ISSN 2321-743X

International Journal of Research in

Engineering and Bioscience

Volume 3 (Issue 2) Pages (01-13)

IJREB

Journal home page: www.ijreb.org

REVIEW: ENERGY EFFICIENT AND ENHANCED DATA EXCHANGE IN DELAY TOLERANT NETWORKS BASED ON SMARTPHONES

Sreejith S Ampady and R.Ganesan

Department of Electronics and Communication, Noorul Islam Center for Higher Education, Kumaracoil-629 180, Tamil Nadu, India

ABSTRACT

Data exchanging between smartphones are complex due to their unpredictable mobile nature. ADHOC sharing schemes are getting more relevant in our current scenario. Here each mobile terminal acts as a node forwarding the data to the destination. A node forwards a message if it gets encountered with other nodes. There may be situations where there will be an unavailability of network connectivity. These are generally delay tolerant networks. Here the encounters are occurring at irregular intervals and it is challenging to achieve effective data delivery. More over the usage of WLAN in peer to peer communication results in the draining of battery, as the mobile terminals like smartphones will be having a small sized battery where the discharging is to be limited. The Power Save Mode in the IEEE 802.11 is already been enhanced by algorithm named Overlapping Aware Scheduled Automatic Power Save Delivery (OAS-APSD. In this review paper various routing techniques for efficient data delivery in delay tolerant networks are studied and also survey is made on the power saving in Wlan. Analysis is made by comparing the packet delivery ratio, number of operations ratio, complexity reduction ratio, energy consumption, content discovery ratio and sharing efficiency.

KEYWORDS: Delay Tolerant Network, mobile computing, wireless networks

ISSN 2321-743X
International Journal of Research in
Engineering and Bioscience
Volume 3 (Issue 2) Pages (01-13)
IJREB
Journal home page: www.ijreb.org

INTRODUCTION

The numbers of smart phone users are increasing very rapidly day by day. The entry of new smart phone operating systems and as the user interfaces have become more convenient as well as customisable for users, the smartphones have become a part of human life. Users are now able share various types of data. Due to the large number of smartphone users the data sharing is getting more congested. One remedy to reduce the troubles relating to data sharing where the connectivity is limited is the use of ad hoc networks.

Ad-hoc networks 1 are wireless networks where nodes communicate with each other using multi-hop links. There is no stationary infrastructure or base station for communication. Each node itself acts as a router for forwarding and receiving packets to/from other nodes. Routing in ad-networks has been a challenging task ever since the wireless networks came into existence. The major reason for this is the constant change in network topology because of high degree of node mobility. Hosts and routers in a wireless network can move around. Therefore, the network topology can be dynamic and unpredictable. Traditional routing protocols used for wired networks cannot be directly applied to most wireless networks because some common assumptions are not valid in this kind of dynamic network. For example, one assumption is that a node can receive any broadcast message sent by others in the same subnet. However, this may not be true for nodes in a wireless mobile network. The bandwidth in this kind of network is usually limited. Thus, this network model introduces great challenges for routing protocols.

The paper deals with delay tolerant networks and its data exchanging capabilities. DTN is a form of networking between computers which is used when there is an unavailability of continuous network connectivity. In space, outer sea, in forests and such challenging environments where no continuous connectivity is available DTN comes into action. The paper deals with the data exchange in delay tolerant networks and the reduction in battery consumption while using wlan, since the consideration is mainly on smartphones.

DATA SHARING IN DISRUPTED NETWORK

DTN are those networks where there is no continuous network connectivity. There may

ISSN 2321-743X
International Journal of Research in
Engineering and Bioscience
Volume 3 (Issue 2) Pages (01-13)
IJREB
Journal home page: www.ijreb.org

be cases occurring where there is never a connected path from source to destination or when a network partition exists at the time a message is originated. The most conventional technique used to overcome this is called epidemic routing. The aim of epidemic routing are to increase data delivery ratio, reduce the time between routing of message between source and destination, and minimize the total resources used in data delivery.

Epidemic Routing is to spread query messages to neighbours, called carriers, where the adhoc network is interconnected. In doing so the query message is spread within that portion of the network where there is interconnection. As these nodes are mobile they will get connected to other parts of network. These connections lead to the spreading of querys to additional nodes at other portions of networks those where not in connection earlier. By these short timed contacts the data will be transmitted and the probability of delivery of the destination is also high. The aim of epidemic routing is to increase data delivery ratio, reduce the time between routing of message between source and destination, and minimize the total resources used in data delivery. To accomplish this by query spreading is limited and the buffer space of each node is reduced as these buffer spaces store data for other nodes. The resources consumed are reduced by keeping a limit to the number of hopes. The message delivery in epidemic routing is not depending on the network structure. Epidemic routing is by spreading the message throughout the network till they reach the destination. The message originated by a node and the messages from the neighbouring nodes are stored within a buffer in each node.

Upon each hope the message is spread to the nearby host. Thus each node encountering the query message will retain the whole message within it. If the hope is large then the message will get spread throughout the network very rapidly. This will typically reduce average delivery time, but will also increase total resource consumption in message delivery. For a message with low priority the hop count will be low and viceversa.

Disruption-tolerant networks (DTNs) transfers data even if there is no continuous network coverage. Resource allocation protocol for intentional DTN (RAPID) routing is a design rule for message exchange to very specifically make a perfect user-specified

ISSN 2321-743X
International Journal of Research in
Engineering and Bioscience
Volume 3 (Issue 2) Pages (01-13)
IJREB
Journal home page: www.ijreb.org

routing metric. The routing of a packet in RAPID is by making copies until the destination receives a copy. Exact copies of packets are made and they are flood through the network opportunistically till they reach the destination. There will be degradation in the performance as well as inefficient usage of resources due to the unsophisticated flooding. Flow of packet through the network will be until the message reaches the destination. But if the network is having a limited bandwidth then the packets have to be replicated very carefully for a user predicted routing metric. A per packet utility function is derived by RAPID from the routing function. When a transfer opportunity arises the copy of packets are made which could give an increase in utility.

For intermittently connected networks the mode of routing depends on hop-by-hope. These routing schemes are of two types depending on the number of copies a single message is retained in the network. Single copy each message will be retained by a single node. When the copy is forwarded to the nearby node then it will retain the message. This will continue till the message reaches the destination. In multiple copy routing, multiple copies of the same message are generated which can be routed independently for increased efficiency and the ability to resist change.

These algorithms flood the message throughout the network. Flooding is generally wastage of energy and also causes traffic congestion which in turn reduces the performance. Spray and wait is another routing scheme used as a remedy. This scheme sprays a number of copies into the network, and then waits till one of these nodes meets the destination. This helps in reducing the overhead on nodes and to reduce the delay due to flooding of messages.

Routing of packets can be made more effective with the prediction of node trajectory. The contact patterns of the nodes within a network are being predicted so that we can trace out the next hop to which packet is to be forwarded. The prediction can be also made use in finding the probability distribution of future contact attempts and choose a proper next hope. This is the technique used in predict and relay. Here the trajectory prediction in DTN is utilized and with this the next node to which message to be forwarded is determined.

ISSN 2321-743X
International Journal of Research in
Engineering and Bioscience
Volume 3 (Issue 2) Pages (01-13)
IJREB
Journal home page: www.ijreb.org

Probabilistic routing is another algorithm (PROPHET) which is for forwarding the packets. Observations show that real users don't follow a random path. But instead the path is predictable. Here a probabilistic metric is developed and called delivery predictability. When two nodes meet the message will be forwarded if and only if the delivery predictability of the destination of message is higher at the other node. This can be used in situations where the movement is completely random. This is more efficient due to the low communication overhead.

The main aim is to provide optimal forwarding protocol which maximises the delivery rate. Optimal Probabilistic Forwarding protocol maintains a constant on number of forwarding per message. OPF uses forwarding thresholds as functions of remaining hop-count and residual time-to-live. An optimal probabilistic forwarding metric is used for forwarding the messages between nodes.

Generally there are two steps in routing messages in DTN, one is content sharing and the other is delivery of message to destination. The routing protocols generally deal with the delivery of message and the content sharing technique discovers the message before its delivery. In searching of contents two approaches are used flooding and random walk. Flooding of queries is normally limited by a Time to Leave, to prevent the unwanted resource usage by the queries. If the TTL value expires before finding the node then the TTL value will be extended and the process is repeated. The spreading of queries can be limited in routing schemes which are based on random walks. A random walk, on the other hand, only needs a connected neighbour to keep moving. There are no critical points, all the nodes are equally unimportant at all times. Content searching is done next along with focusing on controlling the spreading of search requests in an unloaded network. This technique describes query processing techniques.

The locations are required for smartphone based peer to peer communication. GPS used in location sensing lacks its availability in users daily lives as users remain covered form satellite being in door. Whereas WLAN and GSM are available even being indoor. This make the demand for a location based services indoor.

Routing is made easier by many routing schemes. These schemes made the overhead

ISSN 2321-743X
International Journal of Research in
Engineering and Bioscience
Volume 3 (Issue 2) Pages (01-13)
IJREB
Journal home page: www.ijreb.org

heavier. To reduce the overhead and to improve the performance various other algorithms where predicted. Rebroadcasting has to be done to make the data sharing more effective. The radio signals may overlap and also the query spreading is costly and results in congestion and collision of data packets. These results in problem called broadcast storm problem. One remedy is to reduce the redundant data and to differentiate timing of rebroadcasts.

Nodes like wireless sensor networks are always kept moving. Several advanced scenarios, like those including actuators, have multiple sinks. The way how routing is done is changed by the mobility of nodes and the multiple sinks. There are a number of protocols developed for routing in mobile networks. But these cannot be directly employed in WSN due to its peculiarities. Context and Content-Based Routing protocol explicitly designed for multi-sink, mobile wireless sensor networks. It uses content based addressing which helps effectively the data-centric communication patterns which are generally a part of wireless sensor networks.

Wireless sensors can be used to support wildlife tracking for biological research. ZebraNet techniques have wireless sensor nodes fitted to animals in a wide area which are under study. These sensors will act as peer to peer nodes by transferring data to the researcher. It will be having a CPU, transreciever, GPS module and flash memory.

The schemes examined above all are based on transferring data to a single destination. Multicasting are to be examined. Multicast is the delivery of a message or information to a group of destination computers simultaneously in a single transmission from the source. Copies are automatically created in other network elements, such as routers, but only when the topology of the network requires it. Here the scheme relies mainly on the switching relay selection schemes for forwarding probabilities to multiple destinations simultaneously.

Another concept to be considered in peer to peer computing is the selfishness of the nodes. The scheme socially selfishness aware routing (SSAR) is used where the nodes makes ties among themselves so that the messages will be forwarded to those nodes who have made tie in the network. To select a forwarding node, SSAR considers both users' willingness to forward and their contact opportunity, resulting in a better forwarding scheme.

ISSN 2321-743X
International Journal of Research in
Engineering and Bioscience
Volume 3 (Issue 2) Pages (01-13)
IJREB
Journal home page: www.ijreb.org

The work we do here is having schemed to predict the mobility patterns of nodes within the network. For determining the paths and locations of the mobile nodes a scheme called sensloc is used. SensLoc comprises of a robust place detection algorithm, a sensitive movement detector, and an on demand path tracker. Based on a user's mobility, SensLoc proactively controls active cycle of a GPS receiver, a Wi-Fi scanner and an accelerometer.

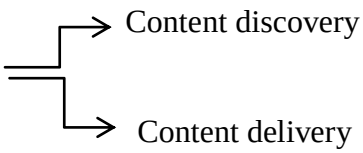
The location sensors used by smartphones have some mismatches in the longitude and latitude values sensed. Beaconprint is a technique which utilizes both Wi-Fi and GSM signals to locate the movements made by a mobile device. This is used in identifying the places of where human visited. BeaconPrint does not automatically assign names or semantics to places. Rather, it provides the technological foundation to support this task. Here the meaningful places are discovered by repeated scans.

CONTENT SHARING BASED ON DISCOVER-PREDICT-DELIVER

The main idea in content sharing as per the conventional system is discover, predict and deliver. In contrast with the random movements predicted by the old levy flight and random walk models, human trajectories show a high degree of temporal and spatial regularity, each individual being characterized by a time independent characteristic travel distance and a significant probability to return to a few highly frequented locations. The individuals travel pattern collapses into a single spatial probability distribution, indicating that, despite the diversity of their travel history, humans follow simple reproducible patterns. These highly frequented locations are called meaningful places.

There are many issues regarding with content sharing in smartphones. Even being in a competition for resources by the smartphones, they are willing to share their resources with other nodes in the network. The routing scheme should allow the users to issue queries for contents; these queries are stored within the smartphones in the network and to calculate the chance of getting the data needed.

Content sharing has two phases.



Content discovery: The user if needs any information first searches its local storage

ISSN 2321-743X
International Journal of Research in
Engineering and Bioscience
Volume 3 (Issue 2) Pages (01-13)
IJREB
Journal home page: www.ijreb.org

drives. If the data not present then it will flood the query message within the whole network.

Content delivery-: The flooding of query continues till the desired content is found within the network. When the content is found then the content delivery starts and the content reaches the query generator.

A. Content discovery

A user in need of any content will flood query about the entire network. The queries will lead to degradation of performance as it consumes more resources. There are two alternatives to approaches to limit the query spreading they are split query lifetime and a query distance limit. Here instead of spreading queries throughout the network, the query lifetime is split so as to determining and delivering the contents. Distance limit to query is also fixed so as to limit the spreading of query to longer distance.

When there occurs need for some content the corresponding node generates query messages (Q), it contains a node identifier (ID). The query carried over to the encountered node will have the percentage of query lifetime used for delivery and percentage of lifetime used for discovery. The query spreading is stopped when the node finds that the query spreading will not improve the performance.

B. Content Delivery

When content is discovered then it has to be delivered. Here instead of giving importance which content to be delivered, how to deliver is given preference? The query and the content headers are broadcasted by the nodes periodically. Based on the mobility information in the content header the exchange of actual contents between the nodes is made.

A term named utility function is used. Spray and focus is the technique used in delivery. When a node gets the query and if it is having the content explained by the query, then it will spray or send messages to all nearby nodes. These nodes will forward this to the next node if the utility function is higher.

C. Mobility Learning

Contents are shared more effectively when the smartphone users stay at a place for a long time. So we have to determine those places where the users stay for long times and generally users have a temptation to return to some places frequently, these places are called meaningful places.

ISSN 2321-743X
International Journal of Research in
Engineering and Bioscience
Volume 3 (Issue 2) Pages (01-13)
IJREB
Journal home page: www.ijreb.org

Movement tracking: for movement tracking a motion detector function is used. The activity manager gives out one among the two outputs moving or stationary. Whenever the user is walking, running, jogging, or in a vehicle output moving is given. If the user stays at a particular area then the output stationary is given.

Discovering and learning meaningful places-: Positioning is very effective when we consider a point outdoors as they are visible to satellites. But in case of a point indoor then satellite can't spot it. Such a case we use meaningful places. As these meaningful places are those which are more frequently visited by smartphone users.

D. Mobility Prediction

The discovery, predict and deliver algorithm predicts the node mobility. This is generally to predict whether the node will reach the destination or whether the node diverges from the destination. Here with the previous observations with the frequent visits the trajectories of the smartphones are predicted.

E. Limitations

Content sharing via the conventional system is effective for sharing contents. But it renders more overhead which increases the cost and wastage of resources. Even with powers saving mechanism within the WLAN the power consumption is more. The mobile devices works on batteries and this type of battery consumption is a serious issue. Moreover it does not explain the routing made if the contact between nodes are short lived even though they are meaningful places.

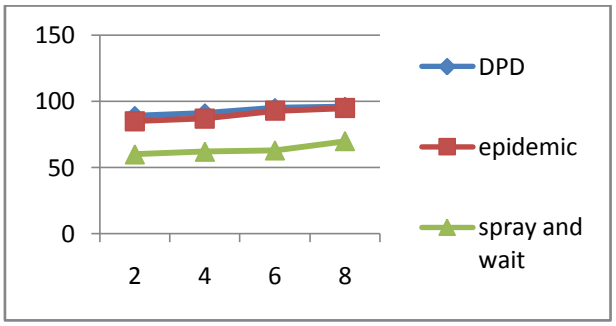


Fig.1 delivery ratio (%) vs content lifetime

Here X-axis shows the content lifetime and Y-axis shows the data delivery ratio. While comparing (Fig.1) DPD with other data sharing techniques it can be seen that the ratio of DPD is higher than any other technique discussed. On an increase of content lifetime within the network we can see the DPD delivers almost whole of the desired data to the destination by the network.

ISSN 2321-743X
International Journal of Research in
Engineering and Bioscience
Volume 3 (Issue 2) Pages (01-13)
IJREB
Journal home page: www.ijreb.org

IMPROVEMENTS

In a delay tolerant network data flows through several intermediate nodes to reach the destinations and each of these transmissions through intermediate nodes are called hops. For transmitting data from source to destination in a delay tolerant network query messages are generated to find the next hop. In the case of a mobile node like smartphone the energy source is limited and resources have constraints.

Generally the source node will generate query messages and spread it throughout the network. This is to find the nearby node within the radio range of the source node. This continuous spreading of query is generally wastage of resources such as bandwidth power etc., which are limited in the case of a mobile device. For mobile devices many techniques like query time limit, query limit etc., are used to limit the resource usage.

By the name delay tolerant network it is meant that some delay is acceptable. In such a scenario a technique can be used to transmit data which is to restrict mobile devices from spreading query messages and to make the fixed nodes which are having a unlimited source of power supply and a more larger bandwidth to generate beacon messages and to spread throughout the network

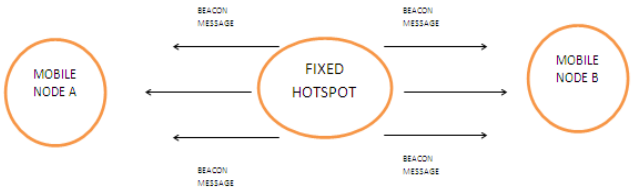


Fig.2 Fixed hotspot beaconing

In the above figure node A transmits a message to node B through a fixed hotspot where A and B being mobile nodes. Here node A has to generate query messages and to spread it. But node A is not generating any query message. Instead of generating query by node A the fixed hotspot between the nodes will be generating beacon messages and spreading it in all direction. The fixed hotspot is continuously acknowledging its presence.

When node A receives the beacon message from the fixed hotspot, it is clear that node A is within the radio range of fixed hotspot. On receiving the beacon message node A send the message to the fixed hotspot. As the destination source is also mobile, when node B comes within the radio range of the fixed hotspot the data is transmitted to node B.

This helps to avoid the over usage of bandwidth and also the consumption of energy

ISSN 2321-743X
International Journal of Research in
Engineering and Bioscience
Volume 3 (Issue 2) Pages (01-13)
IJREB
Journal home page: www.ijreb.org

due to the spreading of query message by mobile nodes.

CONCLUSION

Data sharing in delay tolerant networks has been briefly reviewed in this paper. Various techniques through which the technology evolved have been discussed. Content sharing by considering the meaningful places is effective but is still having some limitations. By this review it is clear that the data sharing will be more effective in delay tolerant networks if we use social contact patterns along with the discover predict deliver. It will result in effective sharing even if the contacts are short lived. The scheduling of traffic streams will result in power saving so that this can be used in smartphones where the battery usage has to be limited.

REFERENCES

T3I Group LLC, http://www. telecomweb. com, 2010.

Kevin Fall Intel Research, Berkeley "A Delay-Tolerant Network Architecture for Challenged Internets" SIGCOMM'03, August 25-29, 2003, Karlsruhe, Germany Copyright 2003 ACM 1-58113-735-4/03/0008

A. Vahdat and D. Becker, "Epidemic Routing for Partially Connected Ad Hoc Networks," technical report, Dept. of Computer Science, Duke Univ., Sept. 2000.

A. Balasubramanian, B.N. Levine, and A. Venkataramani, "DTN Routing as a Resource Allocation Problem," Proc. ACM SIGCOMM, pp. 373-384, 2007.

T. Spyropoulos, K. Psounis, and C. Raghavendra, "Efficient Routing in Intermittently Connected Mobile Networks: The Single-Copy Case," IEEE/ACM Trans. Networking, vol. 16, no. 1, pp. 63-76, Feb. 2008.

T. Spyropoulos, K. Psounis, and C.S. Raghavendra, "Efficient Routing in Intermittently Connected Mobile Networks: The Multiple-Copy Case," IEEE/ACM Trans. Networking, vol. 16, pp. 77-90, Feb. 2008.

T. Spyropoulos, K. Psounis, and C.S. Raghavendra, "Spray and Wait: An Efficient Routing Scheme for Intermittently Connected Mobile Networks," Proc. ACM SIGCOMM Workshop Delay-Tolerant Networking (WDTN '05), pp. 252-259, 2005.

I. Cardei, C. Liu, J. Wu, and Q. Yuan, "DTN Routing with Probabilistic Trajectory Prediction," Proc. Third Int'l Conf. Wireless Algorithms, Systems, and Applications (WASA '08,), pp. 40-51, 2008.

Q. Yuan, I. Cardei, and J. Wu, "Predict and Relay: An Efficient Routing in

ISSN 2321-743X

International Journal of Research in

Engineering and Bioscience

Volume 3 (Issue 2) Pages (01-13)

IJREB

Journal home page: www.ijreb.org

Disruption-Tolerant Networks," Proc. 10th ACM MobiHoc, pp. 95-104, 2009.

A. Lindgren, A. Doria, and O. Schelen, "Probabilistic Routing in Intermittently Connected Networks," SIGMOBILE Mobile Computer Comm. Rev., vol. 7, no. 3, pp. 19-20, 2003.

C. Liu and J. Wu, "An Optimal Probabilistic Forwarding Protocol in Delay Tolerant Networks," Proc. ACM MobiHoc, pp. 14, 2009.

N.B. Chang and M. Liu, "Controlled Flooding Search in a Large Network," IEEE/ACM Trans. Networking, vol. 15, no. 2, pp. 436- 449, Apr. 2007.

C. Avin and C. Brito, "Efficient and Robust Query Processing in Dynamic Environments Using Random Walk Techniques," Proc. Third Int'l Symp.Information Processing in Sensor Networks (IPSN '04), pp. 277-286, 2004.

M. Pitkanen, T. Karkkainen, J. Greifenberg, and J. Ott, "Searching for Content in Mobile DTNs," Proc. IEEE Int'l Conf. Pervasive Computing and Comm. (PERCOM '09), pp. 1-10, 2009

I. Smith, J. Tabert, T. Wild, A. Lamarca, A. Lamarca, Y. Chawathe, Y. Chawathe, S. Consolvo, S. Consolvo, J. Hightower, J. Scott, T. Sohn, J. Howard, J. Hughes, F. Potter, P. Powledge, G. Borriello, and B. Schilit, "Place Lab: Device Positioning Using Radio Beacons in the Wild," Proc. Third Int'l Conf. Pervasive Computing (PERCOM '05), pp. 116-133, 2005.

S.Y. Ni, Y.C. Tseng, Y.S. Chen, and J.P. Sheu, "The Broadcast Storm Problem in a Mobile Ad Hoc Network," Proc. ACM/IEEE MobiCom, pp. 151-162, 1999.

G. Cugola and M. Migliavacca, "A Context and Content-Based Routing Protocol for Mobile Sensor Networks," Proc. Sixth European Conf. Wireless Sensor Networks (EWSN '09), pp. 69-85, 2009.

P. Juang, H. Oki, Y. Wang, M. Martonosi, L.S. Peh, and D. Rubenstein, "Energy-Efficient Computing for Wildlife Tracking: Design Tradeoffs and Early Experiences with ZebraNet," SIGARCH Computer Architect News, vol. 30, no. 5, pp. 96-107, 2002.

W. Gao, Q. Li, B. Zhao, and G. Cao, "Multicasting in Delay Tolerant Networks: A Social Network Perspective," Proc. 10th ACM MobiHoc, 2009.

Q. Li, S. Zhu, and G. Cao, "Routing in Socially Selfish Delay Tolerant Networks," Proc. IEEE INFOCOM, Mar. 2010.

D.H. Kim, Y. Kim, D. Estrin, and M.B. Srivastava, "SensLoc: Sensing Everyday Places and Paths Using Less Energy," Proc. Eighth ACM Conf.

IJREB

ISSN 2321-743X

International Journal of Research in

Engineering and Bioscience

Volume 3 (Issue 2) Pages (01-13)

Journal home page: www.ijreb.org

Embedded Networked Sensor Systems (SenSys '10), pp. 43-56, 2010.

J. Hightower, S. Consolvo, A. Lamarca, I. Smith, and J. Hughes, "Learning and Recognizing the Places We Go," Proc. Seventh Int'l Conf. Ubiquitous Computing, pp. 159-176, 2005.

ElmurodTalipov, Yohan Chon, and Hojung Cha "Content Sharing over Smartphone-Based Delay-Tolerant Networks", IEEE Transactions on mobile computing, Vol. 12, No. 3, 2013.