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Implementation of Minimum Cost Blocking Problem in Multipath Wireless Routing Protocols

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Abstract— Multi-path traffic scheduling and routing protocols in wired networks are deemed superior over conventional single path protocols in terms of both enhanced throughput and robustness. We present a class of Minimum Cost blocking problems in Wireless Networks with multi-path wireless routing protocols. We establish the provable superiority of multi-path routing protocols over conventional protocols against blocking, node-isolation and network-partitioning type attacks. In our attack model, an adversary is considered successful if able to capture/ isolate a subset of nodes such that no more than a certain amount of traffic from source nodes reaches the gateways. We used Genetic algorithm in wireless network for finding minimum cost blocking problems. It blocks the abnormal activities in wireless networks when routes the packet from source to destination. Several approximation algorithms are presented which show that in the best case scenario and it is least exponentially hard for the adversary to optimally succeed in such blocking-type attacks. To the best of our knowledge, this is the first work that theoretically evaluates the attack-resiliency and performance of multi-path protocols with network node mobility. It is also observed that genetic algorithm searches faster than some of the other evolutionary algorithms used for minimum cost blocking problems.

Keywords— "Attacks, Blocking, Multi-path routing, Genetic algorithm, Wireless Network"

I. INTRODUCTION

In wireless networks, even though the dynamic nature of networks and resource constraints entail additional overhead in maintaining and reconfiguring multiple routes, which could offset the benefits seen in wired networks, research has proven that multipath routing provides better Quality of Service guarantees. This adopts a unique approach to further assay their utility by investigating the security and robustness offered by such protocols. Genetic algorithm used in wireless network for finding minimum cost blocking problems. The genetic algorithm is a method for solving both constrained and unconstrained optimization problems that is based on natural selection, the process that drives biological evolution. The genetic algorithm repeatedly modifies a population of individual solutions. At each step, the genetic algorithm selects individuals at random from the current population to be parents and uses them to produce the children for the next generation. Over successive generations, the population "evolves" toward an optimal solution. We can apply the genetic algorithm to solve a

variety of optimization problems that are not well suited for standard optimization algorithms, including problems in which the objective function is discontinuous, non differentiable, stochastic, or highly nonlinear. The genetic algorithm can address problems of mixed integer programming, where some components are restricted to be integer-valued. Wireless Networks are considered as the underlying representative network model. They have a unique system architecture where they have nodes communicating wirelessly over multiple hops to a backbone network though multiple available network gateways. Primary traffic in the WMNs is between the backbone network and mobile nodes/stationary. These make wireless network ideal candidates for applying the full scope of any wireless multi-path protocols and study the impact of these attack scenarios.

II. LITERATURE REVIEW

System demonstrates the superiority of multi-path protocols over traditional single path protocols in terms of resiliency against blocking and node isolation-type attacks, especially in the wireless networks domain. Multi-path protocols for wireless network make it extremely hard for an adversary to efficiently launch such attacks. Multi-path routing protocols unlike standard routing protocols intend to discover multiple paths between source and a destination node. Their utility lies in compensating for the dynamic and unpredictable nature of networks. Specifically, the multiple paths provide load balancing, fault tolerance and higher aggregate bandwidth. It has been proven that using multi-path routing in dense networks enhances performance and result in better throughput than unipath routing. Specifically, the multiple paths provide load balancing, fault tolerance and higher aggregate bandwidth. a new multi-path routing protocol for heterogeneous networks where they choose QoS as a routing metric. However, it is important to note that unlike unipath routing, multi-path routing metrics are aggregate in nature, i.e., paths at each hop are chosen to maximize/minimize the *sum* of the individual paths at each hop and not choose the best path each hop.

A. About Genetic Algorithm

The genetic algorithm is a method for solving both constrained and unconstrained optimization problems that is based on natural selection, the process that drives biological evolution. The genetic algorithm repeatedly modifies a population of individual solutions. At each step, the genetic algorithm selects individuals at random from the current population to be parents and uses them to produce the children for the next generation. Over successive generations, the population "evolves" toward an optimal solution. We can apply the genetic algorithm to solve a variety of optimization problems that are not well suited for standard optimization algorithms, including problems in which the objective function is discontinuous, non differentiable, stochastic, or highly nonlinear. The genetic algorithm can address problems of mixed integer programming, where some components are restricted to be integer-valued. Genetic algorithm generates a population of points at each iteration. The best point in the population approaches an optimal solution. It selects the next population by computation which uses random number generators.

B. About NS2

The network simulator is discrete event packet level simulator. The network simulator covers a very large number of applications of different kind of protocols of different network types consisting of different network elements and traffic models. Network simulator is a package of tools that simulates behaviour of networks such as creating network topologies, log events that happen under any load, analyse the events and understand the network. Well the main aim of our first experiment is to learn how to use network simulator and to get acquainted with the simulated objects and understand the operations of network simulation and we also need to analyse the behaviour of the simulation object using network simulation.

Network Simulator is mainly based on two languages. They are C++ and Tcl. Tcl is the object oriented version of Tool Command language. The network simulator is a bank of different network and protocol objects. C++ helps in the following way:

1) It helps to increase the efficiency of simulation.
2) It is used to provide details of the protocols and their operation.
3) It is used to reduce packet and event processing time.

Tcl helps in the following way:

1) With the help of Tcl we can describe different network topologies
2) It helps us to specify the protocols and their applications
3) It allows fast development
4) Tcl is compatible with many platforms and it is flexible for integration
5) Tcl is very easy to use and it is available in free.

III.ANALYSIS OF PROBLEM

The initial goal of this work was to study and analyse techniques to support multi-path routing in wireless networks. When we use unipath for sending packets from source to destination. Path will block sometimes so that packet does not reach to destination. If we used unipath, it also takes time for sending packet. So we used multipath routing protocol for minimum cost blocking problem. From the works surveyed, AODV-DM emerged as a protocol able to find non interfering routes with a reasonable signalling cost. Unfortunately, the latency in the discovery of the second route seemed very large. Our first idea was to modify the protocol in an attempt to speed up the route discovery process. Eventually, this effort leads to the design of a cluster-based algorithm for route discovery and maintenance. Multi-path traffic scheduling and routing protocols in wired networks are deemed superior over conventional single path protocols in terms of both enhanced throughput and robustness. In wireless networks, even though the dynamic nature of networks and resource constraints entail additional overhead in maintaining and reconfiguring multiple routes, which could offset the benefits seen in wired networks, research has proven that multi-path routing provides better Quality of Service guarantees. Blocking, node-isolation and network-partitioning type attacks are easy to launch and are effective in the wireless networks domain due to channel constraints and dynamic network topologies.

In this subsection we study routing protocols that use multiple paths rather than a single path in order to enhance network performance. The fault tolerance (resilience) of a protocol is measured by the likelihood that an alternate path exists between a source and a destination when the primary path fails. This can be increased by maintaining multiple paths between the source and destination at the expense of increased energy consumption and traffic generation. These alternate paths are kept alive by sending periodic messages. Hence, network reliability can be increased at the expense of increased overhead in maintaining the alternate paths. We proposed an algorithm that routes data through a path whose nodes have the largest residual energy. The path is changed whenever a better path is discovered. The primary path will be used until its energy falls below the energy of the backup path, at which time the backup path is used. Using this approach, the nodes in the primary path will not deplete their energy resources through continual use of the same route, hence achieving longer life. However, the path switching cost was not quantified in the article. We proposed the use of a set of suboptimal paths occasionally to increase if time of the network. These paths are chosen by means of a probability that depends on how low the energy consumption of each path is. The path with the largest residual energy when used to route data in a network may be very energy-expensive too, so there is a trade off between minimizing the total power consumed and the residual energy of the network. We proposed an algorithm in which the residual energy of the route is relaxed a bit in order to select a more energy efficient path.

In multipath routing was used to enhance the reliability of wireless network. The proposed scheme is useful for delivering data in unreliable environments. It is known that network reliability can be increased by providing several paths from source to destination and sending the same packet on each path. However, using this technique, traffic will increase significantly. Hence, there is a trade-off between the amount of traffic and the reliability of the network. This trade off is studied in using a redundancy function that is dependent on the multipath degree and failing probabilities of the available paths. The idea is to split the original data packet into sub packets and then send each sub packet through one of the available multipath. It has been found that even if some of these sub packets are lost, the original message can still be reconstructed. According to their algorithm, it has also been found that for a given maximum node failure probability, using a higher multipath degree than a certain optimal value will increase the total probability of failure. Directed diffusion is a good candidate for robust multipath routing and delivery. Based on the directed diffusion paradigm, a multipath routing scheme that finds several partially disjoint paths is studied in alternate routes are not node disjoint, i.e., routes are partially overlapped. It has been found that the use of multipath routing provides a viable alternative for energy-efficient recovery from failures in wireless network. The motivation for using these braided paths is to keep the cost of maintaining the multipath low. The costs of alternate paths are comparable to the primary path because they tend to be much closer to the primary path.

IV. GENETIC ALGORITHM FORMULATION

In a genetic algorithm, many individual solutions are randomly generated to form an initial population. This population then evolves over successive generations to give better solutions. Each generation is comprised of various phases, the most important being – fitness evaluation, selection (competition), reproduction (cross-over) and mutation. Fitness evaluation is the step in which the quality of an individual is assessed. Selection is an operation used to decide which individuals to use for reproduction and mutation in order to produce new search points. Reproduction is the process by which the genetic material in two or more parent individuals is combined to obtain one or more offspring. Mutation is normally applied to one individual in order to produce a new version of it where some of the original genetic material has been randomly changed.

An individual is represented as a string of numbers known as a chromosome. Chromosomes are composed of genes where each gene is a set of values called alleles that represents an encoded decision variable. The binary encoding scheme of the decision variables is used for test interval optimization, due to its simplicity in mutation

operation and also because the range constraint is automatically implicit. . In a black hole attack, a particular node in a network falsely advertises a route based on metrics specific to the protocol to the destination node so as to force the route discovery algorithm to choose a route through in it. The actual black hole attack occurs when the malicious node drops packets and hence blocks paths to the destination. Similarly, in a wormhole attack, an attacker records at packets at one location in the network, tunnels them to another location, and retransmits them into the network. However, it has to be also noted that multi-path routing is not necessarily affected by wormhole attacks. We do not consider black hole and wormhole attacks explicitly in this paper. Further, Sybil attack where a node can be assigned multiple identities is precluded from our threat model since the focus is on primarily the blocking attack.

A. Energy

A wireless network interface can be in one of the following four states: Transmit, Receive, Idle or Sleep. the protocols selecting the path consuming the minimum energy. The advantage is that each transmission of a packet from its source to its destination minimizes the energy consumed.

```
BEGIN {   total_pkts = 0;
          count = 0;
       }
       {      event = $1
              time = $2
              energy = $6
             printf"%f %f\n",time,energy
       }
  END {

       }
```

B. Throughput

In wireless network, network throughput is the average of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second or data packets per time slot.

```
BEGIN {   start = 0;
          sent_packets = 0;
          count = 0;
          thruput=0;
       }
       {      event = $1
              time = $2
              node_id = $3
             pkt_size = $8
             level = $4
            if(event=="s")
               {
                  start = 1;
                  sent_packets = pkt_size;
                  start_time = time;
               }
          else if(event=="r" && start==1 && sent_packets>0)
               {
                  start=0
                  end_time = time
                  latency = (end_time - start_time);
                  if(latency == 0)
                  {
                           latency = 0.0000001;
                  }
                  thruput = pkt_size / latency
                  printf"%f %f\n",time,thruput
                  count = count + 1
```



```
            }
        }

END {
    }
```

V. PROPOSED WORK

Blocking, node-isolation and network-will be too many parameters to the consider Partitioning type attacks are easy to launch and there are effective in the wireless networks domain due to the channel constraints and dynamic network topologies. We also try to design best-case scenarios for these attacks to succeed. Both low node-mobility and high node-mobility scenarios are considered. For comparison purposes, we also launch similar attacks on conventional single-path protocols and measure their impact. As we consider multipath routing protocols, the attacker has to consider the operation of multi-path routing since multiple paths will exist from the source to the destination. This attack cost due to the nodes close proximity to base stations. In a black hole attack, a particular node in a network falsely advertises a route based on metrics specific to the protocol to the destination node so as to force the route discovery algorithm to choose a route through in it. The actual black hole attack occurs when the malicious node drops packets and hence blocks paths to the destination. Similarly, in a wormhole attack, an attacker records at packets at one location in the network, tunnels them to another location, and retransmits them into the network. However, it has to be also noted that multi-path routing is not necessarily affected by wormhole attacks.

In a genetic algorithm, many individual solutions are randomly generated to form an initial population. This population then evolves over successive generations to give better solutions. Each generation is comprised of various phases, the most important being fitness evaluation, selection, reproduction and mutation. Fitness evaluation is the step in which the quality of an individual is assessed. Selection is an operation used to decide which individuals to use for reproduction and mutation in order to produce new search points. Reproduction is the process by which the genetic material in two or more parent individuals is combined to obtain one or more offspring. Mutation is normally applied to one individual in order to produce a new version of it where some of the original genetic material has been randomly changed. An individual is represented as a string of numbers known as a chromosome. Chromosomes are composed of genes where each gene is a set of values called alleles that represents an encoded decision variable. The binary encoding scheme of the decision variables is used for test interval optimization, due to its simplicity in mutation operation and also because the range constraint is automatically implicit. Using genetic algorithm, we calculated energy, throughput, jitter, delay and packet determination. We plotted the graph of energy, throughput, jitter, delay and packet determination.

VI. CONCLUSIONS

This system demonstrates the superiority of multi-path protocols over traditional single-path protocols in terms of resiliency against blocking and node isolation-type attacks, especially in the wireless networks domain. Multi-path protocols for wireless network make it extremely hard for an adversary to efficiently launch such attacks. We believe that the results of our research will impact a number of areas including the security and robustness of routing protocols in mesh networks, threshold cryptography and network coding. Moreover, even though we do not necessarily consider insider attacks, we would like to point out that our analysis does allow for an attacker to possess topological information of the network, which is the case of an insider attack. Even in this case, our analysis shows that staging a blocking attack is hard for the attacker, in a network of reasonable size.

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