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DYNAMIC ROUTING WITH SECURITY CONSIDERATIONS

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Abstract- One of the major issues for data communication over wired and wireless networks is the sensitive data security. In the past decades, various security-enhanced measures have been proposed to improve the security of data Transmission. The past works are based on the designs of cryptography algorithm. we proposed a Dynamic routing algorithm as improved dynamic routing with security consideration, and it is based on the concept of Zone Routing Protocol ZRP ZRP could randomize delivery paths for data transmission. This algorithm is easy to implement and follow popular routing protocols, such as the Routing Information Protocol R IP in wired networks and Destination-Sequenced Distance Vector D SDV protocol in wireless networks without introducing extra control messages. By doing so improves security as well as controls traffic in the network. In the past decades, a series of simulation experiments are conducted to verify the results and to show the capability of the proposed algorithm. Given algorithm is mainly proposed to improve the security and to overcome the limitations existing with the present cryptographic algorithms and protocols. Despite the fact that some designs such as IP security, Secure Socket Layer provide essential security, but they unavoidably introduce substantial overheads in the Gateway/Host performance and effective network bandwidths. The main objective of the project is to propose a dynamic routing algorithm to improve the security of data transmission.

Keywords- SSL Secure socket Layer, Routing information protocol, Distance-Sequenced Distance Vector Routing, Bellman Ford Algorithm

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Introduction

In the past decades, various security-enhanced measures have been proposed to improve the security of data transmission over public networks. Present work on security-enhanced data transmission includes the designs of cryptography algorithms and system infrastructures and security-enhanced routing methods. Their common objectives are mostly to defeat various threats over the Internet, mainly eavesdropping, spoofing, session hijacking, etc. Among many known designs for cryptography based systems, the IP Security I PSec [3] and the Secure Socket Layer SSL [1] are popularly supported and implemented in many systems and platforms. Although SSl and IPSec do greatly improve the security level for data transmission, they Surely introduce substantial overheads [1,3,7], especially on gateway/host performance and effective network bandwidth. For example in the data transmission overhead is 5 cycles/byte over an Intel Pentium II with the Linux IP stack alone, and the overhead increases to 68 cycles/byte when Advanced Encryption Standard AES [10] is adopted for encryption/decryption for IPSec [7]. Another alternative for security-enhanced data transmissionis to dynamically route packets between each source and its destination so that the chance for system break-in, due to successful interception of consecutive packets for a session, is slim. The intention of security-enhanced routing is different from the adopting of multiple paths between a source and a destination to increase the throughput of data transmission. particularly, Lou, et al. [4,5] proposed a secure routing protocol to improve the security of end-to-end data transmission based on multiple path deliveries. The set of multiple paths in between each source and its destination is determined in an online fashion, and extra control message exchanging is necessary. Bo hacek, et al. [2] proposed a secure stochastic routing mechanism to improve routing security. Similar to the work proposed by Lou, et al. [8,9], a set of paths is discovered for each source and its destination in an online fashion based on message flooding. Therefore, a mass of control messages is needed. Yang and Papavassiliou [5] explored the trading of the security level and the traffic dispersion. They introduced a traffic dispersion scheme to reduce the probability of eavesdropped information along the used paths provided that the set of data delivery paths is discovered in advance. Although excellent research results have been proposed for security-enhanced dynamic routing, most of them rely on the discovery of different multiple paths either in an online or offline fashion. For them online path searching methods, the discovery of multiple paths includes a significant number of control signals over the Internet. as well as, the discovery of paths in an offline fashion might not be suitable to networks with a dynamic changing configuration. Therefore, in this paper we will propose a dynamic routing algorithm to provide security enhanced data delivery without introducing any extra control messages

Secure Socket Layer

In Secure Socket Layer we concern with the implementation of the client and server entities and the SSL transaction between respective client and server. This transaction comprises of the authentication, key exchange and large data transfer. Our implementation ensures secure and reliable communication message exchange and data transfer files between the two entities. Now-a-days Information is one of the most valuable resources in the world. Whether it is an informal letter or an industrial secret, all information or data has a worth to someone. This considers issues of security and privacy for such information or data that is stored. It discusses the reasons for wishing to provide security for the data and the methods available for doing so. For secure transmission of information between the sockets at distant places which mainly requires security so that the message or data may not be tampered while it has been transferred. When a client and server communicate with each other, SSL ensures that the connection is private and secure by providing authentication and encryption. Authentication confirms that the server and the client are trustworthy. Encryption then creates a secure “tunnel” between the two, which helps to prevents any unauthorized system from reading the data. SSL enabled clients Netscape or Microsoft browser) and SSL-enabled servers such as Apache or IIS confirm each other’s identities using digital certificates.

Digital certification is done by trusted third parties called Certificate Authorities or CAs and provide information about an individual’s claimed identity, as well as their public key. With the help of validating digital certificates both parties can ensure that an imposter has not intercepted a transmission.

Existing System

Existing work on security-enhanced data transmission includes the designs of cryptography algorithms and system infrastructures and security enhanced routing methods. Their common objectives are mostly to defeat various threats over the Internet, such as eavesdropping, spoofing, session hijacking, etc. Among many known designs for cryptography based systems, the IP Security and the Secure Socket Layer SSL are popularly supported and implemented in many systems and platforms. Although SSL and IPSecdo greatly improve the security level for data transmission, they unavoidably introduce to much overheads, mainly on gateway/host performance and effective network bandwidth

Proposed System

The objective of this work is to explore a security-enhanced dynamic routing algorithm based on distributed routing information widely supported in existing networks. In other words, routing protocols over networks could be classified roughly into two kinds:distance-vector algorithms and link-state algorithms [10]. Distance- vector algorithms rely on the exchanging of distance information among neighboring nodes for the seeking of routing paths. Examples for distance-vector-based routing algorithms include RIP and DSDV. Link-state algorithms are mostly used in the Open Shortest Path First protocol [10] are for global routing in which the network topology is known by all nodes. Our Objective is to propose a distance-vector-based algorithm for dynamic routing to improve the security of data transmission. We will propose a dynamic routing algorithm that could randomize delivery paths for data transmission. The proposed algorithm is easy to implement and compatible with popular routing protocols, such as the RIP in wirednetworks and Destination-Sequenced Distance Vector protocol in wireless networks, without extra control messages.

Methods Used/Literature Survey

Bellman Ford Algorithm

In Bellman-Ford algorithm, single source shortest paths in a weighted digraph is computed. For graphs with only non-negative edge weights, the faster Dijkstra's algorithm also gives solution to the problem. Thus, Bellman-Ford is used for graphs with negative edge weights. Bellman-Ford’s basic structure is very similar algorithms like Dijkstra's algorithm, but despite of selecting the minimum-weight node not yet processed to be relaxed, it also relaxes all the edges, and does this |V|-1 times, where |V| is the number of vertices. In the graph, repetitions allow minimum distances to propagate. As in the absence of negative cycles, the shortest path can only visit each node only ones. Not like the greedy approach, which depends on some specific structural assumptions derived from real positive weights, this straightforward approach extends to the general case.

Routing Information Protocol R IP

The Routing Information Protocol RIP is a dynamic routing protocol used in local and wide area networks and it is also classified as an interior gateway protocol IGP which uses the distance-vector routing algorithm. The protocol has been extended several times which results in RIP Version 2 RFC 2453. Today both versions are still used and they are considered technically outdated by more advanced techniques like Open Shortest Path First OSPF and the OSI protocol. Routing Information Protocol RIP is also been use in IPv6 networks, also known as RIPng.

The Routing Information Protocol RIP is a distance-vector routing protocol, which means the hop count as a routing metric. The hold down time is 180 seconds. This protocol prevents routing loops by implementing a limit on the number of hops allowed in a path from the source to a destination but number of hops allowed for RIP does not exceed 15. This hop limit, however, also limits the size of networks which RIP could support. If a hop counts 16 then it is considered an infinite distance and used to deprecate undesirable routes in the selection procedure. RIP implements the split horizon, route positioning and hold-down mechanisms to prevent incorrect routing information from being spread. Due to stability features of RIP it is also possible to use RMTIR outing Information Protocol with Metric-based Topology Investigation algorithm to cope with the problem which helps in detecting every possible loop with a very small computation effort.

Destination-Sequenced Distance Vector routing

Destination-Sequenced Distance-Vector Routing DSDV which is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm which was developed by C. Perkins and P. Bhagwat in 1994 and its major role was to solve the Routing Loop problem. Each entry in the routing table contains a sequence number. Generally, the sequence numbers are even if a link is present otherwise an odd number is used. As number is generated by the destination were as the emitter needs to send out the next update with the number generated by destination. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently. The procedure in selection of router is as follows. If a new information is received by the router, then the latest sequence number is used. If the sequence number is the same as the one already in the table, then the route with the better metric is used. The entries that have not been updated for a while are called stale entries. Such entries and the routes using those nodes as next hops are deleted.

Adaptive Multipath Routing for Dynamic Traffic Engineering

CMR Concurrent Multipath Routing is often taken to mean simultaneous management and utilization of multiple available paths for the transmission of streams of data emanating from an application. In this, each stream is assigned a separate path, uniquely to the extent supported by the number of paths available. If the number of streams more than available paths then some streams will share paths with each other. It provides maximized utilization of available bandwidth by creating multiple active transmission queues. It also provides a methods of fault tolerance, if a path fail then only the traffic assigned to that path is affected and the other paths continuing to serve their stream flows. An alternative path immediately available upon which to continue or re start the interrupted stream.

This method provides a best transmission performance and fault tolerance by providing:

- A simultaneous, parallel transport over multiple carriers.
- A load balancing over available assets.
- An avoidance of path discovery when re- assigning an interrupted stream.

A more powerful form of CMR true CMR) goes beyond merely presenting paths to applications to which they may bind. True CMR combines all available paths into a single and virtual path. Other all applications offer their packets to the given virtual path, which is demuxed on the Network Layer and the packets are then being distributed to the actual paths via some method such as round-robin or weighted fair queuing. If a link fail, succeeding packets are not directed to those paths. Thus the stream continues uninterrupted to the application. And thus method provides significant performance benefits over the former:

- By initially providing packets to all paths, the paths are more fully utilized.
- No matter how many nodes fails, at least one path constituting the virtual path is still available and all sessions remain connected. This results that no streams need to be restarted from the beginning and node-connection penalty is incurred.

It is noted that true CMR may cause Out Of Order Delivery (OOOD) of packets, which is severely Weakening the standard TCP. Whereas standard TCP has proved to be inappropriate used for wireless environments and is also augmented by a facility, such as a TCP gateway, that are designed to meet the challenges. The gateway tool like SCPS-TP, through its Selective Negative Acknowledgement SNACK) capability deal successfully with the OOOD problem. Another major use of true CMR is that it is desperately needed in wireless network communications due to its support for enhanced security. For an exchange to be compromised so multiple number of the routes it traverses must be compromised.

Analysis of an Equal-Cost Multi-Path Algorithm

Equal-cost multi-path routing ECMP is a routing strategy where next hop packet forwarding to a single destination can occur over multiple best paths and which tie for top place in routing metric illustration. As multipath routing can be used in conjunction with most routing protocols and it provides a per-hop decision that is limited to a single router. It causes substantial increases in bandwidth by adding load-balancing traffic over multiple paths.

Load balancing by per-packet multipath routing is generally deprecated due to the impact of rapidly improving latency, packet rearranging and maximum transmission unit (MTU) which differences within a network flow and which can disrupt the operation of many Internet protocols. In many situations, ECMP may not offer any real advantage over best-path routing like if the multiple best next-hop paths to a destination re converge downstream into a single low-bandwidth path and it will add complexity to the traffic paths to that destination without improving any available bandwidth. Were as ECMP may also interact negatively with other routing algorithms where the physical topology of the system differs from the logical topology like in systems that employ VLANs at layer 2, or virtual circuit-based architectures such as ATM or MPLS. Multipath routing is the routing technique of using multiple alternative paths over a network and can yield a variety of benefits like fault tolerance, increased bandwidth, or improved security in the network. But the multiple paths computed might be overlapped. Extensive research has been done on multi-path routing techniques but multi-path routing is not yet widely used in practice now.

Zone Routing Protocol

The Zone Routing Protocol ZRP w as introduced in 1997 by Haas and Pearlman which is either a proactive or reactive protocol and it is a hybrid routing protocol. Zone Routing Protocol combines the advantages from proactive and reactive routing OLSR). It takes the advantage of pro-active discovery within a node's local neighborhood Intra zone Routing Protocol IARP, and using a reactive protocol for communication between these neighborhoods protocol like Inter zone Routing Protocol IERP. Broadcast Resolution Protocol BRP is responsible for the forwarding of a route request. It shown in the [Fig-1]. ZRP divides its network in different zones. Which means the nodes local neighborhood and each node may be within multiple overlapping zones but each zone may be of a different size. The size of a zone is not determined by any measurement. It is given by a radius of length and where the number of hops is the perimeter of the zone. Each node has its own zone. Radius=2 for Hop E, D, B, J, E and H are border-nodes in the system.

Before constructing a zone and the border nodes, a node needs to know about its local neighbors. A node may use the media access control MAC) protocols to learn about its direct neighbors. It also may require a Neighbor Discovery Protocol NDP. ZRP does not strictly specify the protocol used but allows for local independent implementations. NDP relies on the transmission of hello messages by each other nodes. When the node like node A gets a response from a node B which has received the hello messages and the node A realized that it has a direct point-to-point connection with that node B.

Problem Analysis

Hybrid Broadcast Routing With Security Considerations

Notations And Data Structure

The objective of this section is to propose a hybrid broadcast routing algorithm to improve the security of data transmission. The hybrid Routing with security consideration Protocol is based on zone routing protocol ZRP [3,4]. Like ZRP it Performs intra zone and inter zone routing; however, it differs from ZRP in security aspects. In ZRP where there is no security consideration, hybrid broadcast routing with security Consideration designed to address all measure security concerns like end to end authentication, message/packet integrity as well as data confidentiality during both intra and inter-zone routing. For end to end authentication and nformation integrity RSA digital signature mechanism [5] is employed, where as data confidentiality is ensured by an integrated approach of both symmetric and asymmetric key encryption [6]. Each communicating node has two pairs of private/public keys, one pair is for signing and verifying and the other for encrypting and decrypting. We propose to rely on existing information exchanged among neighboring nodes referred to as routers as well in this paper) for the seeking of routing paths. In ZRP. each node Ni maintains a routing table [Table-1] in which each entry is associated with a tuplet, WNi, t, Next hop, where t, WNi, t, and Next hop denotes unique destination node, uses an estimated minimum cost to send a packet to t, and the next node along the minimum-cost path to the destination node, respectively. With the goal of this work in the randomization of routing paths, the complete routing table shown in [Table-1] is extended to accommodate our security enhanced dynamic routing algorithm. In the extended routing table, we chose to associate each entry with a tuplet, WNi, t, CtNi, HtNi CtNi is a set of node candidates for the next hop note that the candidates election will be elabo-rated in Procedure 2 of Section 3.2, where one of the next hop candidates that have the minimal cost is marked. HtNi as a set of tuples, used to records the history for packet deliveries through the node Ni to the destination node t. Each tuple Nj, hNj in HtNi is used to represent that Ni previously used the node hNj as the next hop to forward the packet from the source node Nj to the destination node t. Nbri and wNi, Nj represents the set of neighboring nodes for a node Ni and the cost in the delivery of a packet between Ni and a neighboring node Nj, respectively. Each node Ni used to maintains an array referred to as a link table in which each entry corresponds to a neighboring node Nj Є Nbri and contains the cost for a packet wNi, Nj delivery. size of a routing table depends on the topology and the node number of a network under discussions. In the worst case scenario, we have a fully connected network. For every entry in the routing table shown in [Table-2], the additional spaces required for recording the set of node candidates as shown in the third column of [Table-2] and for recording the routing history as shown in the fourth column of [Table-2] are O(|N|. Because there are |N| destination nodes at most in each routing table, the additionally requires fre spaces for the entire routing table for one node are O(|N|2. Since the provided distributed dynamic routing algorithm HBRA is a distance- vector-based routing protocol for intra domain systems, have limited number of nodes and the network topology is hardly fully connected. Hence, the increase in space requirement is considerably small However, its impact of the space requirement on the search time will be analyzed in the following section [1,2] The proposed algorithm achieves considerably small path similarity for packet deliveries between a source node and the corresponding destination node. However, the total space requirement would increase to store some extra routing information. The size of a routing table depends on the topology and the node number of a network under discussions. In the worst case, we have a fully connected network. For each entry in the routing table shown in [Table-2], the additional spaces required for recording the set of node candidates as shown in the third column of [Table-2] and for recording the routing history as shown in the fourth column of [Table-2] are O(|N|. Because there are |N| destination nodes at most in each routing table, the additionally required spaces for the entire routing table for one node are O(|N|2. Since the provided distributed dynamic routing algorithm HBR A is a distance-vector-based routing protocol for intra domain systems, the number of nodes is limited, and the network topology is hardly fully connected. Hence, the increase of the total space requirement is considerably small However, the impact of the space requirement on the search time will be analyzed in the following section[2,3]

Table 1- The routing table for the original distance-vector-based routing algorithm

Destination Nodet	Cost WNi,,t	Nexthop
N1	9	N6
N2	10	N21
N3	11	N9

Table 2- The routing table for the proposed security enhanced routing algorithm

Destination Nodet	Cost wNi, t	Next hop Candidates C Ni	History Record for Packet Deliveries to The Destination Nodet (HNi t
N1	9	{N6, N21, N9}	{(N2, N21, N3, N6,…, N31,N20}
N2	10	{ N9, N21}	{(N1, N9, N3, N9,…, N31,N21}
N3	11	{ N9}	{(N1, N9, N2, N9,…, N31,N9}

Hybrid Broadcast Routing With Security Consideration Algorithm

The HBRA introduced in this paper consists of two parts

1. Randomization process for packet transmission and
2. Maintenance and improvement of the extended routing table.

Randomization Process

Consider the delivery of a packet with the destination tata node Ni. In order to minimize the probability that packets are eavesdropped over a specific link, a randomization process for packet deliveries shown in Procedure 1 is adopted. In this process, the previous next hops defined in of **Table 1b** for the source node s is identified in the first step of the process line 1. Then, the process randomly picks up a neighboring node in excluding hs as the nexthop for the current packet transmission. The exclusion of hs for the nexthop selection avoids transmit- ting two consecutive packets in the same link, and the randomized pickup prevents attackers from easily predicting routing paths for the coming transmitted packets.

```
Randomized Selector s, t, pkt)
1: Let hs be the used nexthop for the delivery for the source node s.
2: if hs Є CtNi then
3: if | CtNi |> 1 then
4: Randomly choose a node x from { CtNi -hs } as a nexthop, and
send the packet pkt to the node x.
5: hs← x, and update the routing table of Ni..
6: else
7: Send the packet pkt to hs.
8: end if
9: else
10: Randomly choose a node y from CtNi as a nexthop, and
send the packet pkt to the node y.
11: hs← y, and update the routing table of Ni.
12: end if
```

Routing Table Maintenance

Let every node in the network be given a routing table and a link table. We assume that the link table of each node is constructed by an existing link discovery protocol, such as the Hello protocol. On the other hand, the construction and maintenance of routing tables are revised based on the well- known Bellman-Ford algorithm [4] and described below.

DV Process t,WNj,t

```
1: if the destination node t not in the table then
2: Add the entry t,wNi, Nj+WNjt, CNi,t={Nj};HNit=Ø)
3: else if WNi;Nj +WNj, t<WNi,t then
4: CNit←{Nj} and Nj is the minimum-cost nexthop.
5: WNi, t←WNi,Nj+WNj,t
6: for each node Nk <Nbri except Nj do
7: ifWNk,t <WNi,t then
8: CNit←CNi.t U{Nk}
9: end if
10: end for
11: Send t,WNi,t to each neighboring node Nk €Nbri.
12: else if wNi,Nj + WNj, t >WNi,t then
13: if Nj € CNi, t then
14: if Nj was marked as the minimal-cost nexthop then
15: WNi,t←MINNk€Nbr,i WN,,Nk+WNk,t
16: CNit←Ø
17: for each node Nk €Nbri do
18: ifWNk,t <WNi,t then
19: CNi←t U {Nk}
20: end if
21: end for
22: Send t,WNi, t to each neighboring node Nk € Nbri.
23: else ifWNj,t >WNi,t then
24: CNit←CNi-{Nj}
25: end if
26: else if Nj € CNit^ WNj,t <WNi, tthen
27: CNit ←CNit U {Nj}
28: end if
29: end if
```

Initially, the routing table of each node e.g., the node Ni consists of entries {(Nj, wNi,Nj, CNjNi ={Nj}, HNjNi =ø},where Nj Є Nbri and wNi,Nj = wNi,Nj. By exchanging distance vectors between neighboring nodes, the routing table of Ni is accordingly updated. Note that the exchanging for distance vectors among neighboring nodes can be based on a predefined interval. The exchanging can also be triggered by the change of link cost or the failure of the link/node. In this paper, we consider cases when Ni receives a distance vector from a neighboring node Nj. Each element of a distance vector received from a neighboring node Nj includes a destination node t and a delivery cost WNj; t from the node Nj to the destination node t.

Conclusion

This paper has suggested a security-enhanced dynamic routing algorithm based on distributed routing information widely supported in existing networks. The proposed algorithm is easy to implement and compatible with popular routing protocols which includes RIP and DSDV in existing infrastructures. An substantial study was developed for the proposed algorithm and was verified against the experimental results. A simulation experiments were Conducted to show the capability of the proposed algorithm and for that we have very encouraging results. Thus we must point out that the proposed algorithm is completely orthogonal to the work based on the designs of cryptography algorithms and system infrastructures. Our security enhanced dynamic routing could be used with cryptography-based system designs to further improve the security of the data transmission over networks.

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