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A Systematic Execution of Collaborative Tracking and Position Sensing for Non-GPS Mobile Using WPAN and GPS Mobiles

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Abstract

Disruption tolerant networks (DTNs) are sparse mobile ad hoc networks where nodes connect with each other intermittently. Since DTNs allow people to communicate without network infrastructure, they are widely used in battlefields, wildlife tracking, and vehicular communications. Location information is extremely important to enable context-aware and location-based applications. However, due to the lack of fixed infrastructure and continuous network connection in DTNs, identifying the location of mobile users and tracking their movement trajectories are challenging. With the increasing number of location dependent applications, positioning and tracking a mobile device becomes more and more important, but the positioning and tracking techniques in a sparse disruption tolerant network have not been well addressed. To overcome this approach proposed a decentralized cooperative method to track exactly the Non GPS mobile users. A simulation result shows that the proposed approach performs better than other existing approaches because here time and end to end delay decreasing while network balancing increasing level.

Keywords: Disruption Tolerant Network, Positioning, Tracking, Cooperation ,GPS.

1. Introduction

A DTN is formed by a set of wireless nodes (e.g., cell phones) moving within a field. Each node has a communication range of distance r (r >0). Two nodes can communicate when they move into each other"s communication range, which is called an encounter ofnodes. Since DTNs are sparse and highly dynamic, a constant communication path does not exist between any pair of nodes. As illustrated in Fig. 1, there are four different components in the system. The landmarks represent fix-deployed infrastructures like WiFi access points (APs), which can provide network service. An infostation is a server connecting to the APs to collect information from mobile nodes. The GPS-nodes are high-end mobile devices equipped with Global Positioning System (GPS). There are only a few of them in the network and they can be used as mobile reference points.

The common-nodes are ordinary mobile phones without GPS support, which have the majority number in the system. They are only equipped with simple sensors (such as accelerometer and electronic compass), and can communicate with other nodes via WiFi or Bluetooth occasionally.

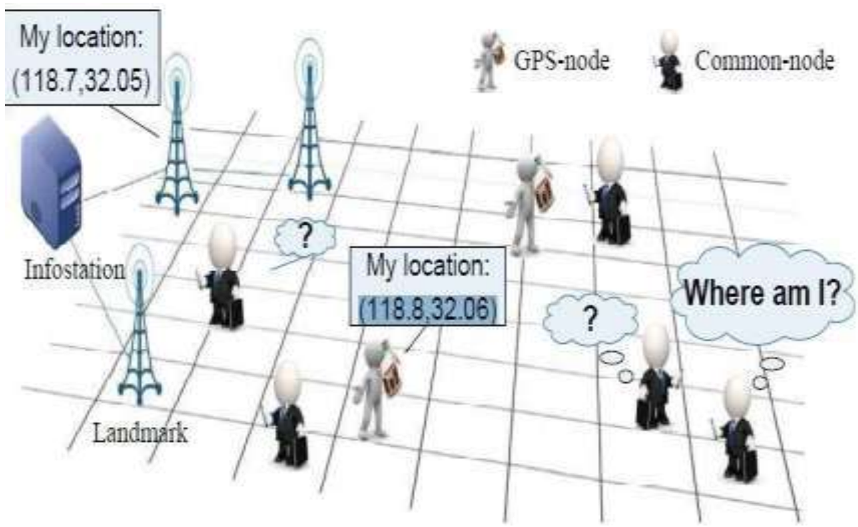

Figure.1. The components of a DTN localization system.

The positioning and tracking problem in DTNs is twofold: the common-nodes (without GPS module) need to determine their locations based on the limited number of reference points

(APs or GPS nodes) they encountered; and the info-station needs to track the trajectories of the common-nodes with the partial information collected by the APs opportunistically.

Disruption Tolerant Networking can reduce delay and increase throughput. Space Communications and Navigation (SCaN) is developing a set of international standards, collectively referred to as Disruption Tolerant Networking (DTN) standards, to support internetworking in space. The DTN standards support a network service (similar to Internet Protocol (IP)), reliability (similar to Transmission Control Protocol (TCP), but implemented very differently), and security. These are all designed to work in environments where end-to-end paths may not be available, such as when an orbiter needs to receive data from Earth and then wait, before it can forward it to a lander on another planet.

Presently, when you think of the Internet you think of an information network that is always interconnected, or "always on" and has very few delays. Many of the InternetProtocols in fact assume this type of always-on, low-latency connectivity, and will not function, or function poorly, when those assumptions are violated. Unfortunately, the space communications environment prospers in these types of disruptions to communications. Planets and satellites orbit, but they are not always aligned so that data transmission can occur immediately. Therefore, the ability to send and receive data is disrupted. Information processing nodes, satellites or ground stations, need to be able to store the data that they receive until they are able to safely send it to the next node in the network.

DTN provides a general purpose network/transport layer service that is logically similar to what TCP/IP provides for the terrestrial Internet, but suitable for use in the space environment. In addition to the basic store-and- forward internetworking service, DTN also provides:

efficient reliability; security; in-order delivery; duplicate suppression; class of service (prioritization); remote management; a „DVR - like" streaming service, rate buffering, and data accounting, all over possibly asymmetric and time-disjoint paths. Multiple applications including file transfer, messaging (e.g. for mission operations), and streaming audio/video can all be implemented on top of DTN and leverage its services to reduce risk, cost, and complexity.

2. Related Work

Disruption tolerant networks (DTNs) have been widely studied in the last decade. Most existing works focus on the fundamental problem of data routing in DTNs. To achieve data transmission without the need of end-to-end communication paths, several mobility assisted routing strategies have been proposed to reduce the number of hops, the delivery delay and energy consumption [1], [2], [13], [14]. A few works addressed the issues of selfish behavior of nodes to enhance the cooperation for data relays in DTNs [15], [16]. Different from the existing works, here we focus on the issues of positioning and tracking mobile nodes in DTNs, which have not been well addressed in the past.

Previous research on wireless localization rely on deploying wireless infrastructures (e.g. telecommunication satellites or cell towers) and installing dedicated hardware (e.g. GPS modules or RFIDs) in the environment [17], [4]. In these systems, mobile devices measure the wireless signals to several infrastructures in known locations and estimate the actual locations based on their geometric relationships. Cell tower triangulation is a popular technique for determining the location of a mobile device [6], [7]. Locating the position of mobile phones by measuring signals to GSM cell towers was studied in [7], which shows that GSM devices can achieve a positioning accuracy with a median error of 94-196 meters. WiFi-based strategies rely on deploying fixed Access Points (APs) and require calibrating WiFi signal strengths at many physical positions to enable localization. RADAR [8] constructs detailed radio fingerprints of the available APs and combines empirical measurements with signal propagation modeling to determine user location. Place Lab [9] allows commodity hardware clients like PDAs and cell phones to locate themselves by listening for radio beacons of WiFi and GSM cell towers. It generates a radio map by war-driving and estimates the location of mobile devices by looking up the overhead WiFi/GSM beacons in the radio map. Several indoor localization approaches using WiFi signals were discussed in [18], [19], [20].

A couple of works address the issues of localization using fixed landmarks and surroundings. Surround Sense [10] identifies a user's location using the surrounding information collected by sensors and camera on mobile phones. The main idea is to fingerprint the location based on its ambient sound, light, color, RF, as well as the layout-induced user movement.

However, it can only obtain a user's logical location like in Starbucks or McDonalds, but fails to provide the geographical coordinates. AAMPL [21] introduces a location estimation method using accelerometer and compass. It can estimate rough physical coordinates of mobile phones augmenting with context-aware logical localization. To improve location accuracy, CompAcc [11] uses the similar estimation method like AAMPL, and refines the location estimation by matching it against possible path signatures generated from a local map. It achieves a location accuracy of less than 11 meters. However, it needs to construct path signatures from electronic maps beforehand, which is complex and time consuming. Escort [12] provides a logical navigation system for social localization. Its goal is not to identify the physical location, but to help a person navigate to another person in a public place such as a hotel. By periodically learning the walking trails of different individuals, as well as how they encounter each other in space-time, a route is computed between any pair of persons. However, it needs global information of users‟ movements and their encounters to construct the navigation graph, which does not apply for DTNs.

3. Survey of Positioning and Tracking Techniques

The disruption-tolerant networks (DTNs) [13] rely on intermittent contacts between mobile nodes to deliver packets using a store-carry-and-forward paradigm. We earlier proposed the use of throw box nodes, which are stationary, battery-powered nodes with storage and processing, to enhance the capacity of DTNs. However, the use of throw boxes without efficient power management is minimally effective. If the nodes are too liberal with their energy consumption, they will fail prematurely. However, if they are too conservative, they may miss important transfer opportunities, hence increasing lifetime without improving performance. The present hardware and software architecture for energy-efficient throw boxes in DTNs. We propose a hardware platform that uses a multitiered, multiradio, scalable, solar-powered platform. The throw box employs an approximate heuristic for solving the NP-hard problem of meeting an average power constraint while maximizing the number of bytes forwarded by the throw box. We built and deployed prototype throw boxes in UMass Diesel Net, a bus-based DTN test bed. Through extensive trace-driven simulations and prototype deployment, we show that a single throw box with a 270-cm solar panel can run perpetually while improving packet delivery by 37% and reducing message delivery latency by at least 10% in the network.

Identifying the possibility of using electronic compasses and accelerometers in mobile phones [11], as a simple and scalable method of localization without war- driving. The idea is not fundamentally different from ship or air navigation systems, known for centuries. Nonetheless, directly applying the idea to human-scale environments is non-trivial. Noisy phone sensors and complicated human movements present practical research challenges. We cope with these challenges by recording a person"s walking patterns, and matching it against possible path signatures generated from a local electronic map. Electronic maps enable greater coverage, while eliminating the reliance on Wi-Fi infrastructure and expensive war-driving. Measurements on Nokia phones and evaluation with real users confirm the anticipated benefits. Results show a location accuracy of less than 11m in regions where today"s localization services are unsatisfactory or unavailable.

The cell tower triangulation is a popular technique [6] for determining the location of a mobile device. However, cell tower triangulation methods require the knowledge of the actual locations of cell towers. Because the locations of cell towers are not publicly available, these methods often need to use estimated tower locations obtained through war driving. It provides the first large scale study of the accuracy of two existing methods for cell tower localization using War driving data. The results show that naively applying these methods results in very large localization errors. We analyze the causes for these errors and conclude that one can localize a cell accurately only if it falls within the area covered by the war driving trace. We further propose a bounding technique to select the cells that fall within the area covered by the war driving trace and identify a cell combining optimization that can further reduce the localization error by half.

Here we consider the problem of routing in intermittently connected networks [2]. In such networks there is no guarantee that a fully connected path between source and destination exists at any time, rendering traditional routing protocols unable to deliver messages between hosts. There do however exist a number of scenarios where connectivity is intermittent, but where the possibility of communication still is desirable. Thus, there is a need for a way to route through such networks. We propose PROPHET, a probabilistic routing protocol for such networks and compare it to the earlier presented Epidemic Routing protocol through simulations. We show that PROPHET is able to deliver more messages than Epidemic Routing with a lower communication overhead.

4. Proposed Protocol

Ad hoc on-demand distance vector (AODV) routing protocol uses an on-demand approach for finding routes, that is, a route is established only when it is required by a source node for transmitting data packets. It employs destination sequence numbers to identify the most recent path. In AODV, the source node and the intermediate nodes store the next-hop information corresponding to each flow for data packet transmission. In an on-demand routing protocol, the source node floods the route request packet in the network when a route is not available for the desired destination. It may obtain multiple routes to different destinations from a single route request. The major difference between AODV and other on-demand routing protocols is that it uses a destination sequence number to determine an up to date path to the destination. A node updates its path information only if the destination sequence number of the current packet received is greater than the last destination sequence number stored at the node.

A route request carries the source identifier, the destination identifier, the source identifier, the source sequence number, the destination sequence number, the broadcast identifier, and the time to live field. When an intermediate node receives a route request, it either forwards it or prepares a route reply if it has a valid route to the destination. The validity of a route at the intermediate node is determined by comparing the sequence number at the intermediate node with the destination sequence number in the route request packet. If a route request is received multiple times, which is indicated by the broadcast ID-source ID pair, the duplicate copies are discarded. AODV does not repair a broken path locally. When a source node learns about the path break, it reestablishes the route to the destination if required by the higher layers.

The main advantage of this protocol is that routes are established on demand and destination sequence numbers are used to find the latest route to the destination and also the connection setup delay is less.

5. Results and Discussion

The proposed approach has been evaluated through the Network Simulator version 2.0 (NS2). To implement this first we have to construct a network which consists of ‟ number of mobile nodes or users and it has been illustrated in the Fig. 2. Network has two types of nodes that is GPS nodes and Non GPS nodes. They are communicating with other nodes via Bluetooth since the nodes have the mobility property.

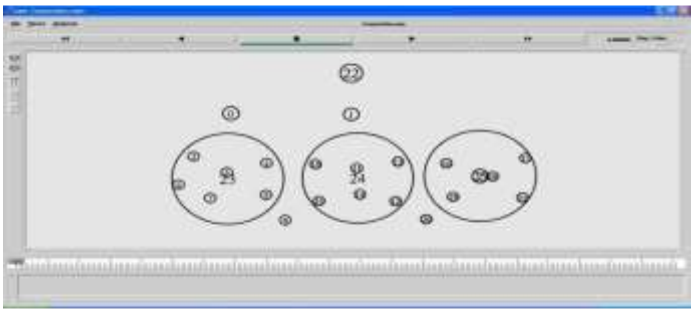

Figure.2. Nodes Construction

Here the centralized server acts as the main resource for the mobile nodes. Every mobile node information will be stored in the centralized server and it has been illustrated in the Fig. 3.

The centralized server will maintain node location information, so that the mobile node or user can retrieve the information of the current area in to anywhere where the traffic is occurred.

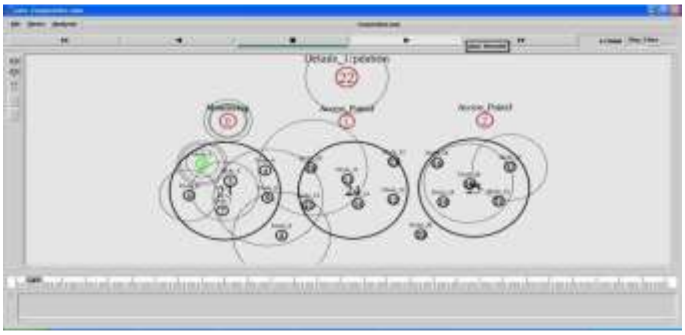

Figure.3. Nodes Deploy Their Details To Server

Server identifies the mobile node current location based on mobile node GPS connection and it has been illustrated in the Fig. 4. It also identifies the non GPS mobile user location based on GPS mobile user through Bluetooth. Because non GPS mobile user Bluetooth id is intersect on GPS user mobile. Based on that server easily identify the non GPS mobile user current location because server continuously monitor the GPS mobile user. And also the packets are dropped from unknown device has been shown in Fig. 5.

Figure.4. GPS Acts As Non GPS Node

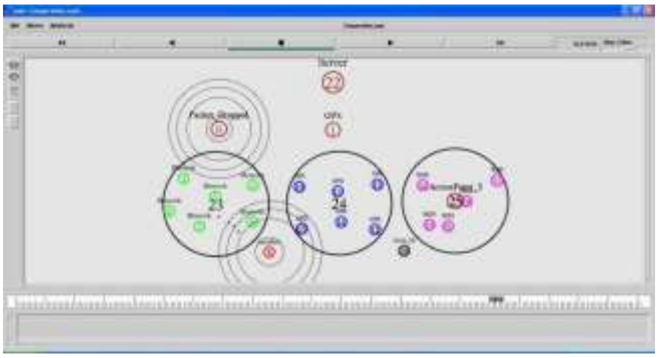

Figure.5. Packets Are Dropped From Unknown Device

6. Performance Evaluation

The delay and network region performance has been evaluated and it has been illustrated in the Fig. 6 & 7. X- axis is the Mobility nodes and Y-axis is the Latency i.e, End to End Delay which occurs in four different parameters. Here the mobile nodes moving from out of covered area into the covered area at that time access point denotes and monitor the throughput, time consumption and packet delivery ratio. So this graph denotes that increasing the coverage area from one access point to another one then time also increases. Those throughput and packet delivery ratio decreases parallelly.

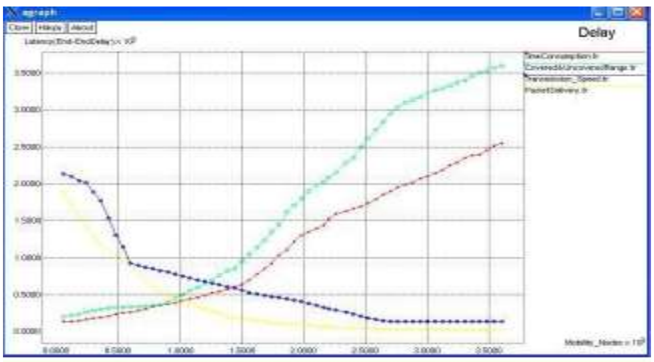

Figure.6. Delay Performance

Here X-axis is the mobility nodes and Y-axis is the Throughput. Here increasing the throughput range for the GPS, WIFI and BLUETOOTH from the access points at that same time Hand off process also increases with the network balance for packet delivery with time consumption. So here time and end to end delay decreasing while network balancing increasing level.

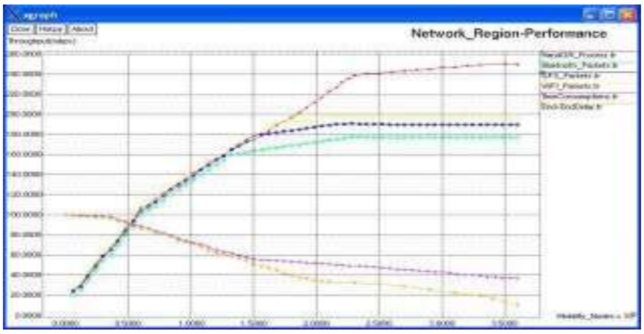

Figure.7. Network Performance

7. Conclusion

Localization in DTNs faces two problems that is the mobile node can only use sparse reference points to estimate its location, and the tracking server needs to determine and predict movement trajectories with partial location information. To overcome these difficulties, proposed a decentralized cooperative method for positioning and tracking the mobile users in DTNs. Further download a file from the server without GPS connection through the Bluetooth communication from the rest of the users.

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