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# PEER TO PEER NETWORKING APPLICATION

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***Abstract:*** **Videos streaming P2P networking is an enabling technology for system devices to self-organize in an unstructured style and communicate in a peer-to-peer fashion. Due to user system and/or the unrestricted switching on/off of the system devices, links are intermittently connected and end-to-end paths may not exist, causing routing a very challenging problem. Moreover, the limited wireless spectrum and device resources together with the rapidly growing number of portable devices and amount of transmitted data make routing even harder. To tackle these challenges, the routing algorithms must be scaling up, distributed, and light weighted. Nevertheless, existing approaches usually cannot simultaneously satisfy all these three requirements. In this paper, we propose two opportunistic routing algorithms for intermittently connected video streaming P2P networks, which exploit the spatial locality, spatial regularity, and activity heterogeneity of human system to select relays. The first algorithm employs a depth-search approach to diffuse the data towards the destination. The second one adopts a depth-width-search approach in a sense that it diffuses the data not only towards the destination but also to other directions determined by the actively moving nodes (activists) to find better relays. We perform both theoretical analysis as well as a comparison based simulation study. Our results obtained from both the synthetic data and the real world traces reveal that the proposed algorithms outperform the state-of-the-art in terms of delivery latency and delivery ratio.**

***Keywords:*** **Intermittently connected systems P2P networks, Opportunistic routing, Human system.**

## I. INTRODUCTION

Now a days, Trillions of system devices are connected into the assistance of infrastructure, Due to high cost, lack of flexibility, and low utilization of the local wireless resources because infrastructure usually have limited wireless coverage and are harm to nature disaster or other failures only using this way may be lead to networks. At the end of the stage, a new networking called a paradigm named mobile peer-to-peer networking has drawn massive attention in recent years. In a mobile P2P network, devices can communicate in a peer-to-peer fashion and self-organize in an unstructured style without the need of any infrastructure, making the local wireless connectivity better overburden. Such a networking paradigm, data delivery is significant as end –to-end paths may not exists due to user mobility .In this generation the number of portable devices are rapidly growing in which makes routing even harder. Thus an unrestricted effective an efficient routing algorithm in intermittently connected system P2P networks.

The following three designs requirements:

***1. Scaling up-*** A number of different approaches enable databases to grow to every large size while supporting an ever-increasing rate of transactions per second. Not to be discounted, of course, is the rapid pace of hardware advances in both the speed and capacity of mass storage devices, as well as similar advances in CPU and networking speed.

***2. Distributed system –***A network of processes. The nodes are processes, and the edges are communication channels are involved in the requirement.

***3.Light weighted-*** This article reports an approaches of light-weighted mirror design and analysis to increase the weight reduction ratio and improve optical performance based on the finite element method and opto-mechanical analysis .The approach is to represent mirror surface deformation derived from finite element analysis (FEA) by Zernike polynomials, such that the impact of deformation on optical system performance can be evaluated by the optical design and analysis program .the experimental model analysis was also performed to validate the FEA results. The numerical result shows that the light –weighted primary mirror of cassegrain telescope is obtained by this approach and predicted deformation fulfills the requirements of optical design.

Simultaneously, it satisfies all these three requirements. In this paper, we propose two opportunistic routing algorithms for intermittently connected to mobile P2P networks.

Our design is inspired by the following observations: the mobility of the mobile devices is mainly controlled by their carriers, the human begins is driven by their sociality, which is stable in long term. Thus by exploiting the stable characteristics of human mobility in both the time domain and the space domain, the relay selection can be simplified and the effectiveness as well as the efficiency of routing decisions can be guaranteed \relays. Since our algorithms require each node to maintain only the mobility characteristics of itself, which is a relatively stable piece of information in a dynamically mobile environment, they scale well in network size and incur low burden on each node. Moreover, our algorithms are distributed in nature as they involve no centralized decision/computation The rest of the paper is organized as follows. The related work is presented in section II .section III introduces the human mobility characteristics exploited in our algorithms and presents our routing model. The corresponding algorithms are detailed in section IV. Section V provides our theoretical analysis on the proposed algorithms and the corresponding numerical validation .The simulation study is reported in Section VI. This paper is concluded by section VII.

## II. RELATED WORK

Existing routing algorithms for intermittently connected mobile P2P networks can be classified into two categories:

Deterministic approaches [5] provide deterministic routing decision assuming that some kinds of network connectively information are known as prior. For example, Jain et al. [5] modify the Dijkstra's algorithms to compute the routes when the network connectivity patterns are known. In [6], a graph indexing system is proposed to minimize the long range communication cost for multicast, given the trajectories of moving peers and traffic demand are known in advance. By assuming that the contact rate between any two nodes in the network is available,[7] formulates a unified knapsack problem for relay selection to support multicast, studies the co-evolution of content popularity and delivery, and proposes a data dissemination algorithm to select a relay in light of its social contact patterns and interests.

However, it is challenging to obtain the network connectivity due to the uncertainty and dynamism of intermittently connected mobile P2P networks. Hence deterministic approaches are hard to implement in practice. This stirs the research of stochastic approaches, which are summarized as follows. Goa et al. exploit the transit contact pattern for each node, through which a node with a higher contact chance is selected as a relay. BUBBLE wrap combines the knowledge of the community structure with node centrality to make forwarding decisions. If the current relay does not meet a node whose community is the same as that of the destination, it selects the next hop according to the global centrality of the encountered nodes; if meets, it then considers the local centrality. SimBet routing computes each node's centrality within the network and its social similarity to the destination for relays selection, Dang et al. propose a cluster-based routing protocol, where a cluster is formed and a gateway is selected based on the nodal contact probabilities. Nodes within the same cluster use direct transmissions to communicate, their gateways must relay the data.

The schemes mentioned above, all infer some kind of network connection information through the history nodal contacts. Epidemic, on the other hand, selects relays randomly without inferring any network connection information. To enhance the delivery ratio, Epidemic disseminates a large number of copies of each data, which incurs a heavy communication overhead. To trade off between the communication overhead and the delivery ratio, the binary spray algorithm and the utility-based spray algorithm are proposed. The binary spray algorithm employs a copy quota Q to limit the maximum number of copies spread in the network. If a node holding the data meets another one without the data and the copy quota of this node is larger than 1, it delivers the data to the other node with half of the copy quota and keeps the other half for itself. The utility – based spray algorithm requires each node i to maintain a utility function Ui (j) for every other node j in the network and selects relays according to the utilizes of the nodes.

We claim that none of the existing algorithms simultaneously satisfies the three design requirements described in section I for intermittently connected mobile P2P networks. For example, [5] is a centralized scheme, whose route computation complexity increases rapidly with the increase rapidly with the increase of the network size; though [7], are distributed, the computation overhead on each relay is high and increases rapidly when the number of nodes in the network increases; selects cluster heads as gateways, resulting in the potential communication bottleneck problem; force each node maintain an entry for every other node in the network, thus scaling badly in network size; needs to detect the community before relay selection, while the complexity of community detection increases exponentially with the network size; adopts the flooding policy to deliver the data, which makes the delivery cost dramatically increase with the increase of the network size; though limits the copy quota for each data, a large copy quota is needed for a good delivery ratio due to its simple relay selection strategy, again resulting in a poor scalability.

On the other hand, our proposed algorithms scale well and incur low overhead because the information maintained at each node is relatively stable and the relay selection is node-based rather than node-relationship-based, which implies that our algorithms require no frequent information updates and the overhead On each node does not increase rapidly with the increase of the number of the nodes in the network. In addition, our algorithms are distributed because they involve no centralized routing decision/computation and communication hub. These advantages are achieved from exploiting the characteristics of human mobility, which will be introduced in the following section.

## III. MOTIVATION AND ROUTING MODEL

In this section, we first summarize the characteristics of human mobility that motivates our algorithm design and then secondly Human mobility exhibits spatial locality. In other words, people usually move within a local region. Reports the probability density function of the average displacement of all mobile nodes from their corresponding centers (most frequently visited place). According to the probability of moving away from its center for a node decrease sharply with the increase of the displacement, ex –A Characteristics of Human Mobility habiting spatial locality of human mobility. Our algorithms exploit three characteristics of human mobility. The activities of human mobility are heterogeneous. Mobility introduced in our prior work to simplify the in real world, nodes have different locations visited These characteristics are briefly reviewed in this section for within a given time, we observe that about completeness. they are obtained by analyzing real world 52% ~58% nodes visit less than 10 APs; about 20% nodes dataset, i.e. the Dartmouth college's wireless local area net-visit 10~20 Aps; about 2% ~3% nodes visit 40~50 Aps; some work (WLAN) traces. This trace data records when each nodes visit more than 80 Aps; and one or several nodes even node connects to 200 Aps. Different mobility activities result in Dartmouth College during 2001 to 2004. Different chances of contacting with others. We analyze the data from the following four months:

It indicates that nodes stay in their first two preferred places with i) Human mobility demonstrates a high degree of spatial a probability over 40%, demonstrating the spatial regularity of regularity. This indicates that each node has a significant human mobility; A three-month record capturing the mo-probability of returning to a few highly frequently visited ability patterns of 50,000 nodes chosen from about 10 million Anonymous mobile phone users shows that a user is found with the probability of 70% in his/her most visited location during the observed hour; in addition, most individual's daily activity is confined to a limited neighborhood of 1 to 10 km and a few users cover hundreds of kilometers. This trace data verifies the spatial regularity and spatial locality of human mobility. This trace data collecting approximately 275 freshmen PDA users for 11 weeks reveals that 50% users visit 21 APs or more, 20% users visit 56 APs or more, 10% users visit 71 APs or more, and in extreme cases, some users visit over 130 APs, which demonstrates the heterogeneous activity of human mobility.

By taking advantage of the human mobility characteristics summarized in this section, we design two routing algorithms to disseminate the data through depth or/and width searches as described in section IV.

***Routing Model***

In this section, we introduce our network model in detail. The whole intermittently connected mobile. There are many methods for a node to figure out the center coordinators of a zone. For example, the center coordinates of a zone can be broadcasted by the access points or access routes in an infrastructure-based network; or they can be determined based on a mapping function if the node is aware of its own physical location. There exist two simple strategies for a node to determine its home: i) a node can statically configure the zones it usually visits as its home; ii) it can dynamically add a zone to its home once the visiting frequently of the zone is larger than a given threshold. Similarly, a zone can be deleted from a node's home either statically or dynamically. The neighbor set of node i, denoted by N, is the set of nodes that can communicate directly with i.

We assume that any two nodes located at the same zone can communicate directly with each other. Therefore, all the nodes covered by the zone where I resides belong to N includes the nodes in a neighboring zone that can communicate with i directly. Note that I / N.

*Definition 3.1:* The home of node i, denoted by H.
*Definition 3.2:* The neighbor set of node i, denoted by N.
*Definition 3.3:* If the number of different zones visited by a node within a unit time exceeds a threshold, the node is called an activist.
*Definition 3.4:* The distance between the homes of two nodes i and j is the minimum distance between any two zones of H.
*Definition 3.5:* Node i is called a home node of a packet if the distance between the home of i and that of the destination of the packet is 0, i.e., H=0. In our model, once two nodes contact, they need to ex-change their home information. If a node is an activist, it should indicate this status.
*Algorithm 1*- The depth-search algorithm:

## IV. OUR ALGORITHMS

In this section, we propose two algorithms to select relays for routing in intermittently connected mobile P2P networks exploiting the three characteristics of human mobility introduced in section III-A.

### *A. DEPTH – SEARCH*

As shown in section III-A, human mobility exhibits a high degree of spatial regularity and spatial locality. Thus, the destination appears in the zones or near the zones of its home with a high probability. Therefore to achieve a high delivery ratio, it is better to select as relays the nodes that usually visit such zones. According to the above idea, we propose the depth-search algorithm, which selects as relays the nodes whose homes' distances to that of the destination are within a given threshold L (Line 9). In particular, when L=0, the depth-search algorithm only selects home nodes as relays. The pseudo-code of this algorithm 1, where Q is the copy quota of node j and function send (B, I, Q) sends data B to node i with copy quota Q. The copy quota of a node limits the number of copies delivered to other relays. If Q = 1, no copy is allowed to deliver to other relays.

Algorithm 1 selects a relay according to the following policy:

For a node j currently holding the data, if it meets the destination d, it should deliver the data to d directly (Lines 3-8); if it meets a node satisfying the relay condition and its copy quota is larger than 1, it delivers the data to the node and gives the node [Qj/2] copy quota, leaving with itself [Qj/2] copy quota (Lines 9-12).

### *B. DEPTH – WIDTH – SEARCH*

The depth-search strategy exhibits a single-direction search, which may miss better relays from other directions. To make up this deficiency, we propose the depth-width-search approach, which not only exploits the spatial regularity and the spatial locality of human mobility, but also the activity heterogeneity of human mobility. The underlying rationale lies in that the nodes with high mobility activities usually have 1: repeat 2: Update the neighbor set of each node holding the data 3: for each node j holding the data do 4: for each node I ∑ Nj. do 5: if i =d then 6: send (B, I, 1) return 7: end if 8: end for 9: if Q

***SUPPLEMENT:***

*EMERGING TECHNOLOGIES IN COMMUNICATIONS – PART 1*

Algorithm 2 - The depth-width-search algorithm:

In this section, high chances to meet with others, and thus the probability that it meets better relays is high. Therefore the depth-width-search approach selects as relays the activists besides the nodes whose homes are near to the home of the destination (Line 9). The pseudo-code of this algorithm is presented in Algorithm 2. It is worth nothing that in a large network with sparse mobile nodes, the source may spend a long time to find a node satisfying the relay condition. In relay condition. In such a scenario, our algorithms suffer from a so-called slow start phase, which largely affects the data diffusion speed in the network. To overcome this problem, we can slightly modify the algorithms by adding the following consideration: if the source does not meet a node satisfying the relay condition for a given amount of time, it selects as a relay the node from its neighbor set whose home is the nearest to the home of the destination. There also exist other variations that can further enhance the performance of our algorithms, which will not be detailed in this paper due to space limitations.

## V. THEORETICAL ANALYSIS AND NUMERICAL VALIDATION

In this section, we elaborate on the theoretical analysis of our algorithms and provide simulation results for our algorithms and provide simulation results for validation purpose.

### *A. Theoretical Analysis*

We assume that there are Z zones and U nodes in the network. The maximum number of copies a data packet can have in the network is denoted by Q. Note that in our analysis we omit the wireless transmission delay when calculating the data delivery latency because it is negligible compared to the duration that two nodes contact2. Similar to [24], we employ a continuous time Markov model to analyze our algorithms. a state i indicates that there are i relays in the network and the absorbing state O represents the state at which the data is delivered to the destination. we let the transfer rate from state2 A similar assumption is adopted by. 1: repeat 2: Update the neighbor set of each node holding the data 3: for each node j holding the data do 4: for each node i∑ Nj. do 5: if i = d then 6: send(B, i,1) return 7: end if 8: end for 9n : if Q j According To Definition 4.2,if the number of different zones visited by node within a unit time is beyond a threshold, the node is an activist. Given this threshold, the number of activists in the network can be determined. We assume that there are m activists in the network. Then with a proof similar that of Lemma .Let π be the probability that a node is a potential relay of our algorithms .Then in depth-search, let the average rate at which any node contacts with others are λ. When there am i nodes except the destination holding copies of a data packet, the data delivery Proof:

When i nodes have copies of the data in the network, the probability that a node except the destination has a copy i/ (U - 1).Since the rate of the destination contacting with other node is λ, we have to address the following question: when there are i relays in the network, how many of them can forward their copies to other nodes? To answer this question, we need first to investigate another question: when there are j relays in the network and the maximum copy-limitation is Q, how do these j relays share the copy quota Q? According to this question is very similar to the integer partition problem which asks for the number of possible partitions of a given integer. Let N (Q |j) is the average number of nodes among the j nodes that can forward their copies to other nodes when the maximum copy-limitation is Q. According to N (Q|j). When there are 1 j<Q relays in the network, in average N (Q|j) relays have the capacity (whose copy quota is larger than 1) to send the data to other nodes. since any relay meets other nodes with the rate of λ and each node its meets has he probability of to satisfy the relay condition, a (t) be the distributions of the probabilities at which the state is in i and o, respectively .According to the kolmogorov’s equation, we have: Our simulated network contains 50 × 50 zones and 100 mobile nodes. For these 100 mobile nodes, we randomly allocate serval zones to each of them as their homes. They move from one zone to another zone of their homes randomly .The most ten active mobile nodes are selected as the activists. We set Q= 10 OR 20 an L=20, will be explained in the following section. To validate f (t), we employ 10000 different random seeds to produce 10000 different simulation instances. The reported f (t) is the statistical result of the 10000 result of the 10000 simulation instances at which each node i contacts with others is set according to the statistical value obtained rate at from the simulation which each node study, through which contacts with others (t) and the numerical value obtained from the theoretical analysis, from which ewe observed that the trends of both results are matched.

In the next section, we further evaluate our algorithms using both the synthetic data described above and the real world trace data. We do not use the real world trace data for validating f (t) because the rate at which each node contacts with others is quite different .Thus the computed by normalizing Deviates significantly from the actual rate at which node contacts with others. Through normalizing results in a large deviation, it is un avoidable when modeling the data diffusion speed .we would like to emphasize that this is a commonly accepted method to perform similar analysis.

## VI. SIMULATION RESULTS

In this section, we evaluate the performance of or algorithms based on the real world trace data and the synthetic data introduced in Section V-B .we will compare our algorithms with binary spray (labeled by binary ) and BUBBLE wrap (labeled by BUBBLE).

In the binary spray algorithm, a node with a copy quota large than 1 for packet delivers its data to another node it meets with half of its copy quota and leaves itself with the other half if the encountered node has no copy of the data.

The BUBBLE wrap algorithm is a famous opportunistic routing algorithm for intermittently connected mobile P2P networks. As introduced in section II, BUBBLE combines the knowledge of the community structure with node centrality to make forwarding decisions. The intermittently connected mobile P2P network is a typical complex network.

### *A. SIMULATION RESULTS OVER THE SYNTHETIC DATA*

In this subsection, we evaluate our algorithms based on the synthetic data introduced in subsection. We select 100 source-destination pairs from then 100 mobile nodes and test the cases when L =0, 10, 20 and 30. Our results indicates that L = 20 yields the best performance because this setting provides the best tradeoff between the number of relays and the quality and the quality of relays.

The performance of binary in the worst because it selects relays only based on whether or not the encountered node has a copy of the data and ignores other key properties of nodes. The performance gap between BUBBLE and our algorithms is resulted from the fact that former selects as relays the nodes that usually contact the destination through communicates while ours select relays based on the zones they usually visit. The contacts among the nodes in a community are usually indirect, which may lead to unsatisfactory performance. For example, if nodes a, b and c belong to the same community but a usually contacts with b, who usually contacts with c. In the case that the destination is c, and the centrality of a higher than that of b, a data packet will be delivered to a rather than b. Then c may not receive the data because it cannot contact a directly.

### *B. PERFORMANCE EVALUATION OVER THE REAL-WORLD TRACE DATA*

In this subsection, we evaluate our algorithms using the Dartmouth college mobility trace data.

In our simulation study, each AP represents a zone, and any to nodes within the same nodes can communicate directly because the trace data contains over 5000 mobiles nodes, we can limit the number of nodes to a manageable size. Different from these existing literatures, we do not deliberately select the well' connected mobile nodes such as "good neighbors" to construct the simulation topology. We connect mobile nodes to the completely randomly from the Dartmouth college trace data to retain possible characteristics of the raw data. Since the number of nodes in the network needs to be limited to a manageable size, we construct the simulation scenarios according to the following steps: We first randomly choose 300 mobile nodes to construct a 300- node scenario, and select 100 source-destination pairs from these 300 mobile nodes. These 100 communication pairs remain unchanged during our simulation study.

## VII. CONCLUSION

In this paper, we propose two opportunistic routing algorithms for intermittently connected mobile P2P networks, with both taking advantage of the mobility characteristics, namely the spatial regularity, the spatial locality, and the activity heterogeneity of human mobility, for enhancing the routing efficiently. The first one is a depth-search algorithm that data toward the destination direction while the second one adopts the depth-width-search, delivers the data toward both the destination direction and other directions guided by the activists. To validation the performance of our algorithm, we first perform a theoretical analysis, and then conduct a comparison based simulation study over both the synthetic data and the real world traces. The results indicate that our algorithms outperform the most related once in terms of the delivery ration and average delivery latency.

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