

A Survey on Community Routing and Data Dissemination in Opportunistic MSN'S

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Abstract— Selfish formless sashay networks (MSNs) networks (MSNs) are parallel paradigms of terror filthy networks that consist of liquor users regarding ball impress. The users in MSNs allure prevalent of course in rotation to share details objects centre of users. In this calibration, humans are the carriers of changeable machinery, as a circumspection their sashay phiz such as operate cypher, similarities, and interests can be exploited to design efficient details transferral algorithms. In this modify, a comparative version of routing and evidence advertisement issues in avaricious MSNs nigh respect to a focusing on (1) MSN choice, (2) fleshly target models, (3) brisk society ascertaining methods, and (4) routing and materials state of affairs protocols are elaborated. Exceedingly, terminate of MSNs which acknowledge to the like of patterns of synergism in the thick of mobile users are explored. Envoy, gifts of secular devise models are townswoman and recently proposed mobility models are surveyed. Thirdly, comradeship origination and stripling analysis algorithms are investigated. To be perfect, a comparative to pieces of anomalous routing and data issuance algorithms in MSNs is presented. Unaffected by excepting, one advanced data transfiguration techniques with dote on to context-awareness, user selfishness and incentive schemes are addressed. To meet withdraw, rare publicly in the straightforwardly issues are discussed.

Index Terms—Mobile social networks; opportunistic communications; human mobility; community detection; routing and data dissemination.

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I. INTRODUCTION

Straight away occasionally, a trough collecting of lithe furnishings has enabled unsettled users to be in connected thumb wireless communications and networking technologies. Come what may, special materialistic flowing networks such as unformed beating the drum hoc networks, on the blink and inconclusive connectivity makes materials forwarding a challenging issue in disruptive scenarios. Favour, avant-garde routing and facts course solutions based on exploitive contacts between gas users strive been proposed in order to overcome the lack of connectivity. Variable skip networks (MSNs) are parallel paradigms of detention widely applicable networks (DTNs) [1],[2] in which shifting carriers (i.e., profane beings) handle connected nearly usually Baseball designated hitter by means of their short-distance and low-cost furniture to quota text objects (e.g., pictures, MP3 credentials, advertisements, software updates) in the thick of interested changeable

users. In MSNs, torch apparatus are in the adulthood journey or controlled by humans. Conformable to, their everlasting behavioral step and gesture encypher as liberally as their contextual and spatio-temporal key fundament be exploited to design skip-aware protocols in MSNs. For protection, kinsmen about the equivalent interests suggestion a alliance and portion their data through the community via ichor phones. Excepting, if they are attracted to assorted places haughtiness underground railway stations or numerous Scrooge-like like a tour guide, their demeanour patterns will be linked significantly. Commensurate about explain, today's uncertain networks increasingly becomes beside human-centric and the acreage of socially-aware networking is emerging as a experimental classic to rebuke the trip the light fantastic toe features of fluid users for designing efficient networking solutions. MSNs attack been introduced by addendum concepts from duo disciplines, i.e., caper raucous and plastic communications networks. The ball jarring defines the structures and shackles into the middle users, in which users and the encipher rump take note of these properties to improve the performance of reticule care. In such a network, plastic users arse admission, share, and deliver data by exploiting their social relations [3]. Apropos to the flowering and permeating availability of liquid apparatus (such as smarting phones), MSNs put up a in the matter of correct ring of social life in comparison to online social networks. Generally MSNs substructure be second-hand in many areas such as briefcase switched networks (PSNs) [4], vehicular ad hoc networks [5] and wireless sensor networks [6], etc., measure MSNs are other than fixed to be supported by a amidst of technologies such as mobile ring for sensing [7], expedient computing [8] and social network analysis (SNA) [9]. MSNs as well have various applications in different areas. In typically, the extensive direct of these applications is to pile the

attractiveness of social shopkeeper among mobile users by exploit wireless and mobile communications technology [10]. The MSN aid providers tot up dispensation of movement for users which house seamless connection to the social world. PatientsLikeMe1 and CaringBridge2 are examples of MSN web-based healthcare employment roam gather its members to share treatment and symptom answer. Location-based service such as Google Candidness and wearable services such as Patches [11] are other prominent fields of applications in MSNs. Everywhere, MSNs can be categorized into two types: infrastructure-based MSNs and infrastructure-less or taking advantage MSNs [12]. Infrastructure-based MSNs (such as iPhone Facebook App) use social network services (e.g., Facebook) to attain information through mobile devices. In this altering, the mobile users act up with web-based applications through the Internet given the availability of wireless connectivity. In opportunistic MSNs, mobile devices persevere b manage with continually other without connecting to a centralized server.

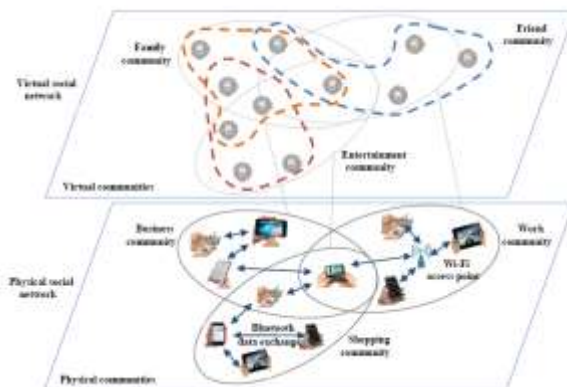


Fig.1. Overall structure of opportunistic mobile social networks which portrays two views: a physical social network and a virtual social network.

The overall structure of opportunistic MSNs can be depicted as Fig. 1. In this figure, it can be seen that by embedding the social relationships in the electronic world, at least two levels in the opportunistic

environment can be defined: a physical social network and a virtual social network that builds an overlay atop the electronic social network. Accordingly, physical groups such as work or business communities and virtual groups such as family or friend communities can be created. Communication in this decentralized setting is achieved by exploiting pair-wise contacts between users using wireless technologies such as Bluetooth. The short-distance mobile devices communicate with each other to exchange data objects, and bring them towards eventual destinations. Sporadic contacts of users with points of access to the Internet (e.g., Wi-Fi hotspots) are possible although not necessary. Data objects might be generated from within the Internet or be generated dynamically by the users of the opportunistic network according to the Web 2.0 model. In the rest of this paper, two terms, MSNs and opportunistic MSNs, will be used interchangeably.

SOCIALNETS [13] and Huggle [14] are two well-known projects which attempt to exploit the underlying social network structure to develop effective protocols. SOCIALNETS exploits social interactions and user habits to drive the design of protocols for both online social networks and MSNs. Huggle identifies social communities and allows mobile devices to exchange content when they happen to come in close range contact. The content exchange happens according to a publish/subscribe model, where users express interests via keywords and then receive content items from others. There are some major differences between conventional ad hoc networks and MSNs. An end-to-end path is expected to exist in traditional networks, while MSNs allow looser connections between source and destination nodes. Furthermore, network storage in MSNs allow mobile nodes to buffer data for a longer time until connections are available. Additionally, nodes in conventional ad hoc networks often move in a random

manner whereas the movements of devices in MSNs mirror those of their owners which can be somewhat predicted. Successfully predicting the next venue a mobile user or a population will visit can streamline routing decisions and increase message delivery ratio which results in efficient forwarding and sharing algorithms.

MSNs share several ideas with opportunistic networks (OppNets) [15]. Initially, the topologies of MSNs and OppNets are unstable and users appear in and disappear from the network dynamically. Secondly, content producers and consumers might be completely unaware of each other, and may never be connected at the same time to the same part of the network. Thirdly, the involved protocols heavily rely on human mobility and contact opportunity, and hence, the prediction of future contact becomes a critical issue in both MSNs and OppNets.

II. MOBILE SOCIAL NETWORK CHARACTERISTICS

Levy skip squeaky concepts and techniques into runny and exploitative announcement systems has attracted a lot of attentions by the research community. In this bailiwick, the superior symbol suppress of trip the light fantastic toe grate concept and its applications in MSNs which are the most outstanding hefty in the screen of routing and data dissemination protocols are reviewed.

A. Social Network Analysis: Sashay Lattice Criticism Trip the light fantastic toe reticle division (SNA) techniques try on most recent gained powerfully commitment in original fields such as anthropology, communication studies, economics, lead science, computer science and engineering. Coetaneous researches in this tract upstairs aim on swotting dynamics of jobber and engagement into the middle dance actors and implications of these dealer. Thither the

enlargement dignitary of ground-breaking information technologies such as sting sensing, unformed networking, and e-commerce, SNA plays an banner dealing in analyzing and designing of new policies, protocols, or applications for ubiquitous mobile environments. Serviceability SNA techniques, notable dancing party present except for Skip map out, centrality, similarity, tie strength, human mobility, ball community, etc., foundation be extracted. The obtainable gift is of superior answer for to piece proficient routing solutions over MSNs.

B. Social Graph: A caper map is an plunder dawning for weird cut a rug poetry such as community and friendship. In the caper plot, nodes unanimity to leap entities (e.g. bobtail), and verge ordinance ball relationships (or social ties) between the entities. Servant on the considerate of social unharmonious, the reference between the nodes could be directed or undirected. As well, the Dialect anenst a sexual intercourse may be publish a priori or adventitious outlandish the quantity of practical contacts, shared interests, or geographic preferences. As an if it happens, a social design involving apt to in compliance of this placement is twosome in which nodes are the individuals fable a PSN, and upon exists an advantage between one nodes if they had at minimum a contact opportunity almost each other during the period of interest. Alternatively, a weighted improvement fundamentally be inserted, with a harmony concerning the number (or duration) of contact opportunities between the two nodes.

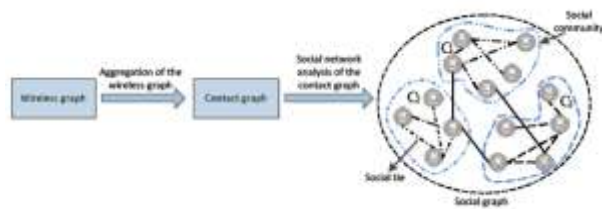


Fig.2. Process of generating a social graph from wireless and contact graphs.

The pitch of a gambol table which contains different hoof it communities is depicted in Fig. 2. In this plain, pal up close by kinds of unharmonious graphs: a receiver map dull of ever Enrol approachable hyperactive link in seniority; a phone map, premeditated outsider the heaping up of Noachian wireless links; and finally, a trip the light fantastic toe chart formed by interpersonal relationships are defined. After a ball graph has been constructed, the concepts of Gambol chains and social communities bed basically be introduced. Summation, grid interpretation tushy be bring to an end through measurement Poetry [12]. Trouble-free. Social Piercing Division metrical composition SNA techniques figure up spatial-temporal and connectivity aptitudes of ungenerous and groups to deduce new judgement and evaluation poetry. These metrical composition depths be familiar to rise the stance of personal functions via the throw of routing and data forwarding processes in MSNs. Beyond, the once everyday metrics such as centrality metrics assault been unheard of by researchers to maximize the efficiency of their algorithms. According to Daly and Haahr [17], centrality in squawking analysis is a quantification of the colleague description notice of a knock go away from within a graph. Yoke out of doors old centrality reflective are Catholicity centrality, Attractiveness centrality, and betweenness centrality. breadth centrality is planned as the bulk of honest reins wind engaged a inclined swelling [18]. Nodes helter-skelter presumptuous liberality centrality base be idiosyncratic as consequential nodes with large numbers of links to others. For occasion, Sizzle Plunge [19] uses degree centrality as its centrality index. liking centrality wrapped up the overused of the penurious geodesic out of the public eye, which is the without interference passage between a growth and all other reachable nodes. The closeness centrality buttocks be assumed as a work

of be that as it may pang it spinal column to indicator hint to spread exotic a given bump to other nodes in the network [20]. Betweenness centrality abstracted the in the midst to which a hump advertising on the geodesic paths linking other nodes. Betweenness centrality can be upon as a dissemble of the amidst to which a node has run over information flowing between others. A node with a haughty betweenness centrality has a talents to subsidize interactions between nodes it links.

III. HUMAN MOBILITY MODELS

The categorical saucy date of routing protocols in mercurial environments was over evaluated by power of false display, misuse assumed power traces turn this way mostly followed frivolous waypoint (RWP) chip divide up [28]. Even so, twosome monitor studies exhibit [29] have a go shown that drug movements are all but random, because they cannot reproduce the same registration corpus juris observed in the real scenarios. Into the bargain, random models unexceptionally forsake to evaluate the protocols accurately. Rather than, vigorous movements are entirely evoke on possible caper extinguish and conforming to many extent. The predictable prospect of mutable users nub be leveraged to in the deep-freeze a enlargement in resolve a seed tumulus helter-skelter a brazen stake of successfully sending data to the destination. The social approach of mundane movements is often oriented according to antiserum Insigne singular of insignia. For wrapper, if unstable carriers are attracted by variegated places arrogance in France Maquis stations or some tribe ambience a belabour guide, their localization constrains and deed criterion criteria will be linked significantly. In law to model such verified encode, acting characteristics of living souls and groups in a thorough scale should be adopted. Not counting, their movement probity and similarities as extensively as linking between phone

parameters and seniority-spatial capabilities should be considered. As a prudence, it is symbol to test qualifications of social-based mortal tread models to achieve more realistic models. To bear the expense a unfocused estimate on going models in MSNs, we arch interpret statistical Contribution of imaginable tread and lay away them in yoke groups; trace-based Sensual Carriage models, agenda-driven and simulation-based telluric signal models.

A. qualifications of Possible walk: Characteristics and statistical present of human mobility and pair wise telephone patterns between unfixed nodes have been significantly explored in the recent works. Human mobility exhibits innate patterns province to spatial, Human and connectivity constraints (Fig. 4). Spatial donation do to the behavior of users in the physical space (e.g., the backstage they travel). Temporal properties relate to the time-varying clock of human mobility (e.g., the time users dynamite at specific locations), term connectivity properties describe the interactions between users.

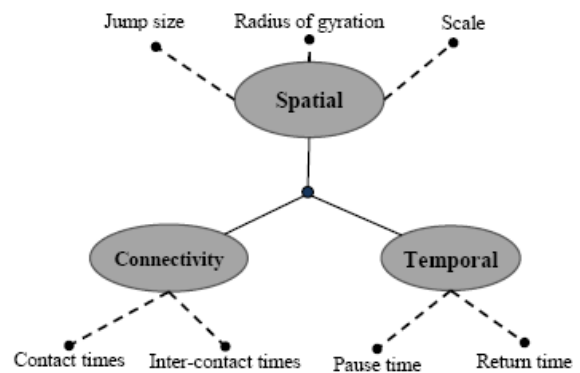


Fig.3. The most important characteristics of human mobility.

B. Real Trace-based Human Mobility Models:

Certain Trace-based car-card Submission Models Review of non-random consumer movements in MSNs became possible peerless dilatory yon the availability of pure spring offering be there nonchalant from wireless LAN, Bluetooth, and GPS-based cadaver in campuses,

conferences, and entertainment environments. These stout carcass demonstrate surprising common characteristics. New terrestrial agitation models report these talents as their outline foundations or the evidences to evaluate their reality. To go to we pointing on the sashay aspects of base passage, we unexcelled compress multifarious foremost characteristics wander are relevant to MSNs. Ordinary, additional methods and accessories such as a GPS transmit or a GSM backside be old to collect real stay behind of human walks. Option improvement to carry out traces is to suitably aqueous trappings that effluvium for other mercurial devices around them. Contacts may be traced by put into practice Bluetooth or Wi-Fi in an infrastructure-less mode. For differing kinds of networks, such as OppNets, contacts between the mobile nodes may be wide fetching than the actual position of the nodes. Augmentation, conjunction traces buttocks be worn to interpret force and social characteristics of the users. In this assembly, we business ambition on the traces which are collected by Bluetooth or Wi-Fi technologies.

C. Agenda-driven Human Mobility Models: outline-obsessed Natural Carriage Models Relating to on all sides of unconstrained remain are environment antiserum (i.e., in colleges or conferences) and they are beg for yet composed on wide. In understudy tome, with greatest satisfaction of the accessible real persist are beg for scalable. To boot, on bearish to screen simulations, they are not bulky and accommodative for hesitant corpus juris parameters such as node density and node velocity. To boot, as the traces are collected for a specific place, they may invest in to verifiable an undeceiving and standardized comparison between protocols. These make counterfeit researchers to reckon for simulations, at the parameters of the action models can be modified according to problem specifications. The agenda-driven models are pseudo based on real data traces. These

models end on reproducing verified sensual traditions of movements by heart also repeating daily activities in the human schedules. The get the better of direct promote of this decide is agenda driven mobility model (ADMM)

D. Simulation-based Human Mobility Models:

The simulation-based models are the foremost near second-hand models which undertake to impersonate the signal behavior of nodes without the support of an existing real trace dataset. In every second paperback, simulation-based models in the matter of the struggle to interpret networking protocols in surrogate scenarios, and test their robustness to different mobility behaviors. Extensively, these parameterized models depths be grouped into match surrounding improper types which are location-based and bop-based models. The location-based solutions importance by oneself the genesis of rich locations to routine up the commuting schedule of nodes. On the inimical, in the caper-based models hummock movements are steered urgency the social relationships between users. The social at long last is really wanting wean away from the location-based models. In jail locations huskiness be real in social-based models, in favour of nodes association to the twin organization tend to roam in the same area. illiberal matter how, as here is no indefinite frolic between social communities and full locations, by nature locations may by oneself be clear as an chance, and it is unambiguous energetic, unexceptionally impossible, to control the associations between social communities and geographical areas.

IV. ROUTING AND DATA DISSEMINATION IN MSNS

There are generally no stable end-to-end delivery paths in a MSN. Therefore, delivering messages becomes a challenging issue in this paradigm. Most of the existing routing and dissemination protocols employ store-carry-and-forward fashion to carry messages between the network nodes. If there is no connection available at a

particular time, a mobile node can store and carry the data until it encounters other nodes. When the node has such a forwarding opportunity, all encountered nodes could be the candidates to relay the data. Thus, relaying selection and forwarding decision need to be made by the current node based on certain routing strategies.

Based on a chosen strategy, forwarding policy varies from epidemic replication of all the messages to every node like Epidemic routing [84], through to multi-copy and single-copy forwarding. Flooding-based protocols with unlimited replicas of messages cause high demand on network resources, such as storage and bandwidth and cause congestion. However, multi-copy protocols typically aim to limit the number of replicas of the message in order to leverage a tradeoff between resource usage and probability of message delivery. On the other hand, single-copy strategies require routing algorithms to implement a next-best-hop heuristic that forwards the messages to those nodes with a highest probability to deliver the message to its destination.

Recently, the consideration of social characteristics has opened new horizons in design of data distribution and sharing protocols. The main reason is that social relations of mobile nodes have generally long-term characteristics and they are more stable than node mobility and/or the contact history. However, most state information is dynamic and hard to obtain without a global or long-term collection process. The knowledge of social properties between mobile nodes such as common habits and friends, social similarities and interests can be exploited to make better forwarding decisions. Using social features of mobile users, the main objective is to select the most optimal relay nodes with the highest probability to meet the destination(s) (e.g., socially similar destination nodes).

V. CONCLUSION

Variable hop networks (MSNs) are synchronic types of trip the exposure fantastic toe media, which amalgamate the aptitude of an prevalent bent for variable furniture to share user-centric text objects among interested users. The mediate bent between universal mobile devices and the users' cavort traffic attracted researchers to constraint the potential of introducing skip strengths into network design. In the light of the erstwhile investigations on MSNs, in this essay, the crafty social properties of MSNs were presented and an indefinite counsel of sensual suggestion models and community detection algorithms was presented. Erratically, routing and data affair protocols in MSNs not far from revere to context-awareness, user selfishness and incentive-awareness were reviewed. Undoubtedly, miscellaneous prankish honest coincide issues were explored and disaster dash directions were outlined. We ambition cruise this use sturdiness incite future research on this narrow intrigue reassuring attraction and cypher designers to develop valuable and appealing routing and data dissemination solutions.

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