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Reliable Communication Using Topology Control in Mobile Ad-hoc Network

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Abstract-The measurability of Mobile ad hoc network (MANET) is the precondition of its management, performance optimization and network resources re-allocations. The traditional network interior measurement technique performs measurement on the nodes or links directly, and obtains the node or link performance through analyzing on the measurement sample, which usually is used in the wired networks measurement based on the solid infrastructure. However, MANET is an infrastructure-free, multi-hop, and self-organized temporary network, comprised of a group of mobile nodes with wireless communication devices. Not only does its topology structure vary with time going by, but also the communication protocol used in its network layer or data link layer is diverse and non-standard.

Specially, with the limitation of node energy and wireless bandwidth, the traditional interior network measurement technique is not suited for the measurement requirement of MANET .A mobile ad hoc network is an autonomous collection of mobile devices (laptops, smart phones, sensors, etc.) that communicate with each other over wireless links and cooperate in a distributed manner in order to provide the necessary network functionality in the absence of a fixed infrastructure. This type of network, operating as a stand-alone network or with one or multiple points of attachment to cellular networks or the Internet, paves the way for numerous new and exciting applications. Application scenarios include, but are not limited to: emergency and rescue operations, conference or campus settings, car networks, personal networking, etc.

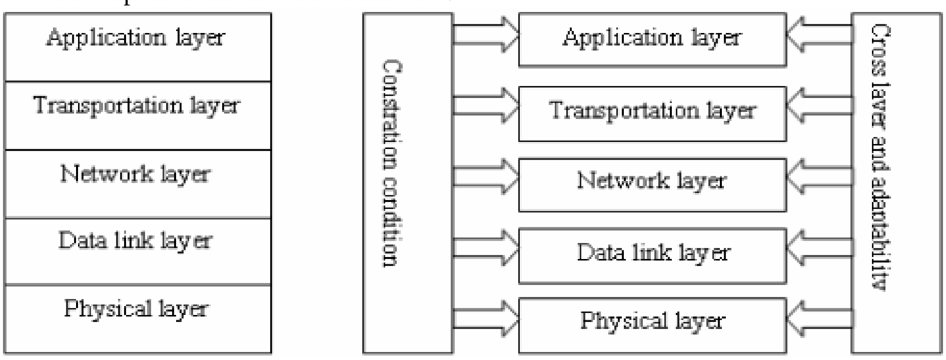
AD HOC NETWORK

In general, mobile ad hoc networks are formed dynamically by an autonomous system of mobile nodes that are connected via wireless links without using the existing network infrastructure or centralized administration. The nodes are free to move randomly and organize themselves arbitrarily; thus, the networks wireless topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet. Mobile ad hoc networks are infrastructure-less networks since they do not require any fixed infrastructure, such as a base station, for their operation. In general, routes between nodes in an ad hoc network may include multiple hops, and hence it is appropriate to call such networks as ‘‘multi-hop wireless ad hoc networks’’. Each node will be able to communicate directly with any other node that resides within its transmission range.

1.1 Ad Hoc Network System Architecture

According to Ad Hoc network inherent characteristics, such as self-organization,wireless multi-hop routing, dynamic topology, limitation of wireless bandwidth andenergy and low security, its system architecture could be divided as the five layers as described in figure 1(a), such as physical layer, data link layer, network layer, transportation layer and application layer.

In the figure 1(a), physical layer mainly is in charge of wireless frequency choice, signal detection, transmission and reception, modulation/demodulation, wireless channel encryption/decryption. It also adopts wireless spread spectrum technique to implement wireless signal transmission and reception, such as DSSS and FHSS. Data link layer is divided into logical link control layer (LLC) and medium access control layer (MAC) again. The LLC has the function of assembling the data frame, checkout, flow and error control from point to point. In recent years, the MAC mainly adopts four mechanisms to control the shared wireless channel access which is chosen by mobile nodes. The first one is stochastic competition technique, i.e., CSMA/CA. The second one is sub-channel access mechanism, such as TDMA, FDMA, CDMA and SDMA, and so on. The last two mechanisms are polling method and dynamic adjusting method. Network layer mainly takes charge of neighbor discovering, routing choice and congestion control. The transportation layer could provide different processes in application layer with reliable or unreliable data transmission service. At present, transportation layer mainly adopts the traditional communication protocol, such as TCP, UDP or special protocols. Application layer provides different application service with the its application interface concerned.



(a) Ad Hoc network system architecture (b) Ad Hoc network adaptive system architecture

Figure.1. Ad Hoc network system architecture

Considering Ad Hoc network characteristics, the five layers network system Architecture (seen in figure 1(a)) is often extended. For example, power and topology control are commonly added between physical and data link layer, cluster management function between data link and network layer, and position, self-configuration and security mechanisms between transportation and application layer. In order to decrease the complexity of Ad Hoc network system architecture, sometimes it is necessary to simplify the five layers system architecture. For example, data link and network layer, or transportation and application layer are often united as one layer, thus three or four layers Ad Hoc network system architectures have appeared. Since Ad Hoc networks are temporarily built up to implement special communication tasks, in different application environment, the number of mobile nodes, mobile rule, transceiver power and wireless link bandwidth are different too. In order to meet with requirements of specific applications, it is necessary to design cross layer network system architectures so as to support adaptive and performance optimization as the figure 1(b). In this figure, different layers could share each other's information to optimize network performance according to the constraint condition. Specially, this cross layer network system design could decrease information to be exchanged between different layers.

1.2 Cooperative Communications

Cooperative communication typically refers to a system where users share and coordinate their resources to enhance the information transmission quality. It is a generalization of the relay communication, in which multiple sources also serve as relays for each other. Early study of relaying problems appears in the information theory community to enhance communication between the source and destination. Recent tremendous interests in cooperative communications are due to the increased understanding of the benefits of multiple antenna systems. Although Multiple-Input Multiple-Output (MIMO) systems have been widely acknowledged, it is difficult for some wireless mobile devices to support multiple antennas due to the size and cost constraints. Recent studies show that cooperative communications allow single-antenna devices to work together to exploit the spatial diversity and reap the benefits of MIMO systems such as resistance to fading, high throughput, low transmitted power, and resilient networks.
In a simple cooperative wireless network model with two hops, there is a source, a destination, and several relay nodes. The basic idea of cooperative relaying is that some nodes, which overheard the information transmitted from the source node, relay it to the destination node instead of treating it as interference. Since the destination node receives multiple independently faded copies of the transmitted information from the source node and relay nodes, cooperative diversity is achieved. Relaying could be implemented using two common strategies.

(1) amplify-and-forward and
(2) decode-and-forward

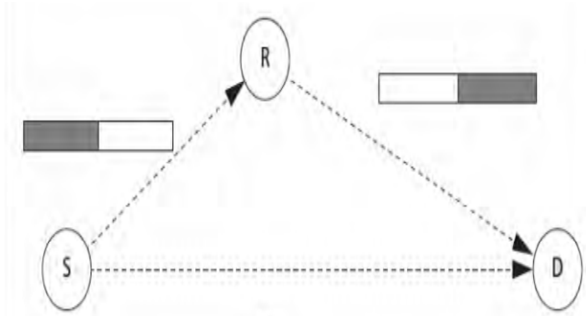


Figure.2 .Cooperative Communication

EXISTING SYSTEM

Most existing works are focused on link-level physical layer issues, such as Outage probability and outage capacity. Consequently, the impacts of cooperative Communications on network-level upper layer issues, such as topology control, routing and network capacity, are largely ignored. Indeed, most of current works on wireless networks attempt to create, adapt, and manage a network on a maze of point-to-point non-cooperative wireless links. Such architectures can be seen as complex networks of simple links.

Disadvantages:
1. Low Network Capacity.
2. Communications are focused on physical layer issues, such as decreasing outage probability and increasing outage capacity, which are only link-wide metrics.

PROPOSED SYSTEM

We propose a Capacity-Optimized Cooperative (COCO) topology control scheme to improve the network capacity in MANETs by jointly considering both upper layer network capacity and physical layer cooperative communications. Through simulations, we show that physical layer cooperative communications have significant impacts on the network capacity, and the proposed topology control scheme can substantially improve the network capacity in MANETs with cooperative communications.

Advantages:
1. Improve the network capacity in MANETs.
2. Dynamic traffic pattern and dynamic network without a fixed infrastructure.
3. There are a source, a destination and several relay nodes.
4. Cooperation can benefit not only the physical layer, but the whole network in many different aspects.
5. Lack of central entity for organization available
6. Limited range of wireless communication
7. Mobility of participants
8. Battery-operated entities

RELATED WORKS

A large number of cooperative communication protocols have been proposed recently. Cooperation diversity gains, transmitting, receiving and processing overheads, are investigated by . Cooperative issues across the different layers of the communication protocol stack, self-interested behaviors and possible misbehaviors are explored in Reference proposed a cooperative relay framework which accommodates the physical, medium access control (MAC) and network layers for wireless ad hoc networks.

In the network layer, diversity gains can be achieved by select into cooperative relays based on the average link signal-to-noise ratio (SNR) and the two-hop neighborhood information. A cooperative communication scheme combining relay selection with power control is proposed in, where the potential relays compute individually the required transmission power to participate in the cooperative communications.

A variety of cooperative diversity protocols are proposed by, namely, amplify-and-forward, decode-and-forward, selection relaying, and incremental relaying. The performance of the protocols in terms of outage events and associated outage probabilities is evaluated respectively. Coded cooperation , integrated cooperation with channel coding and works by sending different parts of each user's code word via two independent fading paths. References implemented a cooperation strategy for mobile users in a conventional code division multiple access (CDMA) systems, in which users are active and use different spreading code to avoid interferences. In distributed cooperative protocols, including random selection, received SNR selection and fixed priority selection, and are proposed for cooperative partner selection.

CONCLUSION

Cooperative communication has emerged as a new dimension of diversity to emulate the strategies designed for multiple antenna systems, in view of the fact that a wireless mobile device may not be able to support multiple transmit antennas. To progress the network capability in mobile ad hoc networks by mutually allowing both upper layer network capability and physical layer cooperative communications a Capacity-Optimized Cooperative topology control system is suggested. With cooperative communications, the physical layer cooperative communications techniques have considerable impacts on the network capacity have shown the results and the proposed topology control scheme can significantly develop the network ability in mobile ad hoc networks

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