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Improving Multicast Capacity in Infrastructured Ad hoc Networks

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Abstract—

Now-a-days, multicast capacity in wireless and ad hoc networks plays a vital role in both industrial and educational fields. Combinations between mobility and infrastructure, as well as multicast transmission and infrastructure, have already showed effective ways to increase multicast capacity. In this work, the impact of the above three factors (node's mobility, infrastructure of the network and multicast transmission) are jointly considered on network capacity. An ad hoc network is taken into consideration, which is assumed to have 'm' static base stations and 'n' mobile users are placed in the network. A general mobility model is adopted, such that each user moves within a bounded distance from its home point with an arbitrary pattern. In addition, each mobile node serves as a source of multicast transmission, which results in a total number of 'n' multicast transmissions. The situations in which base stations actually benefit the capacity improvement are focused, and found that the multicast capacity in a mobile hybrid network falls into several regimes. For each regime, reachable upper and lower bounds are derived. Here, theoretical analysis of multicast capacity in hybrid networks is made and guidelines for the design of real hybrid systems combing cellular and ad hoc networks are also provided.

Keywords--Wireless ad hoc network; multicast capacity; mobility; infrastructure; hybrid network.

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1. INTRODUCTION

With optimal scheduling, routing and relaying of packets, the per node capacity decreases as when approaches to infinity. The scalability of throughput capacity can be improved by introducing different characteristics such as mobility of nodes, an infrastructure of the network:

a multicast transmission scheme. When considering mobility in ad hoc networks, it is shown that a store-carry-forward relaying scheme sustain a per-node capacity if each node can visit the whole network area with a uniformly ergodic mobility process. The mobility is generalized through a restriction that each moving node is located within a circle of radius. By mapping the network to a generalized random geometric graph per node capacity is achievable.

Infrastructure in an ad hoc network provides a more straightforward increase to the capacity. Infrastructure can offer a linear capacity increase in a hybrid network, when the number of base stations increases asymptotically faster than . If the number of users served by each BS is bounded above, a per-node capacity of can be achieved. This result can be further extended to.

It is assumed that there are number of nodes in an ad hoc network. Multicast transmission refers to the transmission from a single node to other nodes, so as to generalize both unicast and broadcast transmissions. Multicast transmission can obtain a per-flow capacity of , which is larger than that of unicast transmissions. The gain of multicast transmission results from a merge of relay paths within a minimum spanning tree. The multicast transmission is extended to a Gaussian channel model and similar capacity improvement is shown under the corresponding protocol.

Many existing studies focus on the combinations of the above characteristics. Some aim to further increase the network performance, while others try to present a more realistic scenario. Multicast capacity is explored in a static hybrid network with infrastructure support. By establishing multicast tree with the help of infrastructure and employing a hybrid routing scheme, the achievable multicast capacity in a hybrid network with BSs is. Studying the unicast capacity of mobile hybrid networks, and jointly considering the influences of node's mobility and infrastructure support on it, a per-node capacity of for strong mobility, and for weak and trivial mobility is achieved.

1.2 Main Contributions

In this system, the effects of mobility and infrastructure are considered in multicast capacity of a wireless mobile ad hoc network. Mobility is divided into three regimes, and reachable upper and

lower bounds are presented for each regime. Assume that bandwidth is W for wireless channels, and $WB$for wired connections. In cellular routing, wireless frequency resource W is further divided into uplink bandwidth WA and downlink WC.

I. For the first regime (strong mobility regime) where ,

The per-node capacity by ad hoc routing is:

The per-node capacity by cellular routing is.

By always choosing a better routing, the per-node capacity of hybrid routing scheme is:.

II. The second regime (weak mobility regime) stands for the situation that , where. In this regime, mobility is only helpful in delivering intra-cluster message. The inter-cluster message can only be transmitted through cellular routing. As a result, the optimal routing scheme is a serial connection of ad hoc routing and cellular routing.

The per-node capacity by ad hoc routing is.

Furthermore, the per-node capacity by cellular routing is. Considering the nature of serial connection, the per-node capacity by hybrid routing scheme is

III. The third regime (trivial mobility regime) corresponds to In this regime, the mobility is trivial and the network acts as a static one.

2. MODELS AND ASSUMPTIONS

A wireless network consisting of n mobile users and moving over a bi-dimensional surface is considered. Communications are carried out in wireless channels routing with the help of base stations (BSs), which are connected to each other by optical fibers with bandwidth WB. $Xi(t)$–the position of ith MS at any given time t $Yi(t)$–the position of ith BS at any given time t Since BSs are statically placed in the network,.

When referring to both MSs and BSs, denotes their locations. –location of home-point for ith MS – distance between two points:.

2.1 Mobility Model

2.1.1 Network Extension

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Is a Torus, or a square with wrap-around conditions. The side length of the network scales with n according to a non-decreasing function , where . For convenience the whole network is normalized to a unit Torus. Correspondingly, any value representing a distance in the network should be scaled down by .

2.1.2 Home-Point Cluster Model

It is assumed that there are clusters with radius . All the clusters are independently and uniformly distributed in network O .Then each of the n home-points is randomly assigned to a cluster and placed in it uniformly and independently.

2.1.3 MS Mobility

It is assumed that are independent, stationary, ergodic and rotation-invariant processes with stationary distribution : Where is an arbitrary non-decreasing function with finite range.

2.1.4 Mobility Regimes

Let and MS's mobility is strong if Weak mobility corresponds to and. Trivial mobility corresponds to

2.2 Communication and Interference Models

Base stations communicate with each other through optical fiber with bandwidth kind of communication will not cause interference to themselves or wireless communications. A that the available bandwidth in all the wireless channels is *W*. In ad hoc routing, transmissions fully occupy the wireless bandwidth *W*. routing, bandwidth is further divided into uplink bandwidth *WA* and downlink bandwidth communications in wireless channels are characterized by Protocol Model, which is defined as followed.

2.2.1 Protocol Model

Both BSs and MSs adopt the same transmission range . At each time slot wireless transmission from node to node successful only if: and for any other node l that transmits at, Where is a constant defining projection zone

3. BLOCK DIAGRAM

The multicast capacity scaling laws of a mobile hybrid network characterizing both mobility and infrastructure can be studied through this model. It is assumed that, there are m stations and n mobile users placed in the ad hoc network. A general mobility model is adopted, such that each of the n

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users moves around a home within a bounded distance with an arbitrary pattern. In addition, each of thesemobile nodes serves as a source of multicast transmission, which results in a total number of *n* multicast transmissions. The wire-connected base stations are placed in a wireless ad hoc network, of which the area scales with *n* as . There are totally *nc* clusters with radius r = (*n*-*R*) and the number of destinations in the multicast scheme is assumed as .

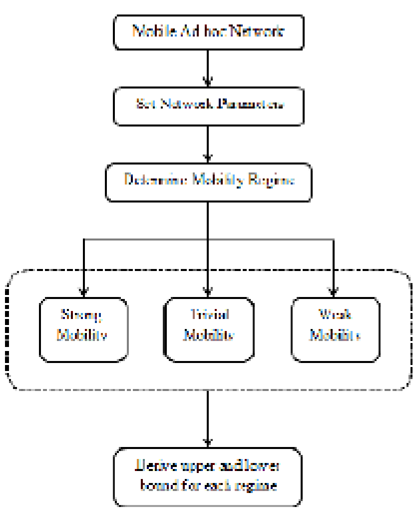

Figure : Architectural Design

A multicast path can be generated with an infrastructure routing and a pure ad hoc routing, as well as a combination of both. Intuitively, in our hybrid routing scheme, it is hoped to circumvent the bottleneck of backbone transmission or access for cellular networks and take the advantage of them, thus the capacity can be improved. The mobility is divided into three regimes, and reachable upper bounds and lower bounds are presented for each regime. The three regimes are

1) Strong mobility regime
2) Weak mobility regime
3) Trivial mobility regime

For each regime, per-node capacity is given by ad hoc routing and cellular routing. The per-node capacity of hybrid routing is given by always choosing a better routing.

4. MULTICAST CAPACITY IN UN DENSE NETWORKS BY AD HOC ROUTING

At first, a definition of a uniformly dense network, as well as some characteristics in such network is provided. When a network falls into strong mobility regime, it is equivalent to classify it as a uniformly dense network. Then reachable upper and lower bounds are presented in both pure ad hoc routing and cellular routing for uniformly dense networks. For pure ad hoc routing, the mobile network is mapped into a random geometric graph, and reachable capacity bounds For cellular routing, the routing scheme is divided into three phases and reachable upper and lower bounds are achieved in each phase.

4.1 Preliminary for Uniformly Dense Networks

4.1.1 Local Density

The local density of nodes at any given point is defined as where is the disk centering at with radius . defines the Borelfield of home-points. Stands for expectation, and represents the indicator function.

4.1.2 Uniformly Dense Networks

A network is said to be uniformly dense if for any , there exist two positive constant q and Q, such that.

4.1.3 Link Capacity

Link capacity between node *i*and *j* is defined by the maximal long term data flow between them:

where is any given scheduling under protocol model, and denotes the set of transmission pairs scheduled by .

4.2 Upper Bound in Uniformly Dense Networks by Ad Hoc Routing

Ad hoc routing, means that MSs only exchange information in wireless channel with a bandwidth *W*, ignoring the effects of BSs. The upper bound of per-node multicast capacity in uniformly dense networks by ad hoc routing is

4.3 Lower Bound in Uniformly Dense Networks by Ad Hoc Routing

Reachable lower bound can be derived asymptotically on multicast capacity in uniformly dense networks by ad hoc routing. Mapping a mobile network into a static graph makes the establishment of a multicast routing possible and realistic.

The sustainable per-node multicast capacity by ad hoc routing in dense networks is

5. MULTICAST CAPACITY IN UNIFORMLY DENSE NETWORKS BY CELLULAR ROUTING

The impact of infrastructure in multicast capacity of a mobile network is considered in this section. Multicast flows will be routed through BSs. The bandwidth in air channels is divided into uplink bandwidth WA and downlink bandwidth WC. Further the bandwidth of optical fibers connecting BSs is assumed to be WB.

Cellular Routing

Cellular routing consists of three phases.

Phase 1: A multicast source node routes the packets to a BS.

Phase 2: The packets are routed to the cells that contain destinations.

Phase 3: BSs of these cells broadcast packets to the destinations.

5.1 Upper Bounds in Uniformly Dense Networks by Cellular Routing

Since cellular routing is divided into three phases, the capacity of cellular routing is restricted by the worst case among three phases. First the upper bound is explored in each phase, then combined together to obtain the overall upper bound.

5.1.1 Upper Bound in Phase 1

n MSs act as sources, and try to forward their messages to one of the BSs. The upper bound of per-node capacity in uniformly dense networks with *m* BSs and *n* MSs, in phase 1 of cellular routing , is

5.1.2 Upper Bound in Phase 2

BSs exchange messages received from MSs through optical fibers, each of which has a bandwidth of . The upper bound of per-node capacity in uniformly dense networks with *m*BSs and *n* MSs, in phase 2 of cellular routing , is

5.1.3 Upper Bound in Phase 3

Each BS transmits messages in its own The upper bound of per-node capacity in uniformly dense networks with *m* BSs and *n* MSs, in phase 3 of cellular routing , is The upper bound of per-node multicast capacity in uniformly dense networks by cellular routing is

5.2 Lower Bounds in Uniformly DenseNetworks by Cellular Routing

Similar to the derivation of upper bounds by cellular routing , lower bounds of cellular routing is derived in 3 phases. Then a combination of the lower bounds is presented.

5.2.1 Lower Bound in Phase 1

A traffic rate is sustainable from any MS to infrastructure system in phase 1 of cellular routing .

5.2.2 Lower Bound in Phase 2

A traffic rate is sustainable between BSs in phase 2 of cellular routing .

5.2.3 Lower Bound in Phase 3

A traffic rate is sustainable from one BS to MSs in phase 3 of cellular routing . The lower bound of per-node multicast capacity in uniformly dense networks by cellular routing is

6. MULTICAST CAPACITY IN UNIFORMLY DENSE NETWORKS BY HYBRID ROUTING

The upper bound of multicast capacity for arbitrary hybrid routing is analyzed. Then reachable lower bound and corresponding routing scheme are presented. The hybrid routing utilizes both ad hoc routing and cellular routing, with the purpose of further improving the network capacity and system throughput.

6.1 Upper and Lower Bounds by Hybrid Routing

In uniformly dense networks, the upper bound of per-node multicast capacity by any hybrid routing is .

6.1.1 Hybrid Routing Scheme

Hybrid routing scheme evaluates both pure ad hoc routing and cellular routing , and adaptively select a better scheme, which provides larger throughput, to route the packets. By hybrid routing , the sustainable pernode multicast throughput in uniformly dense networks is .

6.2 Discussion on Capacity Regimes

The optimal frequency allocation focuses on maximizing the uplink and downlink capacity between MSs and BSs. The frequency allocation between and is, .

7. MULTICAST CAPACITY IN NONUNIFORMLY DENSE NETWORKS

In non-uniformly dense networks without the support of BSs, a larger transmission range should be adopted to guarantee connectivity. It is proved that this transmission range should be , which only provides a capacity of . The poor capacity is a consequence of more interference brought by larger transmission range. Considering this, it is proposed to decrease the transmission range of nodes, and BSs are employed to guarantee connectivity.

Scheduling Scheme

schedules node *i* transmit to node *j* at time slot *t*, the transmission subjects to therestriction of protocol model with the transmission range

7.1 Multicast Capacity in Weak Mobility Regime

Under scheduling scheme , MSs in different clusters cannot communicate with each other directly in air channels. A hybrid routing is proposed to finish the transmission.

Hybrid Routing Scheme

Hybrid routing scheme consists of 2 phases.

Phase 1: Each source node transmits packets to destinations in its own cluster.

Phase 2: Each source node employs cellular routing to transmit packets to destinations in other clusters.

7.1.1 Multicast Capacity in Phase 1 of

The per-node multicast capacity of phase 1 in is.

7.1.2 Multicast Capacity in Phase 2 of

Since cellular routing is applied in phase 2 hybrid routing scheme , the phase 2 of is further divided into three serial steps. Step 1: Source nodes deliver their packets to BSs in the same cluster, through wireless channels with uplink bandwidth . Step 2: With the help of infrastructure, each packet is forwarded to the clusters, where the destinations locate. The traffic rate between BSs is . Step 3: BSs in each cluster transmit the messages to the destinations in wireless channels with downlink bandwidth .

In the first step, transmissions in different clusters cause no interference to each other. Considering a sub-network formed by an arbitrary cluster, there are source nodes try to transmit their packets to BSs. The per-node capacity in the first step of s phase 2 is.

In the second step, exchanges of information take place in the infrastructure system. The transmissions involve m BSs and n MSs, which is the same as phase 2 in . The only difference is the number of destination nodes in other clusters, which is . The per-node capacity in the second step of s phase 2 is.

In the last step, BSs transmit packets to all the destinations in the same cluster. There are BSs and MSs in each cluster. The number of destination nodes in each cluster is.

The per-node capacity in the last step of s phase 2 is. In weak mobility regime, the per-node multicast capacity of mobile ad hoc networks with infrastructure support, by hybrid routing scheme is.

7.2 Multicast Capacity in Trivial Mobility Regime

The critical transmission range within each cluster is when . will cause no inter-cluster interference. Each cluster can be mapped into subnetwork with .

In trivial mobility regime, node's mobility are negligible and the whole network acts as a static one.

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8. CONCLUSION

This paper analyzes the multicast capacity in mobile ad hocnetworks with infrastructure support. Hybrid routing schemes are proposed to achieve reachable upper and lower bounds in each of the regimes. It is worth pointing out that this work generalizes results in previous works on hybrid networks, impact of mobility and multicast transmissions, as well as any combinations of the above. Our results are instructive in the design of real hybrid system combining cellular and ad hoc networks.

REFERENCES

[1] A. Agarwa l and P. R. Kumar, "Capacity bounds for ad hoc and hybrid wireless networks," SIGCOMM Comput.Commun.Rev., vol. 34, no. 3, pp. 71–81, 2004.

[2] B. Liu, Z. Liu, and D. Towsley, "On the capacity of hybrid wireless networks," in IEEE Infocom 2003, vol. 2, San Francisco, USA, 2003, pp. 1543–1552.

[3] M. Garetto, P. Giaccone, and E. Leonardi, "Capacity scaling in delay tolerant networks with heterogeneous mobile nodes," in ACM MobiHoc 2007, New York, USA, 2007, pp. 41–50.

[4] M. Grossglauser and D. N. C. Tse, "Mobility increases the capacity of ad hoc wireless networks," IEEE/ACM Trans. Networking, vol. 10, no. 4, pp. 477–486, 2002.

[5] M. J. Neely and E. Modiano, "Capacity and delay tradeoff for ad hoc mobile networks," IEEE Trans. Inf. Theory, vol. 51, no. 6, pp. 1917–1937, 2005.

[6] P. Gupta and P. R. Kumar, "The capacity of wireless networks," IEEE Trans. Inf. Theory, vol. 46, no. 2, pp. 388–404, 2000.

[7] U. C. Kozat and L. Tassiulas, "Throughput capacity of random ad hoc networks with infrastructure support," in ACM MobiCom 003, New York, USA, 2003, pp. 55–65.

[8] W. Huang, X. Wang, and Q. Zhang, "Capacity scaling in mobile wireless ad hoc network with infrastructure support," in IEEE ICDCS, 2010, Genoa, Italy, 2010, pp. 848–857.

[9] X.-Y. Li, "Multicast capacity of wireless ad hoc networks," IEEE/ACM Trans. Networking, vol. 17, no. 3, pp. 950–961, 2009.

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A Peer Revieved Open Access International Journal
www.ijiemr.org

[10] X.-Y. Li, Y. Liu, S. Li, and S Tang, "Multicast capacity of wireless ad hoc networks under gaussian channel model," IEEE/ACM Trans. Networking, vol. 18, no. 4, pp. 1145–1157, 2010.

[11] C. Wang, X.-Y.Li, S. Tang, C. Jiang and Y. Liu "Capacity and delay in mobile ad hoc networks under Gaussian channel model," SIGMOBILE Mob.Comput.Commun.Rev.,vol. 14, no. 3, pp. 22–24, 2010.

[12] M. Garetto, P. Giaccone, and E. Leonardi, "Capacity scaling in ad hoc networks with heterogeneous mobile nodes: The supercritical regime," IEEE/ACM Trans. Networking, vol. 17, no. 5, pp. 1522–1535, 2009.

[13] P. Gupta and P. R. Kumar, "Critical power for asymptotic connectivity," in IEEE Conference on Decision and Control, 1998, vol. 1, Florida, USA, 1998, pp. 1106–1110.

[14] X. Chen, W. Huang, X. Wang, X. Lin, Multicast Capacity in Mobile Wireless Ad Hoc Network with Infrastructure Support, in Proc. of IEEE INFOCOM 2012, March, Orlando, 2012.

[15] X. Lin, G. Sharma, R. R. Mazumdar, and N. B. Shroff, "Degenerate delay-capacity tradeoffs in ad-hoc networks with brownian mobility," IEEE/ACM Trans. Networking, vol. 14, no. SI, pp. 2777–2784, 2006.

[16] X. Mao, X.-Y. Li, and S. Tang, "Multicast capacity for hybrid wireless networks," in ACM MobiHoc 2008, Hong Kong, China, 2008, pp. 189–198.

[17] X.-Y. Li, X. Mao, and S. Tang, "Closing the gap of multicast capacity for hybrid wireless networks," 2009, [Online]. Available: http://www.cs.iit.edu/ xli.

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