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Social Behavior of Global Community in MANET with Human Mobility

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Abstract— In recent years, social based approaches attempts to exploit social behaviors of DTN nodes to make better routing decisions. Routing performance is improved by taking advantages of positive and negative social characteristics. The general features of human mobility such as time correlation, location heterogeneity, node heterogeneity and node correlation are considered. The network stability is characterized by considering the probability of visiting of each node and transmission resource at each location. Cooperative caching in DTN is enabled for sharing and coordination of cached data among multiple nodes. Throughput optimal policy is developed by stability related optimization problem. The main objective of the project is to optimize the data forwarding scheme by "store and forward" technique, to implement Heterogeneous Human Walk (HHW) mobility model that analyze the overlapping community structure in social networks, to analyze the social behaviors such as positive and negative social characteristics, to learn the positive social characteristics such as community and friendship and to learn the negative social characteristics such as selfishness. For all the entire system is to analyze the performance of data forwarding in overlapping community networks based on mobility model for tracing out the characteristics of social behavior.

Index Terms— DTN Nodes, Routing, Cooperative Caching, Heterogeneous Human (HHW) Walk mobility model.

I. INTRODUCTION

Mobile Ad hoc Networks (MANETs) using the store carry-forward paradigm are also referred to as delay tolerant networks (DTNs). Using the store-carry-forward paradigm, a node can carry buffered data while moving in the network until it reaches a suitable next-hop node to relay the carried data. Thus, data can be delivered from a source toward a destination through multiple transmission opportunities, which may not be possible when nodes are static or data transmission cannot tolerate large delay. In many DTN applications, such as vehicular networks, mobile social networks, disease epidemic spread monitoring networks, mobile sensing networks and pocket switched networks (PSNs), mobile devices are operated or carried by people. Therefore, these DTN applications are also referred to as people-centric DTN applications. As an example, consider sharing popular files among people using Smartphone's. If Wi-Fi/cellular network is not available or cellular service has a high cost, transmission of popular files among Smartphone's within a small region can be realized using short-distance transmission techniques, e.g., Wi-Fi Direct, Bluetooth, LTE-D2D, etc. Thus, when an individual carrying popular files moves to a new location, he/she can share the files with the new neighbors within this location using the aforementioned short-distance transmission techniques. In this way, the popular files can reach different people using the store-carry-forward paradigm. Throughput and delay are important metrics for data dissemination in people-centric MANETs. Different from traditional MANETs, throughput and delay of people-centric MANETs highly depend on the features of human mobility. By extracting the features from the real traces of individuals, recent research discovers some important features of human mobility, including node-correlation, time-correlation, node heterogeneity and location heterogeneity. Specifically, it is shown that human mobility relates to the structure of social networks and has node-correlation. It is observed that trajectories of individuals share similar features to those in Lévy flights/walks, implying the time-correlation in human mobility. Individuals with higher popularity have more opportunities to meet others, which show the heterogeneity of nodes in human mobility. For each individual, different locations may have a different popularity ranking, which shows the heterogeneity of locations in human mobility. However, it is still not known in general how the important features of human mobility affect throughput and delay performance for people centric applications in MANETs. In addition, it is not clear how to design optimal policies to improve throughput and delay performance for people-centric DTN applications.

A. Major Contributions of the System

In this system, we shall address the above issues. We consider a general human mobility model for MANETs, which can capture important features for human mobility, such as node correlation, time-correlation, node heterogeneity and location heterogeneity. Multiple unicast with general arrival processes are delivered and nodes are equipped with infinite buffers. Our goal is to study the impact of human mobility on throughput and delay for people-centric applications in MANETs under our system model. Specifically, we first characterize the network stability region (i.e., network capacity region) in terms of the probability of each node set visiting each location and the amount of transmission resources at each location. Based on the network stability region, we formulate a stability-related optimization problem,

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the optimal value of which indicates the throughput margin between the network stability region and the arrival rate vector. We analyze the impact of the aforementioned important features of human mobility on the network stability region by studying the optimality properties of the related optimization problem. We show that node-correlation and heterogeneity of locations' popularity usually decrease the size of the network stability region, while diversity of locations visited by a node usually increases the size of the network stability region. In addition, by solving the optimization problem using interior-point methods, we develop a stationary randomized policy based on the obtained optimal resource allocation variables and routing variables. We show that the proposed policy is throughput-optimal. We also obtain bounds of the delay performance under the proposed policy. Specifically, we obtain upper and lower bounds using Lyapunov drift technique and first hitting time analysis, respectively. Finally, using numerical simulations based on a theoretical model and some real traces, we verify the analytical results and compare the performance of the proposed policy with some existing policies.

B. Potential Application

The MANET plays a major role in wireless communication and provides effective communication.

- Military Battlefield: Military equipment now routinely contains some sort of computer equipment. Ad- hoc networking would allow the military to take advantage of commonplace network technology to maintain an information network between the soldiers, vehicles, and military information headquarters.
- Commercial Sector: Ad hoc can be used in emergency/rescue operations for disaster relief efforts, e.g. in fire, flood, or earth-quake. Other commercial scenarios include e.g. ship-to-ship ad hoc mobile communication, law enforcement, etc.
- Local Level: Ad hoc networks can autonomously link an instant and temporary multimedia network using notebook computers or palmtop computers to spread and share information among participants at e.g. conference or classroom.

C. Delay Tolerant Networks

A delay-tolerant network is a network designed to operate effectively over extreme distances such as those encountered in space communications or on an interplanetary scale. Delay-tolerant networking involves some of the same technologies as are used in a disruption-tolerant network but there are important distinctions. A delay-tolerant network requires hardware that can store large amounts of data. Such media must be able to survive extended power loss and system restarts. It must also be immediately accessible at any time. Ideal technologies for this purpose include hard drives and high-volume flash memory. The data stored on these media must be organized and prioritized by software that ensures accurate and reliable store-and-forward functionality.

D. Road Map and Summary

Asynchronously time-varying social roles can be modeled by extensive simulations to improve the ratio of queries satisfy and reduces data access delay. The delivery ratio is achieved by using enhanced protocol for better efficiency. More realistic and accurate social characteristics can be used to further improve performance of DTN routing. Model and extract accurate social characteristics in dynamic DTNs can be analyzed. Social-based solutions considering both positive and negative social characteristics together can be applied. Using the following strategies Label Routing, SimBet Routing, BubbleRap Forwarding, Friendship based Routing the data packets are sent. The performance of data forwarding in overlapping community networks is analyzed based on mobility model for tracing out the characteristics of social behavior. The social behavior includes both positive and negative social characteristics are used for tracing out the routing characteristics of data.

II. RELATED WORK

The major part of the project development sector considers and fully survey all the required needs for developing the project. Before developing the tools and the associated designing it is necessary to determine and survey the time factor, resource requirement, man power, economy, and company strength. Once these things are satisfied and fully surveyed, then the next step is to determine about the software specifications in the respective system such as what type of operating system the project would require, and what are all the necessary software are needed to proceed with the next step such as developing the tools, and the associated operations.

Throughput of human mobility and delay on people centric application are studied. The general features of human mobility such as time correlation, location heterogeneity, node heterogeneity and node correlation are considered. Throughput optimal policy is analyzed by solving stationary randomized policy. Delay performance is characterized by obtaining upper and lower bounds. Implementation is done by Simulation based on numerical and theoretical model and real traces. Time heterogeneity can also be considered for better results on simulation.

Social properties in DTNs are summarized and social based DTN approaches are surveyed. Routing performance is improved by taking advantage of positive and negative social characteristics. Positive social characteristics are community and friendship in packet forwarding. Negative social characteristics include selfishness. A social graph is global mapping of everybody and how they are related, also called as social network. Contact graph is generated where each vertex denotes a mobile node and packet forwarding is done when two nodes are in contact. Community is important concept in ecology and sociology in ecology, two or more populations of different species occupying same geographical area. In sociology, group of interacting people living in common location.

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A. Positive social characteristics in DTN routing

- Label Routing: Based on community labels in pocket Switched Networks (PSN). Reduces the amount of traffic created during packet forwarding
- SimBet: Nodes with high between centralities are nodes who can act as bridges in their neighborhood, while nodes with high similarities with the destination are more likely to find common neighbor with the destination.

B. Negative social characteristics in DTN routing

- SSAR: social selfishness Aware Routing, allocates buffers and bandwidths based on packet priority. Forwarding capability reduces the packet dropping rate.
- Give2Get: Two versions is proposed epidemic forwarding and delegation. In epidemic, messages are forwarded to firstly encountered nodes. In delegation, messages are forwarded to nodes that have higher forwarding quality.

Cooperative caching in DTN is enabled for sharing and coordination of cached data among multiple nodes. Network Central Location (NCL) is set for easy access of other nodes in a network. Effective scheme is proposed for NCL selection by probabilistic selection metric. Data is generated with no expiration and checks whether to generate new data. Each generated data has finite lifetime uniformly distributed in range and period of data generation. Queries are randomly generated at all nodes and each query has finite time constraint.

In this system, we consider mobility based on overlapping community structure in social networks. The realistic assumption of an overlapping community structure is done by HHW (Heterogeneous Human Walk). The performance of data forwarding protocols is accurately understood by Human mobility models. Asynchronously time-varying social roles can be modeled. For the heterogeneity mobility HHW (heterogeneity human walk) is developed. The realistic assumption of an overlapping community structure is done by HHW. The trade-off between complexity and reality is done by directly constructing synthetic overlapping communities. Existing HHW model observe the characteristics of both real social networks and mobile user tracers. A model for asynchronously time-varying social roles can be done as future enhancement.

A Social-based privacy-preserving packet forwarding protocol for vehicular DTN is presented. The Road Side Units (RSUs) are deployed for assisting packet forwarding to achieve highly reliable transmission. RSU is placed in the high-social intersections and they provide packet storing and forwarding. Performance evaluation is done by simulation. To identify the design goal network model, node model and threat model is formalized. In network model, social degree of intersection is defined by considering the intersection of vertices. In node model, two kinds of DTNs vehicles and RSUs is characterized. In threat model, RSU nodes are trusted and non-compromised. Few attacks that degrade performance is considered.

- Packet analysis attack – recovers packet content and infers the source.
- Packet tracing attack – the source and destination location of packet is traced.
- Black hole attack – the router instead of forwarding the packet, discards them.
- Grey hole attack – forwards only some packet not all packet.

Enhanced protocol can be used for better efficiency in terms of delivery ratio in vehicular DTNs can be achieved.

III. PROPOSED APPROACH

The proposed system aims for the better performance of throughput in DTN with human mobility. This can be done by considering the node occurring at the same time forming a community structure. When the endogenous data arrive at node (source) and are targeted to different node, then data form a unicast. The social network is formed from the data explored form internet. Routing is done based on features of human mobility such as time correlation, node correlation, location heterogeneity, and node heterogeneity.

Community is being identified in two phases:

- 1st Phase: Small communities are optimized (Modularity).
- 2nd Phase: Aggregate nodes of same community and build new network.

A. Friendship

Friendship describes the close personal relationship between two nodes in the social network. It is defined between a pair of nodes. Two nodes must have long lasting and regular contact between each other to be considered as friends. It can also be stated as, individuals who share similar actions and frequently meet each other. This phenomenon is termed as homophily phenomenon. Therefore friendship in DTNs can be determined between the contact histories of two nodes.

B. Selfishness

Selfishness is a common factor used in both sociology and economics, which is recently involved in the design of computer networks. Selfishness is measured by the behaviour of nodes. Nodes that behave selfishly at individual aim and aim only to maximize the own utility were termed as selfishness. In DTNs, the nodes may drop others message excessively and replicate its own message to increase the delivery rate.

C. Similarity

Similarity is measure of degree of separation. In Social network it can be measured by the number of common neighbours between individuals. The probability of two people being acquainted is possible if they have one or more acquaintance in common. Similarity can be defined as the probability of two nodes being connected by link is higher when they have more common neighbour. Similarity will be low when the nodes are unlikely to be in contact with each

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other and diffusion occurs. Similarity can be defined in two ways, such a similarity on user interests and similarity on user location.

D.Centrality

Centrality is the measure of topological vertex in the graph. The central node has the strongest capability of connecting nodes within the graph. The centrality is of three types namely, degree centrality, between's centrality, and closeness centrality. Degree centrality is defined as the simplest of all centrality and it is denoted by the number of links incident on the given node. In the below example, the degree of centrality of node a is 3, and node b, c, .d has 1.

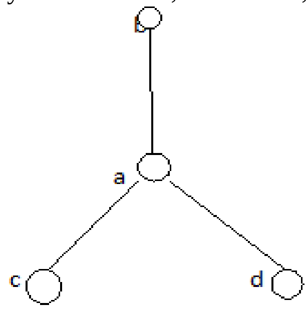

Fig.1 Centrality

Between's centrality is measured by the number of shortest paths passing through the given node. In the below example the between's centrality of node a is 6 and it has the shortest path while all other nodes has 3.Closeness centrality is defined as the inverse of average shortest distance to all nodes in the graph. From the below example, the closeness centrality of node a is 1 while for all the other nodes it is 0.6 probability between nodes but also the data propagation orders

IV. ARCHITECTURAL DESIGN

Once these things are satisfied and fully surveyed, then the next step is to determine about the software specifications in the respective system such as what type of operating system the project would require, and what are all the necessary software are needed to proceed with the next step such as developing the tools, and the associated operations. Generally algorithms shows a result for exploring a single thing that is either be a performance, or speed, or accuracy, and so on. System architecture can comprise system components, the externally visible properties of those components, the relationships (e.g. the behavior) between them.

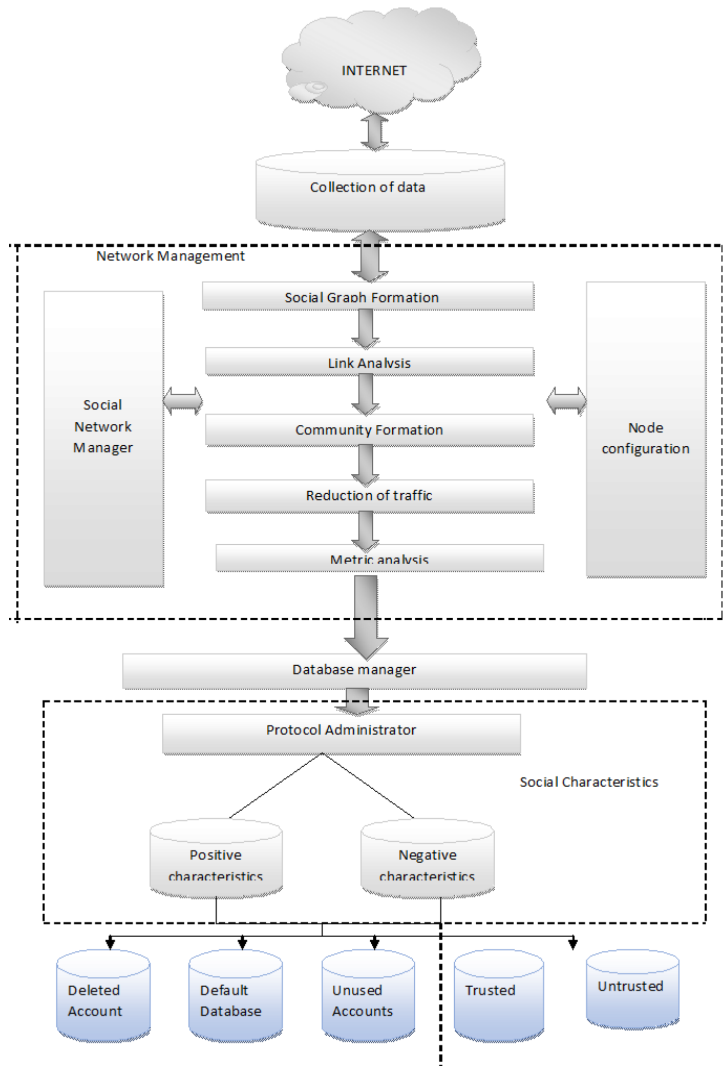

Fig.2 System Architecture

V.MODULES

1. Human Mobility Strategy
2. Throughput and Delay Manipulations
3. Mobility Model
4. Communication Schema

1) Human Mobility Strategy

An important feature of human mobility on the network stability region is the optimality properties of the related optimization problem. We show that node correlation and heterogeneity of locations' popularity usually decrease the size of the network stability region, while diversity of locations visited by a node usually increases the size of the network stability region. In addition, by solving the optimization problem using interior-point methods, we develop a stationary randomized policy based on the obtained optimal resource allocation variables and routing variables. We show that the proposed policy is throughput-optimal. We also obtain bounds of the delay performance under the proposed policy. Specifically, we obtain upper and lower bounds using Lyapunov drift technique and first hitting time

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analysis, respectively. Finally, using numerical simulations based on a theoretical model and some real traces, we verify the analytical results and compare the performance of the proposed policy with some existing policies

2) Throughput and Delay Manipulations

Throughput and delay are important metrics for data dissemination in people-centric MANETs. Different from traditional MANETs, throughput and delay of people-centric MANETs highly depend on the features of human mobility. By extracting the features from the real traces of individuals, recent research discovers some important features of human mobility, including node-correlation, time-correlation, node heterogeneity and location heterogeneity. Specifically, it is shown that human mobility relates to the structure of social networks and has node-correlation. It is observed that trajectories of individuals share similar features to those in Lévy flights/walks, implying the time-correlation in human mobility. Individuals with higher popularity have more opportunities to meet others, which show the heterogeneity of nodes in human mobility. For each individual, different locations may have different popularity rankings, which show the heterogeneity of locations in human mobility. However, it is still not known in general how the important features of human mobility affect throughput and delay performance for people centric applications in MANETs. In addition, it is not clear how to design optimal policies to improve throughput and delay performance for people-centric DTN applications.

3) Mobility Model

In proposed work we consider a mobility model which can capture node-correlation, node heterogeneity and location heterogeneity (but not time-correlation, which is also an important feature of human mobility). They consider stateless and memoryless policies and characterize the network capacity region only under the stateless and memoryless policies. In addition, their mobility model cannot be used to explicitly reveal the impact of the mobility features on the network capacity region.

4) Communication Schema

We assume that at each slot, only the nodes in the same location can communicate with each other due to limited coverage. Each node can be a transmitter or a receiver. At each slot t, if node i and node j are both in location k, i.e., Mi(t) = Mj(t) = k, and node i transmits to node j, they form a transmitter-receiver pair (i, j). Without loss of generality, let D ⊆ {(i, j) : i, j ∈ N, i = j} denote the set of all possible transmitter-receiver pairs. We assume that (i, j) ∈ D if and only if (j, i) ∈ D. We consider the interference among different transmitter-receiver pairs in the same location, and ignore the interference among transmitter-receiver pairs in different locations. It is because the interference among different locations is relatively small due to the path loss effect. To avoid interference in the same location, we apply orthogonal transmission schemes, such as TDMA and FDMA schemes. Considering limited transmission resources, such as power and bandwidth, we assume at each slot, the total transmission rate over all transmitter-receiver pairs in location k is Rk ≥ 0. That is, at each slot, Rk can be orthogonally allocated to different transmitter-receiver pairs in location k.

VI. RESULTS

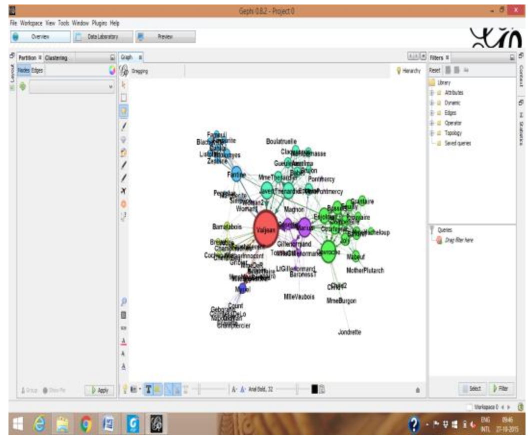

Fig.3 Graph Visualization

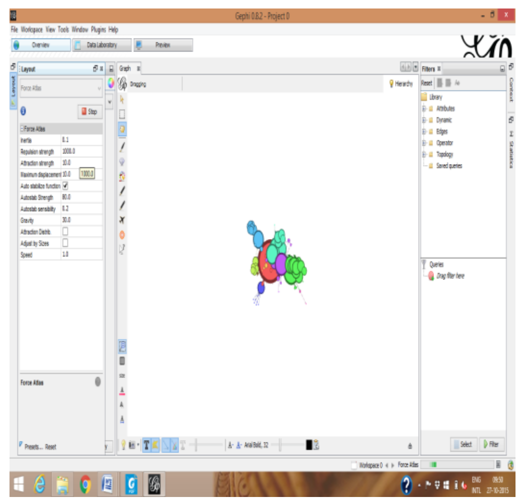

Fig.4 Graph Layout

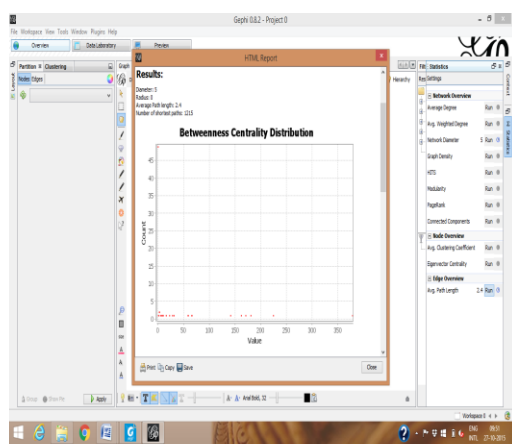

Fig.5 Betweeness Centrality

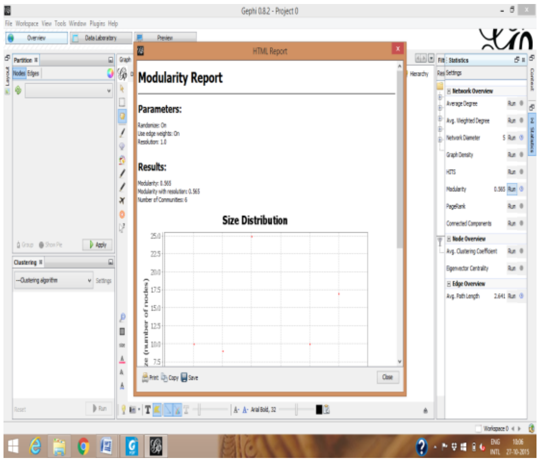

Fig.6 Partition

VII. CONCLUSION AND FUTURE WORK

Since people's social interactions strongly affect their movement decisions, understanding social network structure plays a significant role in accurately modeling their mobility. We propose a general human mobility model for MANETs, which can capture important human mobility features. We aim to study the impact of human mobility on throughput and delay for people-centric applications in MANETs. We characterize the network stability region in terms of communication parameters and mobility parameters. We analyze the impact of human mobility features on the network stability region. We also develop a stationary randomized policy, which is shown to be throughput-optimal. We characterize the upper and lower bounds of the delay performance under the proposed policy characteristics to assist packet forwarding in DTNs. summarizing the social characteristics used by these routing protocols. The social graph is formed and the data are analyzed. The between's, closeness and eccentrality are analyzed. The dynamics of the graph is plotted by enabling both groping the nodes into local and global community. The community is analyzed by the metric modularity. Existing HHW model observe the characteristics of both real social networks and mobile user tracers. A model for asynchronously time-varying social roles can be done as future enhancement. Extensive simulations can be done to improve ratio of queries satisfy and reduces data access delay Enhanced protocol can be used for better efficiency in terms of delivery ratio in vehicular DTNs can be achieved.

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