches that have to perform periodic routing updates route maintenance only monitors the routing process and informs the sender of any routing errors. Without the use of routing tables to keep track of routes mobility management and scalable design can be relatively easy to manage. However the efficiency of DSR depends largely on the hit ratio of route cache. That is the probability a route to the destination exists in the cache. When a miss occurs the system has to invoke a relatively expensive route discovery process via flooding. In this paper we propose a novel approach to reduce the frequency of invoking the routing discovery process. The idea is to keep two node disjoint routes to each destination in the route cache. One route is designated as the primary and the other the backup. When the primary route fails the alternative route can be used without invoking a route discovery process. Another alternative is to use both paths at the same time and packets are split along paths.

Two node disjoint routes are constructed during the route discovery process by restricting the way the query packet is flflooded in the network in the query phase and the way routes are stored in the route cache of each node in the route reply phase. Other than the color mark of each node along a route and a dirty bit associated with each route in the route cache the construction process does not introduce additional overhead compared with the regular route discovery process. Several optimization options are also considered. Simulation is conducted to determine the success rate of finding node disjoint paths. Note that DSR also provides an option of constructing edge disjoint paths so that an alternate path can be used when the primary path fails. However too many paths are maintained in DSR in a trivial matter without any regard to their ultimate usefulness.

Problems with routing in mobile ad-hoc net-works

Dynamic source routing protocol DSR is a reactive routing protocol. Unlike other protocols DSR requires no periodic packets of any kind at any level within the network The approach consists of route discovery and route maintenance. Route discovery allows any host to dynamically discover a route to a destination host. Each host also maintains a route cache in which it caches source routes that it has learned. The source determines the complete path for each routing process.

When the source cannot find a route to the destination from its cache it initiates a route discovery process that consists of two phases query and reply First a query packet initiated from the source floods the network in seeking of a route to the destination When the destination receives a query packet it replies with a reply packet that copies the route from the query packet and traverses it backwards or via a different route back to the source. Route information to the destination is stored in route cache of each node as learned from the reply packet Note that more than one route reply packet may be generated at the destination However the destination can control the number of reply packets Route reply packets can also be generated at an immediate node where the route to the destination exists in

the route cache In this case the number of reply packets is difficult to control Route maintenance maintains source routes to arbitrary destinations Other details of route maintenance are of no interest here and hence they will not be discussed further It shows a routing example in a simple linear network Source s first sends out a query packet A sequence of network hops is accumulated during the query process Once the packet reaches destination d replies with a reply packet that copies the complete route survey and traverses the route backwards Route information to d is stored in route cache of each intermediate node including the source For example u includes route in its route cache Since links in the network can be unidirectional the reply phase may have to use a different route to send out the reply packet to the source.

Related work

Multipath routing is one of the favorite mechanisms to balance network tracking and to provide fault tolerance and quality of service QoS. Mathematical analysis has proven that splitting the track over the two or more paths is more efficient and provides shorter delays overall Once multiple paths are constructed there are in general two ways of using them a One path is selected as a primary and all the rest are backups Only the primary path is used to transmit packets.

Backups are used only when the primary path fails b
All paths are used at the same time and packets are split along paths To tolerate packets loss special codes such as can be used where each original packet is split into n blocks By adding m overhead blocks m n multiple paths protection against m lost blocks A hybrid approach is to use multiple paths in a round robin fashion to distribute load.

Multipath routing has been extensively studied in wired networks and Most approaches use either link state or distance vector to compute multiple paths. This proposed a multipath routing using discussing computation for packet switching networks In general multipath routing is based on constructing first either edge disjoint paths or node disjoint paths with the former being a special case of the latter The multipath routing is also captured in OSPF a link state routing protocol in Internet by the notion of equal cost multipath where track should be split equally between all the equal cost paths.

Multiple path construction in a proactive approach as used in wired networks is not suitable for ad hoc wireless networks because of its excessive overhead Some protocols for ad hoc wireless networks maintain multiple paths Other than DSR the Temporally Ordered Routing Algorithm TORA maintains a directed acyclic graph DAG for each destination with the destination being the sink of the DAG In this way edge disjoint paths are maintained for each destination, it proposed a multipath extension to DSR by constructing node disjoint paths The destination keeps a record of the first arrived packet including the complete path record initiated from a particular source The subsequent packets arrived will be discarded until a packet with a node disjoint path with respect to the first one arrives All subsequent packets are

discarded also provides two extensions to DSR The first one gives a simple extension without extra overhead Basically nodes in the neighborhood of intermediate nodes of a path are used to form a mesh structure providing alternate paths but not node disjoint.

The second approach is similar to the one proposed by Nasipuri Cartaneda and Das. The only difference is that each intermediate node can cancel a route if its length exceeds the length of the first received route Still the destination selects two node disjoint routes In all the existing multipath extensions to DSR no information from route cache can be used to construct multiple paths.

Another way of constructing node disjoint paths in DSR is based on the following strategy and In the query phase each node still forwards the query packet the first time it receives Instead of dropping all late received query packets these packets are cached for the later use In the reply phase the packet can be redirected to the source based on the cache information stored at intermediate nodes That is the selected path can be altered during the reply phase This approach however requires storing a good amount of route information at the cache storage of each node

Unlike the approach in and where node disjoint paths are selected at the destination or the approach in and where node disjoint paths are selected during the reply phase our approach generates two node disjoint paths during the query phase of the route discovery process by restricting the way the query packet is flflooded Extended Dynamic Source Routing In DSR route discovery tries to nd a path to a destination by first sending out a query through flooding If the route discovery is successful the source receives a route reply packet listing a sequence of network hops through which it may reach the destination However DSR is not suitable for constructing multiple node disjoint paths Suppose source s has multiple node disjoint paths to destination d see Figure During the query phase among three neighbors of s suppose w forwards the query packet before w and w both query packets initiated from w and w will be terminated All paths generated at the destination share the common intermediate node w This problem is called single query domination In the proposed extended dynamic source routing EDSR the probereply phases are con structured in a special way so that two node disjoint routes if they exist are constructed as the result of a route discovery Specially one route is called the black route with all nodes along the route colored black and another one is called the white route with all nodes along the route colored white A node that has a white color a black color or both colors is said to be marked for a particular route request otherwise it is unmarked Initially all nodes except the source node are unmarked The source is initially marked both white and black Color white is said to be complement to color black and vice versa We denote white black and black white In order to detect duplicate route requests received each host in the ad hoc wireless network maintains a list of source destination request id color tuples that it has received request id is a sequence number maintained at the sender Each intermediate node can be colored only once for each source destination request id and the destination can be

colored twice with one for each color To avoid the single query domination problem upon receiving the query packet for the first time each intermediate node waits for a units of time before committing to a particular color

Each sender s initially broadcasts two requests s d id black and s d id white Both requests have the same id ie the same sequence number maintained locally at s When an intermediate host v excluding destination receives a route request packet s d id color it processes the request as follows If v has been marked for s d id then the request will be discarded If v is unmarked for s d id and v received the request for the first time then the request is kept for units of time before marking v for s d id If v does not receive a route request packet of s d id color before the expiration of units of time v is marked color for s d id If v receives a route request packet of s d id color before the expiration v is randomly marked either white or black without further delay Once it is marked v performs one of the following actions

On Demand routing protocols (Reactive)

These protocols are also called reactive protocols since they don't maintain routing information or routing activity at the network nodes if there is no communication. If a node wants to send a packet to another node then this protocol searches for the route in an on-demand manner and establishes the connection in order to transmit and receive the packet. The route discovery usually occurs by flflooding the route request packets throughout the network.

Destination Sequenced Distance Vector (DSDV) Protocol

The destination sequenced distance vector routing protocol is a proactive routing protocol which is a modification of conventional Bellman-Ford routing algorithm. This protocol adds a new attribute, sequence number, to each route table entry at each node. Routing table is maintained at each node and with this table; node transmits the packets to other nodes in the network. This protocol was motivated for the use of data exchange along changing and arbitrary paths of interconnection which may not be close to any base station.

AODV (Ad-hoc On Demand Distance Vector Protocol)

It is another type of routing algorithm used in the adhoc networks .It is exactly similar to DSR protocol but the difference between the DSR from AODV and other on-demand protocol is the use of source routing ,where the source node specifies the complete sequence of intermediate nodes for each data packet to reach its destination. In AODV we don't use the concept of source routing .In AODV protocol each node maintains a table known as routing table in which we have to store the destination and next hop IP address as well as destination sequence number.

E. DSR (Dynamic Source Routing Protocol)

DSR is one of the most popular and well-known routing algorithm for ad-hoc wireless networks. In DSR protocol we used the concept of source-routing where the source node specifies the complete sequence of intermediate nodes for each data packet to reach its destination .The communication between nodes exist by forwarding data packets from one node to another by using multiple hops.

The DSR protocol allow nodes to dynamically discover a source node across multiple network hops to any destination in the ad-hoc network .The use of source routing allows packet routing to be trivially loop-free, avoids the need for up-to-date routing information in the intermediate nodes through which packets are forwarded and allows nodes forwarding or overhearing packets to cache the routing information in them.

The advantage of source routing is that no additional mechanism is required to detect routing loops. But also it has disadvantage that data packets has overhead to carry source routes. The data structure that DSR uses to store routing information is route cache with each cache entry storing one specific route from the source to destination. DSR Protocol Overview Source routing is a routing technique in which the sender of a packet determines the complete sequence of nodes through which to forward the packet[9]. DSR is broken down into three functional components: routing, route discovery and route maintenance. Routing has already been described and is relatively trivial. Route discovery and Route maintenance are discuss here.

1. Route Discovery

To perform route discovery, the source node broadcasts a route request packet with a recorded source route listing only itself. Each node that hears the route request forwards the request (if appropriate), adding its own address to the recorded source route in the packet. The route request packet propagates hop-by-hop outward from the source node until either the destination node is found or until another node is found that can supply a route to the target.
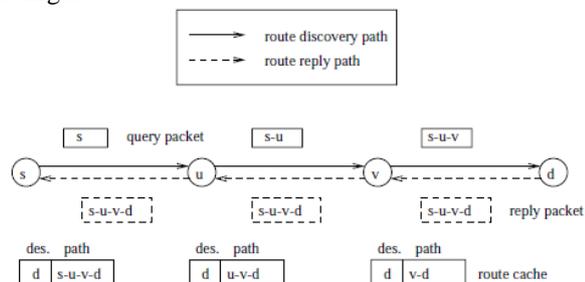

Figure 1 Query and reply phases in the route process

2. Route Maintenance

If the status of a link or node changes, the periodic updates will eventually reflect the change to all other nodes, presumably resulting in the computation of new routes. However, using route discovery, there are no periodic messages of any kind from any of the mobile nodes. Instead, while a route is in use, the route maintenance procedure monitors the operation of the route and informs the sender of any routing errors. Route maintenance can also be performed using end-to-end acknowledgments rather than the hop-by-hop acknowledgments described above.

In the proposed extended dynamic source routing EDSR the probe reply phases are constructed in a special way so that two node disjoint routes if they exist are constructed as the result of a route discovery Specially one route is called the black route with all nodes along the route colored black and another one is called the white route with all nodes along the route colored white. A node that has a white color, a black color, or both colors is said to be marked for a particular route request otherwise it is unmarked. Initially all nodes except the source node are unmarked. The source is initially marked both white and black Color white is said to be complement to color black and vice versa. We denote white` = black and black1 = white.

In order to detect duplicate route requests received each host in the ad hoc wireless network maintains a list of source destination request id color tuples that it has received request id is a sequence number maintained at the sender. Each intermediate node can be colored only once for each source destination request id and the destination can be colored twice with one for each color. To avoid the single query domination problem upon receiving the query packet for the first time each intermediate node waits for units of time before committing to a particular color. Each sender s initially broadcasts two requests (s, d, id, black) and (s, d, id, white). Both requests have the same id, i.e. the same sequence number maintained locally at s. When an intermediate host v (excluding destination) receives a route request packet (s, d, id, color) it processes the request as follows, If v has been marked for (s, d, id) then the request will be discarded. If v is unmarked for (s, d, id) and v received the request for the first time, then the request is kept for units of time before marking v for (s, d, id,). If v does not receive a route request packet of (s, d, id, color) before the expiration of units of time v is marked color for (s, d, id). If v receives a route request packet of (s, d, id, color) before the expiration v is randomly marked either white or black without further .

2. Explicit Link Failure Notification (ELFN)

- When a node detects a link failure, it will notify the TCP sender about the link failure and the packet that encountered the failure.
- When receiving a notification, TCP freezes its retransmission timer and periodically sends a probing packet until it receives an ACK.
- When receiving an ACK, TCP restores its retransmission timer and continues as normal.
- TCP benefits from link failure feedbacks but is still affected by frequent route failures due to the inability of a TCP sender's routing protocol to quickly recognize and remove stale routes from its cache.
- Previous research proposed to turn off replying from caches for a network with a single TCP connection.

But it will degrade TCP performance when multiple traffic sources exist because of increased routing overhead.
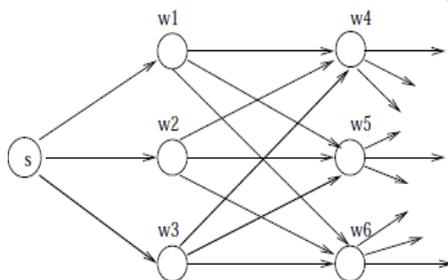

Figure 2 Single query domination problem in DSR

Related works caching

The paper further proposes caching as a technique for reducing control traffic. Caching techniques are an efficient solution for increasing he performance in message or data communication. The original idea of caching is that the data accessed by MHs has the property of temporal and spatial locality. A cooperative cache-based data access scheme is proposed for ad-hoc networks. Multipath routing is one of the favorite mechanisms to balance network trac and to provide fault tolerance and quality of service QoS Mathematical analysis has proven that splitting the traffic over the two or more paths is more efficient and provides shorter delays overall. Once multiple paths are constructed there are in general two ways of using them (a) One path is selected as a primary and all the rest are backups   Only the primary path is used to transmit packets.

Backups are used only when the primary path fails. (b) All paths are used at the same time and packets are split along paths. To tolerate packets loss special codes such as m-for-n can be used where each original packet is split into n blocks. By adding m overhead blocks m + n multiple paths over protection against m lost blocks. A hybrid approach is to use multiple paths in a roundrobin fashion to distribute load. Multipath routing has been extensively studied in wired networks.

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TORA maintains a directed acyclic graph DAG for each destination with the destination being the sink of the DAG. In this way edge disjoint paths are maintained for each destination Nasipuri Cartaneda and Das proposed a

multipath extension to DSR by constructing node disjoint paths. The destination keeps a record of the first arrived packet including the complete path record initiated from a particular source. The subsequent packets arrived will be discarded until a packet with a node disjoint path with respect to the first one arrives. All subsequent packets are discarded Lee and Gerla also provides two extensions to DSR. The firfirst one gives a simple extension without extra overhead. Basically nodes in the neighborhood of intermediate nodes of a path are used to form a mesh structure providing alternate paths but not node disjoint.

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Another way of constructing node disjoint paths in DSR is based on the following strategy. In the query phase each node still forwards the query packet the first time it receives. Instead of dropping all latereceived query packets these packets are cached for the later use In the reply phase the packet can be redirected to the source based on the cache information stored at intermediate nodes. That is the selected path can be altered during the reply phase. This approach however requires storing a good amount of route information at the cache storage of each node.

Unlike the approach where node disjoint paths are selected at the destination or the approach where node disjoint paths are selected during the reply phase. Our approach generates two node disjoint paths during the query phase of the route discovery process by restricting the way the query packet is flflooded.

A. Cache data

In cache Data, the intermediate hosts, which are located along the between the source host and the destination host, cache frequently accessed data items. In cache data, the router node caches the data instead of the path when it finds that the data is frequently accessed.
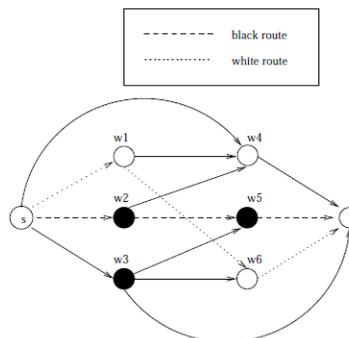
B. Cache Path

Figure 3 Sample multiple routing

In Cache path, the intermediate hosts record the routing path when information of passing data. Cache Path records

only the data path when it is closer to the caching host than the data source. To handle cache consistency, Cache Path and Cache Data is used

Conclusion

We will provide the solution of rerouting in case of broken link problem in mobile area network. As the broken link found that will be discarded from the network. As we know the mobile network is the dynamic network that provide the solution for the inclusion and exclusion of dynamic nodes in the network. We are proposing the way to find the node having packet loss and to perform the elimination of node from network without performing the rerouting.

The proposed work will provide the solution of the above problem as well provide the reliable data transfer over the network. We used two optimizations for our algorithm. First, to reduce duplicate notifications to a node, we attach a reference list to each notification. The node detecting a link failure is the root, initializing the list to be its notification list.

Each child notifies only the nodes not in the list and updates the list by adding the nodes in its notification list. Second, we piggyback a notification on the data packet that encounters a broken link if that packet can be salvaged. When using the algorithm, we also use a small list of broken links, which is similar to the negative cache proposed in prior work, to prevent a node from being re-polluted by in-flight stale routes.

Acknowledgment

The preferred spelling of the word acknowledgment in America is without an e after the g. Avoid the stilted expression, One of us (R. B. G.) Thanks. Instead, try R. B. G. thanks. Put applicable sponsor acknowledgments here; DO NOT place them on the first page of your paper or as a footnote.

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