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Distributed Single Path Routing in Multi-Hop Wireless Networks

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Abstract:-

In the issue of steering in multi-bounce remote systems, to accomplish top of the line to-end throughput, it is urgent to locate the "best" way from the source hub to the goal hub. In spite of the fact that countless conventions have been proposed to discover the way with least aggregate transmission check/time for conveying a solitary bundle, such transmission tally/time limiting conventions can't be ensured to accomplish most extreme end-to-end throughput we propose a Distributed Three-bounce Data Routing convention (DTR). In DTR, as appeared in Figure 1 (b), a source hub isolates a message stream into various fragments. Each fragment is sent to a neighbor versatile hub. In view of the QoS necessity, these versatile hand-off hubs pick between direct transmission or hand-off transmission to the BS. In transfer transmission, a portion is sent to another versatile hub with higher ability to a BS than the present hub. In direct transmission, a portion is straightforwardly sent to a BS. In the framework, the sections are reworked in their unique request and sent to the goal. The quantity of steering bounces in DTR is limited to three, including at most two jumps in the impromptu transmission mode and one jump in the phone transmission mode. To defeat the previously mentioned weaknesses, DTR endeavors to constrain the quantity of bounces. The principal bounce sending appropriates the fragments of a message in various ways to completely use the assets, and the conceivable second jump sending guarantees the high limit of the forwarder. DTR likewise has a clog control calculation to adjust the activity stack between the close-by BSes with the end goal to maintain a strategic distance from movement blockage at BSes. Utilizing self-versatile and circulated steering with high speed and short-way impromptu transmission, DTR fundamentally expands the throughput limit and adaptability of half breed remote systems by conquering the three weaknesses of the past directing calculations. It has the accompanying highlights: _ Low overhead. It dispenses with overhead caused by course revelation and upkeep in the impromptu transmission mode, particularly in a dynamic situation. _ Hot spot decrease. It eases activity clog at portable door hubs while makes full utilization of channel assets through a dispersed multi-way hand-off. _ High dependability. In light of its little jump way length with a short physical separation in each progression, it reduces commotion and neighbor obstruction and stays away from the unfriendly impact of course breakdown amid information transmission. Accordingly, it diminishes the bundle drop rate and makes full utilization of special reuse, in which a few source and goal hubs can impart at the same time without obstruction.

Key Words:- Routing, Wireless Network, Protocol Design

I.INTRODUCTION

Over the past few years, wireless networks including infrastructure wireless networks and mobile ad-hoc networks (MANETs) have attracted significant research interest. The growing desire to increase wireless network capacity for high performance applications has stimulated the development of hybrid wireless networks. A hybrid wireless network consists of both an infrastructure wireless network and a mobile ad-hoc network. Wireless devices such as smart-phones, tablets and laptops, have both an infrastructure interface and an adhoc interface. As the number of such devices has been increasing sharply in recent years, a hybrid transmission structure will be widely used in the near future. Such a structure synergistically combines the inherent advantages and overcome the disadvantages of the infrastructure wireless networks and mobile ad-hoc networks. In a mobile ad-hoc network, with the absence of a central control infrastructure, data is routed to its destination through the intermediate nodes in a multi-hop manner. The multi-hop routing needs on-demand route discovery or route maintenance Since the messages are transmitted in wireless channels and through dynamic routing paths, mobile ad-hoc networks are not as reliable as infrastructure wireless networks. Furthermore, because of the multi-hop transmission feature, mobile ad-hoc networks are only suitable for local area data transmission. The infrastructure wireless network (e.g. cellular network) is the major means of wireless communication in our daily lives. It excels at inter-cell communication (i.e., communication between nodes in different cells) and Internet access. It makes possible the support of universal network connectivity and ubiquitous computing by integrating all kinds of wireless devices into the network. In an infrastructure network, nodes communicate with each other through base stations (BSes). Because of the long distance one-hop transmission between BSes and mobile nodes, the infrastructure wireless networks can provide higher message transmission reliability and channel access efficiency, but suffer from higher power consumption on mobile nodes and the single point of failure problem A hybrid wireless network synergistically combines an infrastructure wireless network and a mobile adhoc network to leverage their advantages and overcome their shortcomings, and finally increases the throughput capacity of a wide-area wireless network. A routing protocol is a critical component that affects the throughput capacity of a wireless network in data transmission. Most current routing protocols in hybrid wireless networks simply combine the cellular transmission mode (i.e. BS transmission mode) in infrastructure wireless networks and the ad-hoc transmission mode in mobile ad-hoc networks That is, as shown in Figure 1 (a), the protocols use the multi-hop routing to forward a message to the mobile gateway nodes that are closest to the BSes or have the highest bandwidth to the BSes. The bandwidth of a channel is the maximum throughput (i.e., transmission rate in bits/s) that can be achieved. The mobile gateway nodes then forward the messages to the BSes, functioning as bridges to connect the ad-hoc network and the infrastructure network. However, direct combination of the two transmission modes inherits the following problems that are rooted in the ad-hoc transmission mode. _ High overhead. Route discovery and maintenance incur high

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overhead. The wireless random access medium access control (MAC) required in mobile ad-hoc networks, which utilizes control handshaking and a back off mechanism, further increases overhead. _ Hot spots. The mobile gateway nodes can easily become hot spots. The RTS-CTS random access, in which most traffic goes through the same gateway, and the flooding employed in mobile ad-hoc routing to discover routes

1.

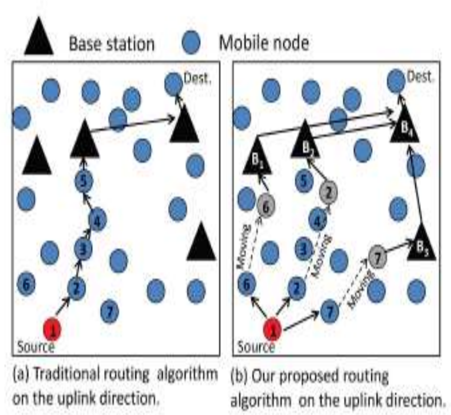

Fig. 1: Traditional and proposed routing algorithms on the uplink direction.

nodes only use the channel resources in their route direction, which may generate hot spots while leave resources in other directions under-utilized. Hot spots lead to low transmission rates, severe network congestion, and high data dropping rates. _ Low reliability. Dynamic and long routing paths lead to unreliable routing. Noise interference and neighbor interference during the multi-hop transmission process cause a high data drop rate. Long routing paths increase the probability of the occurrence of path breakdown due to the highly dynamic nature of wireless ad-hoc networks. These problems become an obstacle in achieving high throughput capacity and scalability in hybrid wireless networks. Considering the widespread BSes, the mobile nodes have a high probability of encountering a BS while moving. Taking advantage of this feature, we propose a Distributed Three-hop Data Routing protocol (DTR). In DTR, as shown in Figure 1 (b), a source node divides a message stream into a number of segments. Each segment is sent to a neighbor mobile node. Based on the QoS requirement, these mobile relay nodes choose between direct transmission or relay transmission to the BS. In relay transmission, a segment is forwarded to another mobile node with higher capacity to a BS than the current node. In direct transmission, a segment is directly forwarded to a BS. In the infrastructure, the segments are rearranged in their original order and sent to the destination. The number of routing hops in DTR is confined to three, including at most two hops in the ad-hoc transmission mode and one hop in the cellular transmission mode. To overcome the aforementioned shortcomings, DTR tries to limit the number of hops. The first hop forwarding distributes the segments of a message in different directions to fully utilize the resources, and the possible second hop forwarding ensures the high capacity of the forwarder. DTR also has a congestion control algorithm to balance the traffic load between the nearby BSes in order to avoid traffic congestion at BSes. Using self-adaptive and distributed routing with high speed and short-path ad-hoc transmission, DTR significantly increases the throughput capacity and scalability of hybrid wireless networks by overcoming the three shortcomings of the previous routing algorithms. It has the following features: _ Low overhead. It eliminates overhead caused by route discovery and maintenance in the ad-hoc transmission mode, especially in a dynamic environment. _ Hot spot reduction. It alleviates traffic congestion at mobile gateway nodes while makes full use of channel resources through a distributed multi-path relay. _ High reliability. Because of its small hop path length with a short physical distance in each step, it alleviates noise and neighbor interference and avoids the adverse effect of route breakdown during data transmission. Thus, it reduces the packet drop rate and makes full use of spacial reuse, in which several source and destination nodes can communicate simultaneously without interference. The rest of this paper is organized as follows. Section 2 presents a review of representative hybrid wireless networks and multi-hop routing protocols. Section 3 details the DTR protocol, with an emphasis on its routing methods, segment structure, and BS congestion control. Section 4 theoretically analyzes the performance of the DTR protocol. Section 5 shows the performance of the DTR protocol in comparison to other routing protocols. Finally, Section 6 concludes the paper.

II. LITERATURE SURVEY

#1 Detecting and Localizing Wireless Spoofing Attacks

Wireless networks are vulnerable to spoofing attacks, which allows for many other forms of attacks on the networks. Although the identity of a node can be verified through cryptographic authentication, authentication is not always possible because it requires key management and additional infrastructural overhead. In this paper we propose a method for both detecting spoofing attacks, as well as locating the positions of adversaries performing the attacks. We first propose an attack detector for wireless spoofing that utilizes K-means cluster analysis. Next, we describe how we integrated our attack detector into a real time indoor localization system, which is also capable of localizing the positions of the attackers. We then show that the positions of the attackers can be localized using either area-based or point-based localization algorithms with the same relative errors as in the normal case. We have evaluated our methods through experimentation using both an 802.11 (WiFi) network as well as an 802.15.4 (ZigBee) network. Our results show that it is possible to detect wireless spoofing with both a high detection rate and a low false positive rate, thereby providing strong evidence of the effectiveness of the K-means spoofing detector as well as the attack localizer.

#2 Access points vulnerabilities to DoS attacks in 802.11 networks

We describe possible denial of service attacks to infrastructure wireless 802.11 networks. To carry out such attacks only commodity hardware and software components are required. The results show that serious vulnerabilities exist in different access points and that a single malicious station can easily hinder any legitimate communication within a basic service set.

#3 Detecting Identity Based Attacks in Wireless Networks Using Signal prints

Wireless networks are vulnerable to many identity-based attacks in which a malicious device uses forged MAC addresses to masquerade as a specific client or to create multiple illegitimate identities. For example, several link-layer services in IEEE 802.11 networks have been shown to be vulnerable to such attacks even when 802.11i/1X and other security mechanisms are deployed. In this paper we show that a transmitting device can be robustly identified by its signal print, a duple of signal strength values reported by access points acting as sensors. We show that, different from MAC addresses or other packet contents, attackers do not have as much control regarding the *signal prints* they produce .Moreover, using measurements in a testbed network, we demonstrate that signal prints are strongly correlated with the physical location of clients, with similar values found mostly in close proximity. By tagging suspicious packets with their corresponding signal prints, the network is able to robustly identify each transmitter independently of packet contents, allowing detection of a large class of identity-based attacks with high probability.

#4 Secure and Efficient Key Management in Mobile Ad Hoc Networks

In mobile ad hoc networks, due to unreliable wireless media, host mobility and lack of infrastructure, providing secure communications is a big challenge in this unique network environment. Usually cryptography techniques are used for secure communications in wired and wireless networks. The asymmetric cryptography is widely used because of its versatileness (authentication, integrity, and confidentiality) and simplicity for key distribution. However, this approach relies on a centralized framework of public key infrastructure (PKI). The symmetric approach has computation efficiency, yet it suffers from potential attacks on key agreement or key distribution. In fact, any cryptographic means is ineffective if the key management is weak. Key management is a central aspect for security in mobile ad hoc networks. In mobile ad hoc networks, the computational load and complexity for key management is strongly subject to restriction of the node's available resources and the dynamic nature of network topology.

In this paper, we propose a secure and efficient key management framework (SEKM) for mobile ad hoc networks. SEKM builds PKI by applying a secret sharing scheme and an underlying multicast server group. In SEKM, the server group creates a view of the certification authority (CA) and provides certificate update service for all nodes, including the servers themselves. A ticket scheme is introduced for efficient certificate service. In addition, an efficient server group updating scheme is proposed.

#5 Spatial Signatures for Lightweight Security in Wireless Sensor Networks

This paper experimentally investigates the feasibility of crypto-free communications in resource constrained wireless sensor networks. We exploit the spatial signature induced by the radio communications of a node on its neighboring nodes. We design a primitive that robustly and efficiently realizes this concept, even at the level of individual packets and when the network is relatively sparse. Using this primitive, we design a protocol that robustly and efficiently validates the authenticity of the source of messages: authentic messages incur no communication overhead whereas masqueraded communications are detected cooperatively by the neighboring nodes. The protocol enables lightweight collusionresistant methods for broadcast authentication, unicast authentication, non-repudiation and integrity of communication. We have implemented our primitive and protocol, and quantified the high-level of accuracy of the protocol via Test bed experiments with *CC1000* radio-enabled motes and *802.15.4* radio-enabled motes.

III. Related Work:-

In this section, we briefly review related works on metric design and protocol implementation. We also compare our work with those on joint routing problems, as well as other works considering reusability.

Routing Metrics

There are a number of works on wireless routing metrics. For single-path routing, several link-quality aware metrics [1], [6], [7], [9] were proposed. RTT [1] weighed the cost of single wireless link by the round trip delay of probe packets on it; ETX [6] assigned the link cost with its expected number of transmissions to successfully deliver a packet. Based on ETX, the authors in [9] designed ETOP metric considering links' actual position on the path. In addition, incorporating the multi-rate ability, ETT [7] took the expected transmission time of a link as its cost; and EMTT [31] extended the work to multicast. What's more, [27] provided some principles for routing metric design. There're also metrics suitable for any path routing [4], [13], [32]. Chachulski provided ETOX in [4] which considers opportunistic receptions at any forwarder. In [32], the EATX metric was defined to reflect overall transmissions in any-path forwarding. Laufer et al. [13] adopted EATX as the hyperlink cost, and defined the any path cost composed of the hyperlink cost and the remaining cost. However, existing routing metrics tend to calculate path cost using some mechanism of lossless combination of link costs. For example, the ETX value of a path is the addition of each link's ETX [6]. Similarly, Laufer calculated the any path cost while considering all the forwarders' costs [13]. Besides, the guidelines in [27], such as consistency, ignored the effect of reusability. Such lossless mechanism thus misses the opportunity of exploiting spectrum spatial reusability in wireless media.

Routing Protocols

The earliest single-path routing protocols [3], [10], [17], [18] applied Dijkstra algorithm for route selection. When it comes to any path routing, for example, ExOR [2] appeared as a coordination mechanism between forwarders; MORE [4] broke such coordination where all the forwarders worked according to their workload. Besides, MORE introduced network coding into any path routing. On that basis, [13] proposed the shortest any path first (SAF) algorithm to determine the forwarders' priorities, and proved its optimality; [19] incorporated rate control and used a notion called credit to realize flow control; CodeOR [14] enabled concurrent transmissions of a window of segments; SOAR [24] considered the problem of path divergence and rate limitation to efficiently support multiple flows; SourceSync [20] synchronized senders to achieve combined signals which

lowers the packet error rate. Besides, [23] developed an optimization framework to exploit communication opportunities arising by chance; Hu et al. [8] proposed POR based on a per-packet feedback mechanism. Because the above routing protocols were designed based on existing transmission cost minimizing routing metrics, they cannot guarantee maximum end-to-end throughput when spatial reusability cannot be ignored. In addition, different from works such as [2] and [20],which should to some degree rely on synchronization between nodes, the throughput improvements of our algorithms in this work do not need MAC-layer coordination.

Other Related Works

Some existing cross-layer approaches jointly consider routing and link scheduling (e.g., [11], [16], [29]). Zhang et al. [29] formulated joint routing and scheduling into an optimization problem, and solved the problem with a column generation method. Pan et al. [16] dealt with the joint problem in cognitive radio networks considering the vacancy of licensed bands. Jones et al. [11] implemented k-tuple network coding and proved throughput optimality of their policy. Although these works can provide good performance theoretically, they need centralized control to realize MAC-layer scheduling, and to eliminate transmission contention. The algorithms proposed in this work do not require any scheduling, and the SASR algorithms can be implemented in a distributed manner. Last but not least, there are also works aimed at exploiting spatial reusability. Specifically, the authors in [12] considered the trade-off between spatial reuse and data rate, and proposed a decentralized power and rate control algorithm for higher network capacity. Zhai et al. [28] investigated the optimum carrier sensing range for throughput maximization. However, none of these works deal with the problem of route selection

IV. CONCLUSION

In this paper, we have exhibited that we can fundamentally enhance the conclusion to-end throughput in multi hop remote systems, via deliberately thinking about spatial reusability of the remote correspondence media. We have introduced two conventions, SASR and SAAR, for spatial reusability-mindful single-way directing and any path directing, separately. We have additionally actualized our conventions, and contrasted them and existing directing conventions with the information rates of 11 Mbps and 54 Mbps. Assessment results demonstrate that SASR and SAAR calculations can accomplish more huge end-to-end throughput gains under higher information rates. For the instance of single-stream, SASR accomplishes a throughput gain of as high as 5:3 under 54 Mbps, while for SAAR, the most extreme gain can reach 71:6%. Besides, in multi-stream case, SASR can likewise enhance the per-stream normal throughputs by more than 20%. In the mean time, the enormous throughput increases as it were require satisfactory extra transmission over heads. The additional transmission overheads of course ask for are under 10% in our assessment. In 80% cases, the by and large transmission checks are expanded by close to 2 with SASR, while for SAAR, the majority of the augmentations are beneath 1. With respect to the future work, one bearing is to further investigate chances to enhance the execution of our steering calculations by breaking down extraordinary failing to meet expectations cases distinguished in the assessment. Another bearing is to explore between stream spatial reusability, and to upgrade framework wide execution.

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