ISSN Application No. 2321-6921

Global Journal of Networks and Applications

Volume No. 12

Issue No. 2

May - August 2024

ENRICHED PUBLICATIONS

ENRICHED PUBLICATIONS PVT.LTD

JE - 18,Gupta Colony, Khirki Extn,
Malviya Nagar, New Delhi - 110017.
E- Mail: info@enrichedpublication.com
Phone :- +91-8877340707

Global Journal of Networks and Applications

Aims and Scope

Global Journal of Networks and Applications welcomes research contributions, surveys and notes in all areas relating to computer networks and applications thereof. The following list of sample-topics is by no means to be understood as restricting contributions to the topics mentioned:

- New design techniques, interesting or novel applications, components or standards.
- Interface issues including special consideration for handicapped persons.
- Computer graphics, 3-D modeling and virtual reality multi-and hypermedia including electronic publishing and digital libraries.
- Computer networks with tools such as WWW or Hyper wave.
- Emerging standards for internet presentation levels (such as XML) and Internet protocol level, new compression standards for still pictures, movies, audio and vector data, 3-D data and cartographic data.
- Work on metadata and its applications.
- Applications of networked and stand-alone multimedia systems to computer assisted presentations.
- Applications of an educational, transactional and co-operational nature.
- Gateways between databases and security, privacy and societal aspects of network and computer technology.

Global Journal of Networks and Applications

Global Journal of Networks and Applications

(Volume No. 12, Issue No. 2, May - August 2024)

Contents

A Review On Energy Proficient And Conservation Techniques In Ad HOC Wireless Communication

Er. Kailash Aseri
Research Scholar, Faculty of Engineering & Technology, Jodhpur National University, Jodhpur (Rajasthan), India

A B S T R A C T

Working on energy proficient communiqué in ad hoc networks is an amusing is the difficulty of trade-offs obtainable to the expensive of power aware systems. In Mobile ad hoc network, mobile devices are battery operated. The progress in battery technology is slower as compared to advances in semiconductor technology. Even though a lot of technique has been recommended to preserve energy at dissimilar layer of the network protocol stack; many methods are planned by dissimilar study, however they have their own lacuna. Here efforts are made to have a glance over them and to abridge them in a technological way. In this article we propose power capable method to decrease power expenditure at protocol level.

Keywords: Mobile communication, ad hoc network, communication protocol, energy proficient, network

I. INTRODUCTION

Wireless/mobile broadband communication networks are increasingly leveraged for minimizing the environmental force of human performance, through applications that aim at realizing the delusion of a sustainable culture and world economy. Moreover, it has been documented that the power expenditure of wireless/mobile networks can become a matter due to the quick extension of traffic and communications. Subsequently, the plan of "green" wireless/mobile broadband networks has become a focus for research in academe and industry. Keeping swiftness with network extension necessitates new paradigms for power use in mobile networks, counting attractive the effectiveness of networking communications and adapting the network power expenditure to the changing traffic load, mobility and interference situation, and overall situations that may be encountered [18]. A wireless sensor network (WSN) is self-possessed of large number of sensor nodes with limited power, calculation, storage and communication capabilities. In current years, main advances have been made in the improvement of low-power micro sensor nodes. The emergence of such sensor nodes has allowed practitioners to imagine networking a large set of nodes scattered over a wide area of importance into a wireless sensor networks (WSNs) [6] for Large scale event monitoring and data collection and filtering. Subsequently when WSNs are deployed in a hostile milieu, security management plays a central role in data encryption and confirmation. The major predicament in key organization is to set up the protected keys between the sensor nodes. This predicament is known as the key consistency predicament [7].

Key conventionality procedure of WSNs include three types in the breathing schemes: trusted server, public key, and key pre distribution.

- Third Party Trusted Server protocols depend on a trusted server for key consistency between the sensor nodes. The Sensor nodes cannot basically use a third party trusted server because of the high communication expenditure and exploitation expenditure. The Public Key protocols involve high subtraction cost. Hence the Symmetric Key Cryptography connecting is measured to be the improved method of cryptography system in WSN. Sensor network dynamic structure, easy node cooperation and self-organization property increase the complexity of key management and bring a broad research issues in this area. Due to the significance and complexity of key management in WSNs, there are a large number of approaches decided on this area. Based on the main method that these proposals used or the individual structure of WSNs, we classify the present proposals as key pre-distribution schemes, hybrid cryptography schemes, one way hash schemes, key infection scheme, and key managing in hierarchy networks, while some schemes combine several methods.

- Public-key Cryptography necessitates a public-key communications that would impress additional computational expenses as well as improved storage needs. However, the partial computational and communication resources of nodes make it in realistic to utilize public-key protocols in WSN.

- Key pre-distribution: The third strategy to set up the secret keys is key pre-distribution, where keys are dispersed to all sensor nodes earlier to deployment. Such schemes are proved to be most appropriate for WSNs [7].

II. REVIEW

Energy expenditure in ad hoc networks –Generally there are three mechanisms to energy expenditure in ad hoc networks. First, energy is inspired during the transmit of individual packets. Second, energy is inspired while forward those packets throughout the network and ultimately, energy are encouraged by nodes that are idle and not transmitting or forward packets. To know how and when energy is inspired in ad hoc networks, it is necessary to believe these costs for data packets forward throughout the network and for control packets used to continue the network.

A. E2E COMMUNICATION

End-to-end communication in ad hoc networks is supported by all nodes participating in route maintenance and data forwarding. subsequently, network wide energy expenditure includes any control overhead from routing protocols, including route setup, preservation and recovery, as well as the impact of the selected routes on the power consumed at the intermediary nodes to forward data to the receiver. The option of a definite route is resolute by the metrics use in the routing protocol. Primary protocols use hop count as a primary metric [8-9], even though wait often completely impacts route choices [10]. More recent protocols propose the use of unlimited metrics such as signal power [11], constancy [12] and load [13], all of which impact performance and so completely impact energy expenditure [14]. Energy can also be used openly to choose routes that reduce energy expenditure [15] or avoid nodes with limited energy resources [16]. Additionally, when a route breaks, it is necessary to use energy-proficient mechanisms to find a new route, avoiding a re-flooding of the network whenever probable. At the network layer, energy-proficient routing protocols combine these techniques with power control for additional energy preservation during active communiqué [18].

B. P2P COMMUNICATION

The basis for all communication in ad hoc networks is the P2P communication between two nodes. At each node, communication impacts energy expenditure in two ways. First, the wireless communication device consumes some base energy when it is stimulated and idle. Second, the act of transmitting a packet from one node to a different consumes energy at both nodes. The transmit power level at the correspondent. Reception energy depends on the base response costs in the wireless card. The amount of time necessary for the packet transmit establishes the amount of time the card must be active, and so directly establish the energy inspired by the base card costs for both transmit and reception. This time is resolute by two factors: the control overhead from packet broadcast and the rate at which the packet is transmitted [18].

The per-packet control operating cost is resolute by the mechanism of the medium access control (MAC) protocol. Depending on the selected protocol, some energy may be inspired due to channel access or disputation declaration. For example, in IEEE 802.11 [17], the sender transmits an RTS (ready to send) message to inform the receiver of the sender's purpose. The receiver respond with a CTS (clear to send) message and to inform the sender that the channel is available at the receiver. The energy consumed for disputation resolution comprises the transmit and reception of the two messages. Additionally, the nodes may expend some time waiting until the RTS can be sent and so consume energy listening to the channel, although it has been made known that such protocols may not be best possible for throughput [14], there is no generally accepted choice for communication in mobile ad hoc networks.

III. MEASURING ENERGY DISBURSEMENT

Before considering various approaches to plummeting communication energy disbursement, it is sensible to matter whether the network interface contributes considerably to the overall energy disbursement of a mobile system. The diversity of devices, functioning modes, energy management techniques and usage situation make it not possible to make coverlet statements about energy expenditure in moveable devices. Observably, measurements of specific systems quickly become obsolete. Nonetheless, measurements [5] show that the network interface represents a important portion of the energy inspired by a laptop PC and is dominant source of energy expenditure in some PDA hardware. More recently, in a preliminary performance of a Bluetooth [2] based sensor device [3], the inter-face accounted for over 40% of the total energy disbursement when the Bluetooth device was in reserve mode. Moreover, the comparative cost of communication may be accepted to increase as advances carry on to be made in low-power hardware and energy proficient operating systems and applications. This trend will accelerate as communication functionality is increasingly integrated into small, devoted scheme such as sensors.

The plan and appraisal of energy capable communication protocols subsequently necessitates sensible comprehending of the energy expenditure performance of the underlying network boundary. The energy inspired by an boundary depends on its operating mode: In the snooze state, an interface can neither transmit nor obtain, so it consumes very small energy. To be able to broadcast or obtain, an interface must openly conversion to the idle state, which involve both time and energy. In the idle state, an interface can transmit or accept data at any time, but it consumes more power than it does in the sleep state, due to the number of circuit rudiments that must be motorized.

Because of their wide accessibility, low cost and comparatively steady, open requirement, IEEE 802.11- based [4] interfaces have involved significant attention. Table 1 recapitulates some investigational measurements of the power expenditure of various network interfaces. Even though the data vary rather amongst the diverse manufacturers, models, and measurement methods, there are dependable patterns.

ENERGY PROFICIENT COMMUNICATION					
Interface	Transmit	Receive	Idle	Sleep	Mbps
IEEE 802.11 Interfaces (2.4 Ghz)					
Aironet PC800[8]	1.38-1.92W	1.3-1.4 W	1.36 W	.075*W	11
Lucent Bronze [10]	1.32 W	.98 W	.85 W	.066 W	2
Lucent Silver [10]	1.32 W	.89 W	.74 W	.048 W	11
Cabletron Roamabout [6]	1.41 W	1.02W	.83 W	.13 W	2
Other Interfaces					
Lucent WaveLAN[20]	3.8 W	1.48 W	1.4 W	-	-

Table 1: some power disbursement measurements [1]

Transmitting necessitates more energy than unloading, but the dissimilarity is much less than a factor of two. The idle energy expenditure is quite high, equivalent to that of receiving and an order of magnitude more than that of sleeping.

IV. APPROACHES TO ENERGY EFFICIENCY OF WIRELESS COMMUNICATION NETWORKS

There has been a important interest in energy effectiveness in sensor networks and multichip mesh network architectures due to the limited battery life of the communicating nodes [20-22]. In conservative cellular communication systems work on the energy competence has rather been restricted to the mobile incurable with their limited battery power [23], and the energy competence of the communications has been mainly mistreated.

There are several current publications [24] that consider the matter of energy effectiveness of communication systems and their machinery on different protocol layers. OPERA-Net [25] investigates the opportunities to develop the energy effectiveness of broadband cellular networks by considering optimized cooling and energy improvement from the base stations and the optimization of the mechanism used in communication systems. The projects PANAMA [26], ELBA [27] and Class-S [28] focus on a more capable design of the power amplifiers in the base stations that classically still run at fairly low effectiveness. The Cool Silicon [29] project focuses on the optimization of individual aspects similar to the system design, communication algorithms and protocols as well as physical mechanism in three main areas: micro/nano technology, broadband wireless right of entry and wireless sensor networks. Mobile VCE Green Radio [30] aims at extending the effectiveness studies to energy metric for cellular and end to end communication [31].

V. CONCLUSION:

Energy protection in ad hoc networks is a comparatively new field of investigates. In this paper, we have accessible some of the new suggestions and stipulation for achieving that ambition. It is comprehensible that there is stationary room for new move towards that embarks upon this extremely complicated predicament of complementary energy preservation with communication excellence in active ad hoc networks.

VI. REFERENCES:

[1] Laura Marie Feene, "Energy Proficient Communication in AdHoc Wireless Networks" Computer and Network Architectures Laboratory, Swedish Institute of ComputerScience, Sweden.

[2] Bluetooth Special Interest Group. Speci cation of the Bluetooth system. http://www.bluetooth.org.

[3] IEEE Computer Society LAN MAN Standards Committee. IEEE 802.11 Stan-dard: Wireless LAN Medium Access Control and Physical Layer Speci cations,August 1999.

[4] Oliver Kasten and Marc Langheinrich. First experiences with bluetooth in the smart-its distributed sensor network. In Proc. of 10th International Conferenceon Parallel Architectures and Compilation Techniques (PACT'01) Workshop on Ubiquitous Computing and Communications (UCC01), September 2001.

[5] M. Stemm and R. H. Katz. Measuring and reducing energy disbursement of net-work interfaces in hand-held devices. IEICE Transactions on Communications, E80-B(8):1125–31, 1997.

[6] I.Akyildiz,W.Su,Y.Sankarasubramaniam, and E. Cayirci, "A survey on sensor networks," IEEE Commun. Mag., vol. 40, no. 8, pp. 102–114, Aug. 2002.

[7] Ms.T P Rani, Dr. C Jaya Kumar, Set upment of secure communication in wireless sensor networks, Computer Science & Engineering: An International Journal (CSEIJ), Vol.2, No.2, April 2012.

[8] B. Johnson and D. A. Maltz. MobileComputing, chapter Dynamic source routing in ad hoc wireless networks, pages 153–181. Kluwer Academic Publishers.

[9] E. Perkins and E. M. Royer. Ad-hoc on- demand distance vector routing. In 2nd IEEE Workshop on Mobile Computing Systems and Applications.

[10] D. B. Johnson and D. A. Maltz. Mobile Computing, chapter Dynamic source routing in ad hoc wireless networks, pages 153–181. Kluwer Academic Publishers.

[11] R. Dube, C. D. Rais, K.-Y. Wang, and S. K. Tripathi, Signal stability based adaptive routing (SSA)for ad hoc mobile networks. IEEE Personal Communications, 4(1):36–45.

[12] C.-K. Toh. Associativity-based routing for ad hoc mobile networks. Wireless Personal Communication, 4(2): 103–139.

[13] S.-J. Lee and M. Gerla. Dynamic load aware routing in ad hoc networks. In IEEE International Conference on Communications (ICC), 2001.

[14] L. M. Feeney and M. Nilsson. Investigating the energy disbursement of a wireless network interface in an ad hoc networking environment. In IEEE INFOCOM, 2001.

[15] K. Scott and N. Bambos. Routing and channel assignment for low power broadcast in pcs. In 5th IEEE International Conference on Universal Personal Communications.

[16] S. Singh, M. Woo, and C. S. Raghavendra. Power- aware routing in mobile ad hoc networks. In 4th Annual International Conference on Mobile Computing and Networking (MobiCom).

[17] IEEE 802 LAN/MAN Standards Committee. Wireless LAN medium access control MAC and physical layer (PHY) specifications. IEEE Standard 802.11.

[18] http://conference.vde.com/iswcs2013/workshops/Pages/EnergyProficientWirelessNetworks.as px.

[19] Dr. Mohammed Ali Hussain, M.RaviSankar, Vijaya Kumar Voleti,Y.Srinivasa Rao, NallaLovanjaneyulu, "Energy Conservation Techniques in Ad hoc Networks, Mohammed" International Journal of Computer Science and Information Technologies, Vol. 2 (3) , 2011,ISSN:09759646.

[20] S. Cui, A. J. Goldsmith, A. Bahai, "Energy-efficiency of MIMO and cooperative MIMO techniques in sensor networks," IEEE J. Sel. Areas Commun., vol. 22, no. 6, pp. 1089–1098, Aug. 2004.

[21] A. Catovic, S. Tekinay, T. Otsu, "Reducing transmit power and extending network lifetime via user cooperation in the next generation wireless multihop networks," J. on Comm. and Networks, vol. 4, pp351–362, 2002.
[22] E. Shih et al., "Physical Layer Driven Protocol and Algorithm Design for Energy-Proficient Wireless Sensor Networks," Proc. ACM MobiCom '01, Rome, Italy, July 2001, pp. 272–86.
[23] E. Shih, P Bahl, M.J. Sinclair ,"Wake on wireless: an event driven energy saving strategy for battery operated devices," Proc. 8th annual international conference on Mobile computing and networking, 2002.
[24] C. E. Jones, K. M. Sivalingam, P. Agrawal, J. C. Chen, "A survey of energy proficient network protocols for wireless networks," Wireless Networks, vol. 7, no. 4, pp. 343–358, Aug. 2001.
[25] Optimizing Power Efficiency in mobile RAdio Networks (OPERA-Net), EUREKA CELTIC project, http://opera-net.org/default.aspx.
[26] Power Amplifiers aNd Antennas for Mobile Applications (PANAMA), EUREKA CATRENE project, 2009-2011.
[27] Energy Efficiency of linear power amplifiers for mobile telecommunication base stations (ELBA), BMBF research project, 08/2006 - 07/2009.http://www.pt-it.pt-dlr.de/de/1760.php.
[28] Class-S, BMBF research project, 09/2006 - 02/2010. http://www.pt-it.pt-dlr.de/de/1760.php. [29]Spitzencluster COOL SILICON, www.cool-silicon.de/.
[30] "Green Radio – Sustainable Wireless Networks", Mobile VCE, Feb. 2009. http://www.mobilevce.com/dloads-publ/mtg284Item_1503.ppt.
[31] http://www.greentouch.org/uploads/documents/ISCCSP-paper-GreenComm_CameraReady-IEEEcompatible.pdf

Routing Protocols In Wireless Sensor Network: A Critical Survey And Comparison

Nirbhay K. Chaubey[1], Dharti H. Patel[2]

[1]*Department of Computer Science, Institute of Science and Technology for Advanced Studies and Research, Vallabh Vidyanagar- 388120, Gujarat, India*

[2]*Gujarat Technological University, PG School Ahmedabad-380001, Gujarat, India*

ABSTRACT

Wireless Sensor Networks (WSNs) consist of small nodes with sensing, processing and wireless communications capabilities. Routing technique is one of the key concerns in the research area of wireless sensor networks now days. In this paper, important routing protocols and its various challenges such as energy efficiency, security, quality of service, scalability, storage and computation in WSNs are discussed. Wireless Sensor Networks a great opportunity for the researchers in the developing countries. The future developments in sensor nodes must produce very powerful and cost effective devices, so that they may be used in applications like underwater acoustic sensor systems, time critical applications, cognitive sensing and spectrum management and coordination in heterogeneous networks and so on.

Keywords—Wireless sensor network, routing, routing technique, challenges and design issues

I. INTRODUCTION

Wireless Sensor Networks (WSNs) is a great enabling technology that can revolutionize information and communication technology. In fact, it has the potential to significantly change the way we live – just like the Internet and World Wide Web – perhaps more so. WSN has opened up the challenge for distributed and cooperative computing and communication. A Wireless Sensor Network is a self-configuring network of small sensor nodes communicating among themselves using radio signals, and deployed in quantity to sense, monitor and understand the physical world. It is highly distributed networks of small, lightweight wireless nodes, deployed in large numbers and monitors the environment or system by measuring physical parameters such as temperature, pressure, humidity. A wireless sensor network (WSN) is a wireless network consisting of dispersed autonomous devices that use sensors to monitor physical or environmental conditions. These autonomous devices, or nodes, combine with routers and a gateway to create a typical WSN system. Data is collected at the wireless sensor node, compressed and transmitted to the gateway directly or, if required, uses other wireless sensor nodes to forward data to the gateway, which provides a connection to the wired world where it can collect, process, analyze and present the analyzed data. This paper is organized as follows: - Section II introduces the concept of architecture of wireless sensor network. Section III presents Wireless Sensor Node Communication Architecture: Protocol Stack. Routing Protocols in WSN are discussed in Section IV. Section V discusses routing challenges and design issues followed by future trends in development of WSN applications discussed in Section VI. Then analyzed and compared various papers proposed by the other researcher. Finally, Section VII concludes the paper followed by future work.

II. ARCHITECTURE OF WSN

Fig.1 shows the first look of wireless sensor network[1].

Sensor Field: A sensor field can be considered as the area in which the nodes are placed.

Sensor Nodes: Sensors nodes are the heart of the network. They are in charge of collecting data and routing this information back to a sink.

Sink: A sink is a sensor node with the specific task of receiving, processing and storing data from the other sensor nodes. They serve to reduce the total number of messages that need to be sent, hence reducing the overall energy requirements of the network. Sinks are also known as data aggregation points.

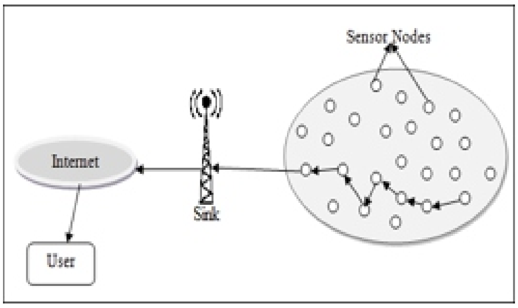


Fig.1 WSN Architecture

III. WIRELESS SENSOR NODE COMMUNICATION ARCHITECTURE: PROTOCOL STACK

Sensor network needs five layers: application layer, transport layer, network layer, data link layer and physical layer. The three cross planes or layers are; power management plane, mobility management plane and task management plane.

Fig.2 shows the sensor network protocol stack. These management planes make sensor nodes work together in a power efficient way, route data in a mobile sensor network, and share resources between sensor nodes.

- Power management plane
  - Manages how a sensor node uses its power
  - For example, the sensor node may turn off its receiver after receiving a message

- Mobility management plane
  - Detects and registers the movement of sensor nodes
  - So a route back to the user is always maintained
  - The sensor nodes can keep track of who are their neighbor sensor nodes

- Task management plane
  - Balances and schedules the sensing tasks given to a specific region
  - Not all sensor nodes in that region are required to perform the sensing task at the same time

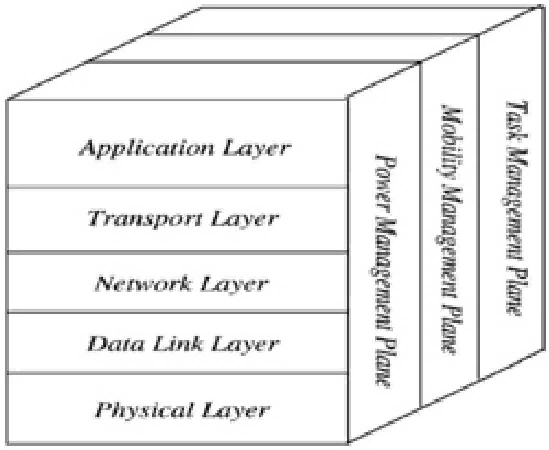


Fig.2 Sensor network protocol stack

1. Physical Layer

This layer provides an interface to transmit a stream of bits over physical medium. Responsible for frequency selection, carrier frequency generation, signal detection, Modulation and data encryption. The minimum output power required to transmit a signal over a distance. In this layer multihop communication in a sensor network can effectively overcome shadowing and path loss effects. Energy-efficiency being pursued using binary and m-ary modulation.

2. Data link layer

The data link layer is responsible for the multiplexing of data stream, data frame detection, medium access and error control. Ensure reliability of point–point or point– multipoint, errors or unreliability. Co- channel interference at the MAC layer and this problem is solved by MAC protocols.

Multipath fading and shadowing at the physical layer and this problem is solved by forward error correction (FEC) and automatic repeat request (ARQ).

3. Network layer

The major function of this layer is routing. This layer has a lot of challenges depending on the application but apparently, the major challenges are in the power saving, limited memory and buffers, sensor does not have a global ID and have to be self organized.

The networking layer of sensor networks is usually designed according to the following principles:

- Power efficiency is always an important consideration.
- Sensor networks are mostly data centric.
- Data aggregation is useful only when it does not hinder the collaborative effort of the sensor nodes.

5. Transport layer

The transport layer is needed when the system is planned to be accessed through Internet or other external networks. The function of this layer is to provide reliability and congestion avoidance where a lot of protocols designed to provide this function are either applied on the upstream or downstream. These protocols use different mechanisms for loss detection ((ACK, NACK, and Sequence number)) and loss recovery ((End to End or Hop by Hop)). This layer is specifically needed when a system is organized to access other networks.

6. Application layer

Potential application layer protocols for sensor networks remain a largely unexplored region. Three possible application layer protocols.

- Sensor management protocol (SMP)
- Task assignment and data advertisement protocol (TADAP)
- Sensor query and data dissemination protocol (SQDDP)

Responsible for traffic management and provide software for different applications that translate the data in an understandable form or send queries to obtain certain information.

IV. ROUTING PROTOCOLS IN WSN

WSN Routing Protocols can be classified in four ways, according to the way of routing paths are established, according to the network structure, according to the generally, routing protocols are: Application specific; Data centric; Capable of Routing in Wireless Sensor Networks protocol operation and according to the initiator of communications. Fig.3 shows the classification of WSN routing protocols.

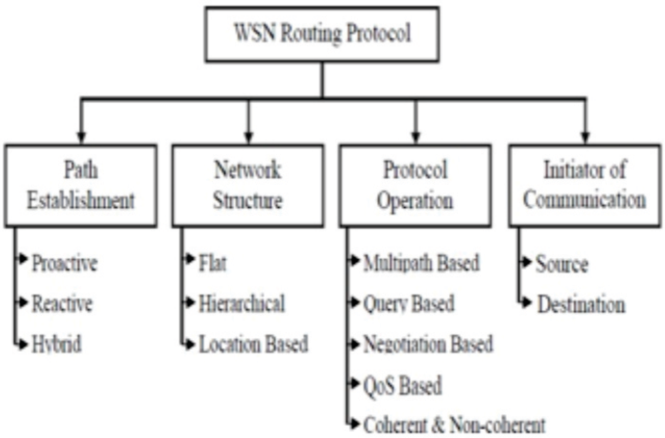


Fig 3. Classification of WSN routing protocols

Based on the network structure, routing in WSNs can be divided into three categories named as flat-based routing, hierarchical-based routing and location based routing

Flat Routing (Data Centric Routing protocols): In flat networks, each node typically plays the same role and sensor nodes collaborate together to perform the sensing task. In this type of network it is not possible to assign a global identifier to each node due to large number of nodes. Therefore, base station send queries to different part of the field and waits for the data from sensors in selected parts of the field.

Sensor Protocol for Information Negotiation (SPIN):In [2] the author mentions that Sensor Protocols for Information via Negotiation (SPIN) that disseminates all the information at each node to every node in the network assuming that all nodes in the network are potential BSs. This enables a user to query any node and get the required information immediately.

These protocols make use of the property that nodes in close proximity have similar data, and hence there is a need to only distribute the data other nodes do not posses.

Directed Diffusion: Directed Diffusion is another type of data centric protocol for wireless sensor network [3]. There are four main features of this protocol: Interest, Gradient, Data, and Reinforcement. Interest message defines the data the recipient interested in. It is disseminated to all the applicable nodes in the network. The gradient message provides neighboring nodes with the information as to where the data is to be forwarded next.

An Energy Efficient Directed Diffusion Model for Wireless Sensor Networks [4], this paper emphasizes on a fact that the flooding procedure followed in interest diffusion phase will inevitably bring about heavy traffic load and affect seriously transmission performance of network.

Load-balance Directed Diffusion in Wireless Sensor Networks [5], this paper talks about the power consumption of the nodes considering in terms of load in the wireless sensor network. In DD, interest is disseminated through flooding process and path gradient is calculated as well as recalculated (while sending exploratory data) using the interest message.

Rumor Routing: Rumor routing [6] allows the routing of queries to nodes that have observed an event of interest. As a result, retrieval of data is based on events and not on an addressing scheme. An event is an activity related to the phenomena being sensed (e.g. increased movement in an area being monitored). In this paper, events are assumed to be localized phenomena which occur in fixed regions of space. A query is issued by the sink node for one of two reasons, as an order to collect more data, or as a request for information.

Minimum Cost Forwarding Algorithm (MCFA): Minimum Cost Forwarding has been defined by author in this paper [7] as an efficient protocol appropriate for simple WSN with limited resources. The aim of MCF is to establish a means of delivering messages from any sensor in a field of sensor nodes along a minimum cost path to an interested client node or base station. MCF exploits the fact that the direction of routing is always known, i.e. data always flows from sensor nodes towards a base station.

Hierarchical Routing: Hierarchical routing works in two layers, first layer is used to choose cluster heads and the other layer is used for routing. To make the WSN more energy efficient, clusters are created and special tasks (data aggregation, fusion) are assigned to them. It increases the overall system scalability, lifetime, and energy efficiency.

Low Energy Adaptive Clustering Hierarchy (LEACH): Among the current researches, the clustering routing technology is the most widely influential. Low-Energy Adaptive Clustering Hierarchy (LEACH) [8] is a classical clustering routing in wireless sensor networks .However the cluster-head selection in LEACH protocol is lack of balancing the whole network energy consumption, with the result that low energy nodes run out of energy prematurely and decline the network life. This paper analyses the effectiveness of LEACH protocol in cluster-head selection, and proposes an improved energy balanced clustering algorithm.

- LEACH C- It is a centralized clustering algorithm. The steady state used in LEACH C is similar to set up phase of LEACH and in Leach-C each node sends the information about the current location and the level of energy to the base station.

-LEACH-B – This algorithm to balance the number of cluster heads based on the residual energy of the sensor nodes.

Self Organizing Protocol (SOP): General self-organized tree-based energy-balance routing protocol [9] - GSTEB is a self-organized protocol, it only consumes a small amount of energy in each round to change the topography for the purpose of balancing the energy consumption.

All the leaf nodes can transmit data in the same TDMA time slot so that the transmitting delay is short. When lifetime is defined as the time from the start of the network operation to the death of the first node in the network.

Virtual Grid Architecture: In this paper [6], a novel scheme called Virtual Grid based Dynamic Routes Adjustment (VGDRA) is proposed for periodic data collection from WSN. It aims to optimize them trade-off between nodes energy consumption and data delivery performance using a single mobile sink while adhering to the low-cost theme of WSN. The authors design a virtual infrastructure by partitioning the sensor field into a virtual grid of uniform sized cells where the total number of cells is a function of the number of sensor nodes. A set of nodes close to centre of the cells are appointed as cell-headers which are responsible for keeping track of the latest location of the mobile sink and relieve the rest of member nodes from taking part in routes re-adjustment.

Location-based Routing: In most cases location information is needed in order to calculate the distance between two particular nodes so that energy consumption can be estimated. Generally two techniques are used to find location, one is to find the coordinate of the neighboring node and other is to use GPS (Global Positioning System).

Geographical Adaptive Fidelity (GAF): The common approach for energy saving is to use sleep modes in nodes expecting no activity in a period of time. This is the main idea behind GAF. Proposed Scheme: The design of GAF [10] is motivated by an energy model that focuses on energy consumption due to the reception and transmission of packets as well as idle time. GAF is based on the mechanism of turning off unnecessary sensors while keeping a constant level of routing fidelity. GAF divides sensor field into grid squares and every sensor uses its location information to associate itself with a particular grid. Size of grid square is chosen in a way such that sensors within the same grid are equivalent with regard to routing and that sensors in adjacent grids can communicate with each other.

SPAN: Its goal is to reduce energy consumption. Span helps sensors to join a forwarding backbone topology as coordinators that will forward packets on behalf of other sensors between any source and destination .Span is an energy efficient coordination algorithm for topology maintenance in wireless ad hoc networks. Each node in Span does the local decision on whether to announce for or withdraw from coordinator. They modify coordinator withdrawal procedure of Span by adding average speed of node as one of the condition for withdrawing it from coordinator.

V. ROUTING CHALLENGES AND DESIGN ISSUES

Some of the important routing challenges in WSN are discussed in this section as follows:

Limited battery power: Wireless sensor nodes have limited energy storage and once they are deployed, it is not practical to recharge or replace their batteries as sensor nodes in WSN have limited battery power, it becomes challenging to perform computation and transmission while optimizing energy consumption. In fact the transmission of one bit of data consumes more energy than processing the same bit of data. Sensor node life time strongly depends on its battery life.

Security: Security is one of the major challenges in WSNs. Most of the attacks that are performed on WSN are insertion of false information by compromised nodes within the networks. Development of security schemes for WSN also faces challenges related to constrained environment.

Scalability: The number of sensor nodes deployed in the sensing area may be in the order of hundreds or thousands, or more. Any routing scheme must be able to work with this huge number of sensor nodes. Scalability is one of the main design attributes of the sensor networks, and this must be encompassed by the protocols.

Node deployment: Node deployment in WSNs is application dependent and affects the performance of the routing protocol. The deployment can be either deterministic or randomized. In deterministic deployment, the sensors are manually placed and data is routed through pre-determined paths. However, in random node deployment, the sensor nodes are scattered randomly creating an infrastructure in an ad hoc manner.

Quality of Service: In some applications, data should be delivered within a certain period of time from the moment it is sensed; otherwise the data will be useless. Therefore bounded latency for data delivery is another condition for time-constrained applications. However, in many applications, conservation of energy, which is directly related to network lifetime, is considered relatively more important than the quality of data sent.

Node Capability: Depending on the application, a sensor node can have different role or capability such as relaying, sensing and aggregation since engaging all these functions on the same node would drain the energy of that node more quickly. Different capabilities of sensor nodes raise multiple issues related to data routing and makes routing more challenging.

Fault Tolerance: Some sensor nodes may fail or be blocked due to lack of power, physical damage, or environmental interference. The failure of sensor nodes should not affect the overall task of the sensor network. If many nodes fail, MAC and routing protocols must accommodate formation of new links and routes to the data collection base stations.

VI. FUTURE TRENDS IN WSN APPLICATIONS

The future developments in sensor nodes must produce very powerful and cost effective devices. Possibilities of further developments in WSN applications are studied in this section.

Cognitive Sensing: Cognitive sensor networks are used for acquiring localized and situated information of the sensing environment by the deploying a large number of sensors intelligently and autonomic ally. Managing a large number of wireless sensors is a complex task.

Spectrum Management: As application of low power wireless protocols is increasing, we can envision a future in which wireless devices, such as wireless keyboards, power point presenters, cell phone headsets, and health monitoring sensors will be ubiquitous. But the pervasiveness of these devices leads to increased interference and congestion within as well as between networks, because of overlapping physical frequencies. Cognitive radios and multi frequency MACs are some approaches that have been developed to utilize multiple frequencies for parallel communication.

Underwater Acoustic Sensor Systems: Underwater sensor networks are designed to enable applications for oceanographic data collection, pollution monitoring, offshore exploration, disaster prevention, assisted navigation and tactical surveillance applications. Underwater sensors are also being in use for exploration of natural undersea resources and gathering of scientific data. So a need of underwater communications among underwater devices arises. Underwater sensor nodes and vehicles should be capable of coordinate their operation, exchanging their location and movement information and hence relay monitored data to an onshore base station.

Time Critical Applications: A new generation of distributed embedded systems, with a broad range of real-time applications, such as fire monitoring, border surveillance, medical care, and highway traffic coordination, can be represented by WSNs. Due to severe resource limitations in highly dynamic environments. These systems face new kinds of timing constraints. Many classical approaches to real-time computing like wireless networking protocols, operating systems, middleware services, data management, programming models, and theoretical analysis are challenged by WSNs.

Table 1.Comparison of routing protocols

	Classification	Power Usage	Localization	QoS	Scalability	Multipath
SPIN	Flat	Limited	No	No	Limited	Yes
Directed Diffusion	Flat	Limited	Yes	No	Limited	Yes
Rumor Routing	Flat	N/A	No	No	Good	No
MCFA	Flat	N/A	No	No	Limited	No
LEACH	Hierarchical	Maximum	Yes	No	Good	No
SOP	Hierarchical	N/A	No	No	Low	No
VGA	Hierarchical	N/A	Yes	No	Good	Yes
SPAN	Location	N/A	No	No	Limited	No
GAF	Location	Limited	No	No	Good	No

Table 2.Comparisons analysis of various papers

Researcher	Paper Title	Abstract	Analysis	Conclusion	Future Work
Abdul Waheed Khan, Abdul Hanan Abdullah, Mohammad Abdur Razzaque and Javed Iqbal bangash	VGDRA : A virtual Grid based Dynamic Routes adjustment Scheme for Mobile Sink based Wireless Sensor Networks[6]	Aims to minimize the routes reconstruction cost of the sensor nodes while maintaining nearly optimal routes to the latest location of the mobile sink	VGDRA scheme partitions the sensor field into a virtual grid and constructs a virtual backbone structure comprised of the cell header nodes	Reduced routes reconstruction cost and improved network lifetime of the VGDRA scheme	Analyze the performance of VGDRA scheme at different sink's speeds and data generation rates of the sensor nodes.
Mrs. T. Nagamalar, Dr. T. R. Rangaswamy	Energy Efficient Cluster based Approach for Data Collection in Wireless Sensor Networks with Multiple Mobile Sink[11]	New cluster based approach using controlled flooding is proposed with multiple mobile sink for prolonging the life time of WSN	WSN lifetime is prolonged with optimal routes and limited flooding of update message to the restricted number of cluster heads.	Multiple mobile sink with reduced reconstruction of route has improved the energy efficiency and increased lifetime of WSN	Link failure due to the mobility of sink and node failure could also be taken into Consideration for maintaining the reliable path
NaliniJori. Neeta Thune	An Sensor Node Energy Improvement In-Network For Wireless Sensor Network[12]	Improves the data fusion and aggregation protocols to save energy efficiently, builds the effective routing tree, overlapping routes increases and eliminates the redundant data	Improves the routing path and builds the efficient routing tree, aggregation quality, the communication cost, delivery efficiency, calculate the energy utilization of each node	N-DRINA shows improved results along the use of energy- wake-up mechanism	Spatial and temporal correlation of aggregated data will also be taken into consideration as well as the construction of routing tree that meets application needs
Jenq-ShiouLeu , Tung-Hung Chiang	Energy Efficient Clustering Scheme for Prolonging the Lifetime of Wireless Sensor Network With Isolated Nodes[13]	a new regional energy aware clustering method using isolated nodes for WSNs, called Regional Energy Aware Clustering with Isolated Nodes (REAC-IN)	CHs are selected based on weight which is determined according to the residual energy of each sensor and the regional average energy of all sensors in each cluster	improves the cluster head selection process problem of node isolation, lifetime and stability of a network is more favorable	

Prerna, Sanjay Kumar	Energy Efficient Clustering Algorithm for WSN[14]	based on static clustering concept and dynamic cluster heads selection technique, which divides the entire network area into a regions	CH is selected that it reduces communicating distance bet-ween nodes, hence reduces energy consumption while transmitting the data from one node to another and increases network efficiency as energy consumed	the proposed (EECA) algorithm is better than the LEACH, LEACH- C and DR scheme in respect of throughput and stability	
Kyung Tae Kim, Man Youn Kim, JiHyeon Choi, Hee Yong Youn	An Energy Efficient and Optimal Randomized Clustering for Wireless Sensor Networks[15]	decides optimal number of clusters by employing a new approach for setting threshold value, including the probability of optimum number of cluster heads and residual energy of the nodes	Introduces a new threshold value used in selecting the cluster heads in the network. Also introduced a new tree construction approach inside each cluster to minimize the energy consumption of sensor nodes	the proposed scheme can significantly reduce energy consumption and increase the lifetime of the network compared to the existing schemes	Extension of the proposed scheme to cope with the mobility and the related challenges is yet another important issue remaining as future work
Suraj Sharma, Sanjay Kumar Jena	Cluster based Multipath Routing Protocol for Wireless Sensor Networks[16]	Uses the clustering and multipath protocols to reduce energy consumption and increase the reliability. The basic idea is to reduce the load of the sensor node by giving more responsibility to the base station (sink)	All the paths are computed prior to its requirement. It is suitable for the static network. It requires route from cluster head to the base station. The base station is responsible for computing the routing path and monitoring the energy level of each sensor node in the network.	The multipath gives more reliability to the network, and it increases the throughput and decreases latency. In addition to that, cluster based data collection reduces the traffic and energy consumption and also increases the lifetime of the network	

Noor M. Khan, Ihsan Ali, Zubair Khalid, Ghufran Ahmed, Alex A. Kavokin	Quasi Centralized Clustering Approach for an Energy-efficient and Vulnerability-aware Routing in Wireless Sensor Networks[17]	QCCA, in which WSN partition into disjoint and equal-sized cells. This approach reduces both energy consumption and communication bandwidth requirements and prolongs the lifetime of the WSN. Provides automatic adaptation to different routes when network condition changes	In the proposed approach, there are two phases of operation: setup phase and steady-state phase. In the setup phase, control information is flooded in the entire network. In the steady-state phase, whenever a source node wants to send data to its CH, it chooses that neighbor from its routing table who has lowest IPvalue	A large amount of energy is saved using this strategy. QCCA not only focus on the shortest path, but also on energy awareness and vulnerability factor of nodes	Extending the routing protocol to allow fault recovery of gateway. Introducing fault tolerance in the protocol while ensuring robustness in an energy- efficient and vulnerability-aware manner will increase the capability of WSN
AshishUpadhyay, Raghvendra Kumar, Sujeet.K.Tiwari	Modified LEACH Protocol for Sensor Network[8]	proposed algorithm solves the extra transmissions problem that can occurs in LEACH algorithm	The energy consumption in proposed algorithm increases and network lifetime decreases. The reason is that sensor nodes that are not included in any cluster have to transmit their data directly to the BS over long distance.	eliminated the extra transmissions that can occur in LEACH algorithm	Future proposed energy efficient protocol that will work on the less energy consumption

VII. CONCLUSION AND FUTURE WORKS

This paper conducts a critical survey of the wireless sensor networks architecture, design issues, different routing techniques and their challenges. Various existing routing protocols are compared and contrasted in the table 1 and table 2. Final findings of our this paper is that in case of Data centric routing in WSN, naming rules such as attribute-value pairs will not work for complex queries that are application dependent. In case of Hierarchical routing, the nodes are grouped together to form clusters.

Cluster heads are responsible for data aggregation and relay of messages to the sink. In case of Location based routing protocols, energy efficient and intelligent utilization of location information.

There are substantial challenges that need to be solved in the sensor networks. In the future, our research work focus on to propose energy efficient routing algorithm based on clustering.

VII. REFERENCES

[1] Jitender Grover, Mohit Sharma, Shikha ," Reliable SPIN in Wireless Sensor Network", IEEE 2014.

[2] Geetu, Sonia Juneja,"Performance Analysis of SPIN and LEACH Routing Protocol in WSN", International Journal of Computational Engineering Research (ijceronline.com) Vol. 2 Issue. 5

[3] Vaishali Jain, Nayyar Ahmed Khan," Simulation Analysis of Directed Diffusion and SPIN Routing Protocol in Wireless Sensor Network", IEEE 2014.

[4] Li Chunlin and QianQiongfen Zhang Xiaoqing, "An Energy Efficient Directed Diffusion Model for wsn," in International Conference on Internet Technology and Applications, 2010, pp. 1-4.

[5] Yuh-Chung Lin, Tsung-Han Chen and Chin-ShiuhShieh Wei Kuang Lai, "Load-balance Directed Diffusion in Wireless Sensor Networks," in Fifth International Conference on Genetic and Evolutionary Computing (ICGEC,11), 2011, pp. 65-68.

[6] Abdul Waheed Khan, Abdul Hanan Abdullah, Mohammad AbdurRazzaque and JavedIqbalbangash, "VGDRA : A virtual Grid based Dynamic Routes adjustment Scheme for Mobile Sink based Wireless Sensor Networks", IEEE Sensors Journal, Vol.0. No. 0, pp. 1-9, January 2014.

[7] William D Henderson, Steven Tron," Verification of The Minimum Cost Forwarding Protocol for Wireless Sensor Networks", University of Northumbria School of Computing, Engineering & Information Sciences Newcastle upon Tyne.

[8] AshishUpadhyay, Raghvendra Kumar, Sujeet.K.Tiwari,"Modified LEACH Protocol for Sensor Network", IEEE 2015.

[9] Zhao Han, Jie Wu, Member, IEEE, Jie Zhang, Liefeng Liu, and KaiyunTian,"A General Self-Organized Tree-Based Energy- Balance Routing Protocol for Wireless Sensor Network", IEEE TRANSACTIONS ON NUCLEAR SCIENCE, VOL. 61, NO. 2, APRIL 2014.

[10] MallanagoudaPatil, Rajashekhar C. Biradar,"A Survey on Routing Protocols in Wireless Sensor Networks", IEEE 2012.

[11] Mrs. T. Nagamalar, Dr. T. R. Rangaswamy, "Energy Efficient Cluster based Approach for Data Collection in Wireless Sensor Networks with Multiple Mobile Sink", IEEE 2015.

[12] NaliniJori. Neeta Thune,"An Sensor Node Energy Improvement In-Network For Wireless Sensor Network", IEEE 2015.

[13] Jenq-ShiouLeu , Tung-Hung Chiang,"Energy Efficient Clustering Scheme for Prolonging the Lifetime of Wireless Sensor Network With Isolated Nodes", IEEE COMMUNICATIONS LETTERS, VOL. 19, NO. 2, FEBRUARY 2015.

[14] Prerna, Sanjay K umar,"Energy Efficient Clustering Algorithm for WSN", IEEE 2015.

[15] Kyung Tae K im, Man Youn K im, JiHyeon C hoi, Hee Yong Youn,"An Energy Efficient and Optimal Randomized C lustering for Wireless Sensor Networks", IEEE 2015.

[16] Suraj Sharma, Sanjay Kumar Jena,"Cluster based Multipath Routing Protocol for Wireless Sensor Networks",ACM SIGCOMM Computer Communication Review, Volume 45, Number 2, April 2015.

[17] Noor M. Khan, Ihsan Ali, Zubair Khalid, Ghufran Ahmed, Alex A. Kavokin,"Quasi Centralized Clustering Approach for an Energy-efficient and Vulnerability-aware routing in Wireless Sensor Networks",ACM 2008.

[18] Jamal N. Al-Karaki Ahmed E. Kamal,"Routing Techniques in Wireless Sensor Networks:A Survey", ICUBE initiative of Iowa State University, Ames, IA 50011.

[19] VivekKatiyar, Narottam Chand, Naveen Chauhan,"Recent advances and future trends in Wireless Sensor Networks", INTERNATIONAL JOURNAL OF APPLIED ENGINEERING RESEARCH, DINDIGUL Volume 1, No 3, 2010.

[20] Rajashree.V.Biradar, V.C .Patil, Dr. S. R. Sawant,"CLASSIFICATION AND COMPARISON OF ROUTING PROTOCOLS IN WIRELESS SENSOR NETWORKS", UbiCC Journal – Volume 4.

[21] Mr. ChiranjibPatra, Dr. ParamaBhaumik and Ms. DebinaChakroborty," Modified Rumor Routing for Wireless Sensor Networks", IJCSI International Journal of Computer Science Issues, Vol. 7, Issue 4, No 9, July 2010.

[22] Sachin Sharma," Speed Aware Modified Span for Wireless Mobile Ad hoc Networks", The Third International Conference on Digital Telecommunications, IEEE 2008.

[23] M. Bala Krishna and M. N. Doja," Self-Organized Energy Conscious Clustering Protocol for Wireless Sensor Networks", ICACT2012.

[24] Safdar Abbas Khan,"Localization and fault detection in wireless sensor networks", Universit_e Paris-Est, 2011

Energy Efficient ACO And Compressive Sensing Based GSTEB Routing Protocol

Shweta Saini, Vishal Arora
Shaheed Bhagat Singh State Technical Campus, Ferozepur, India 152004

A B S T R A C T

WSN has become important section of research in computational theory because wide section of applications. But due to limited battery the ability consumption has become important limits of WSNs protocols. Nevertheless several methods has been proposed so far to enhance the power effectiveness further but still much advancement can be done. To be able to overcome the constraints of the earlier work a brand new increased technique is proposed in that paper. The proposed technique has the capacity to overcome the limits of the GSTEB routing protocol by using the compressive sensing and ant colony based optimization based tree construction.

A. WIRELESS SENSOR NETWORK

Any Wireless Sensor Network (WSN) functions massive amount small sensor nodes having limited calculation potential, small recollection, limited electrical energy, and constrained variety interacting device. Sensor nodes are firmly structured in your community of interest. Every product has feeling and instant interaction features which make it to feeling and obtain information from environmentally friendly environments and then transfer the data to various nodes in the sensor network. Early in the day in your day situations, it's been obtained excellent interest from equally academic teams and company area.

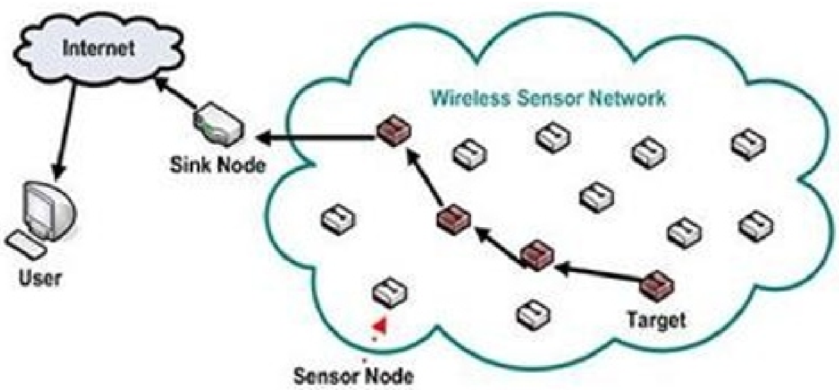


Fig.1 Wireless Sensor Network

All nodes send their data to Base Station (BS) as well as sink, that'll features calculations and decision-making, and can be in comparison to the particular capabilities concerning web server or even in most cases being truly a journey during laptop or computer network i.e. it become a gateway between an alarm nodes and end users. These types of sensor nodes is going to be used above an amazing eographic region to watch organic or even the environmental situations, like heat range, look, demand, etc. WSN has appeared seeing that a crucial region pertaining to study and development. They could be now by having a faster deployment point, applying significant possibility of several applications. It will not be fair to talk about that they are predicted protect a huge position in the world in the coming decade [5].

B. TYPES OF WIRELESS SENSOR NETWORK

In relation to the environmental surroundings, the forms of areas determined in order these could be began could be terrestrial, underground and so on. Various kinds of WSNs contain:

- Terrestrial WSNs
- Underground WSNs
- Underwater WSNs
- Multimedia WSNs
- Mobile WSNs

Terrestrial WSN: Terrestrial WSNs can handle speaking base stations properly, and include hundreds to hundreds and 1000s of wireless alarm nodes used sometimes in unstructured (ad hoc) or prepared (Pre-planned) manner. Inside an unstructured function, the sensor nodes are arbitrarily distributed within the goal area that's slipped from the restored plane.

Underground WSNs: The underground wireless sensor networks are more expensive are far more costly in comparison to terrestrial WSNs as it pertains to deployment, maintenance, and equipment charge factors and careful planning. The WSNs networks include numerous warning nodes which may be concealed in the underside to check underground WSNs conditions. To change data from the sensor nodes to the base station, additional sink nodes are found above the bottom.

Multimedia WSNs: Multimedia wireless sensor networks communities have been planned allow monitoring and monitoring of functions in the shape of multimedia, such as for example imaging, movie, and audio. These communities consist of low-cost sensor nodes built with microphones and cameras.

Mobile WSNs: These techniques include an accumulation of sensor nodes that might be transferred independently and may be interacted with the bodily environment. The lightweight nodes have the capacity to compute sensation and communicate.

Underwater WSNs: Significantly more than 70% of the world is occupied with water. These sites include several warning nodes and vehicles began below water. Autonomous underwater vehicles are ideal for getting knowledge from these caution nodes. Hard of underwater interaction is a prolonged propagation delay, and bandwidth and caution failures.

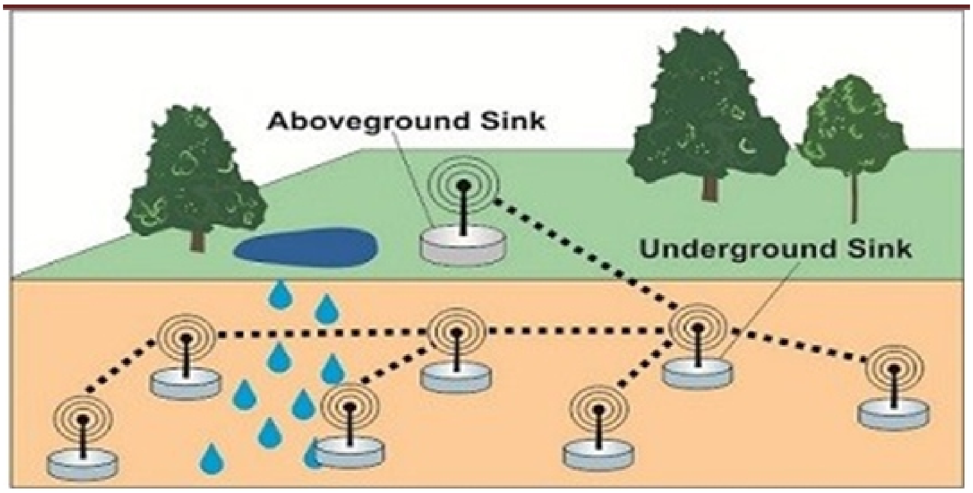


Fig. 2 Underground WSN

C. METHODOLOGY

General Self Organized tree based energy balance routing protocols for WSN

General Self-Organized Tree-Based Energy-Balance routing protocols (GSTEB) [2] constructs a routing tree with a means wherever, just about any rounded, Base station (BS) decides some sort of origin node plus send that alternative to each node. In that case, almost every node decides parent node through using into account simply themselves in addition to community friend's information. This can make GSTEB some sort of strong and energetic protocol. Target involving GSTEB is to enhance system time of various purposes [12]. Generally there are two meanings regarding system life span and two excessive circumstance of data fusion are seen in paper beneath issue to think about that will be called follows: Network lifetime is explained in two ways:

(a) Enough time from the start of function right till first node dies.
(b) Enough time right away of function appropriate till last node or all nodes are now useless.

The cases in data fusion are:

Case (1): The data amongst sensor nodes can be totally fused. Each node directs the exact same information regardless of quantity it receives. Case (2): The info is not fused. Every exchange node directs data which can be an item of that simple sensed data plus data obtained from their child nodes.

Operations of GSTEB: The essential procedures of GSTEB are:

A. Initial Phase:

In that stage, parameters i.e. parameters usually are initialized. Initial stage may be split into some measures.

Step 1: When that stage starts, BS deliver a packet to each and every of the nodes to share with these individuals of start time, your amount of time place plus simply how much of nodes N. Viewing that the nodes get field, they could examine their particular certain energy-level (EL) [11].

Step 2: Each node hits its package in a radius plus a specific range during its time position following Stage 1. For representation, in I time place, node where ID may be I will deliver aside its packet. These package features a discharge plus the important points for example coordinates plus EL of node I .Every extra node within this time around place could see the course, in the event a lot of them are buddies of node I, they'll obtain that package plus record the important points of node I within storage.

Step 3: Each node hits it's packet in a radius along with a particular distance all through their time position following Stage 1. For example, in I time place, node where ID may be I'll deliver away its packet. These packet features a launch plus the important points as an example coordinates plus EL of node I .Every additional node within this time around place often see the route, in the case many of them are buddies of node I, they'll get that packet plus history the important points of node I within storage. [12].

B. Tree Constructing Phase:

Following the routing tree is unquestionably produced, every sensor node gathers data to develop a DATA_PKT that expectations to often be passed to BS.

Step 1: BS assigns any node as root plus produce root ID plus their coordinates to every signal nodes.

Step 2: Each of them node efforts to select a parent or guardian running around in its other individuals who live regional utilizing EL.

Step 3: Considering all nodes prefers the parent by their other individuals who keep regional and each node papers friend's information every one node may only understand each of these other individuals who keep regional parent nodes by computing, and it may also identify each of these kid nodes. If node doesn't have any kid node it define itself as a leaf node, by which knowledge signal begins [14].

C. Self-Organized Data Collecting and Transmitting Phase:

Following the routing tree is obviously created; every sensor node collects information to make a DATA_PKT those expectations to frequently be found in BS [13].

D. Information Exchanging Phase:

Regarding Case1, as a result of reality every node hopes to generate along with deliver DATA_PKT generally in most circular, it'll exhaust their power and expire. That vanishing of any sensor node could simply impudence a topography .Therefore the nodes that may certainly transfer involve to tell others.

Regarding Case2 BS can certainly gather the first EL along with coordinate's knowledge of every one sensor nodes in original Phase. For every single and every round, BS created the routing pine and need to in the machine utilizing the EL along with coordinate's information. The moment the routing tree is made, the energy expenditure of every and every sign node through that round could possibly be used in the form of BS, therefore the info needed for processing a topology for the following round could possibly be discovered beforehand [6].

Steps Involved for Proposed work

The present research energy is planned to be achieved in many levels that need to be preceded in the manner, as explained under.

1. Literature evaluation
2. Make algorithm in MATLAB 7.10.0 (R2010a) programming.
3. Comparison and evaluation is done by utilizing numerous parameters.
4. Documentation

Proposed Algorithm

For obtaining successful results, proposed a better GSTEB redirecting by using Ant Colony optimization approach:

Swarm Intelligence (SI) is the area relationship of various simple agents to achieve a global goal. SI is created on social insect metaphor for resolving several types of problems. Insects like insects, bees and termites are now living in colonies. Each insect in a cultural insect colony seemingly have their agenda. The integration of specific actions does not have any supervisor. In a cultural insect colony, a staff frequently does not accomplish all jobs, but instead specializes in a few tasks.

- FANT (Forward Ants)
- BANT (Backward Ants)

The various steps how these brokers are driving routing data to one another are the following:

- Each system node starts FANT to all or any locations at typical time intervals.
- Ants identify a way to area randomly predicated on new routing tables.
- The FANT generates a collection, pressing in journey instances forever node as that node has reached.
- When area is achieved, the BANT inherit the stack.
- The BANT place the selection things and employs the trail in reverse.

When ants are along the way to find food, they begin from their home and go toward the food. When an ant reaches a junction, it's to decide which part to take next. While strolling, ants deposit pheromone, which marks the course taken. The attention of pheromone on a particular course is an indication of its usage. As time passes, the interest of pheromone decreases due to diffusion effects.

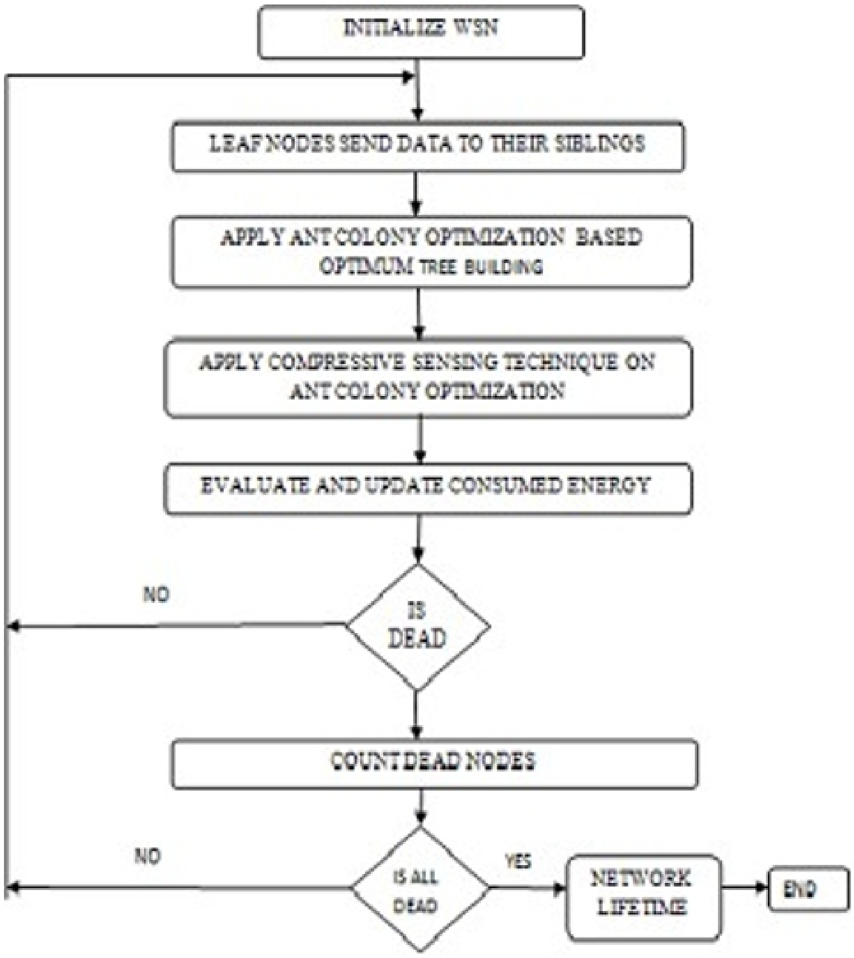


Fig 3. Flow chart of proposed methodology

Step 1: Initialize network

Step 2: Leaf nodes send data to their siblings.

Step 3: Apply Ant colony optimization Based optimum number of trees building for GSTEB Protocol for WSNs

Step 4: Apply Compressive Sensing on Ant Apply Ant colony optimization Based optimum number of trees building for GSTEB Protocol for WSNs.

Step 5: Examine and upgrade the consumed energy.

Step 6: Always check whether all nodes become dead, if sure then display network lifetime and otherwise continue to step 3.

D. EXPERIMENTAL RESULT

On applying recommended compressive sensing based reactive GSTEB routing protocol for Ant Colony Optimization, the below success shall be achieved.

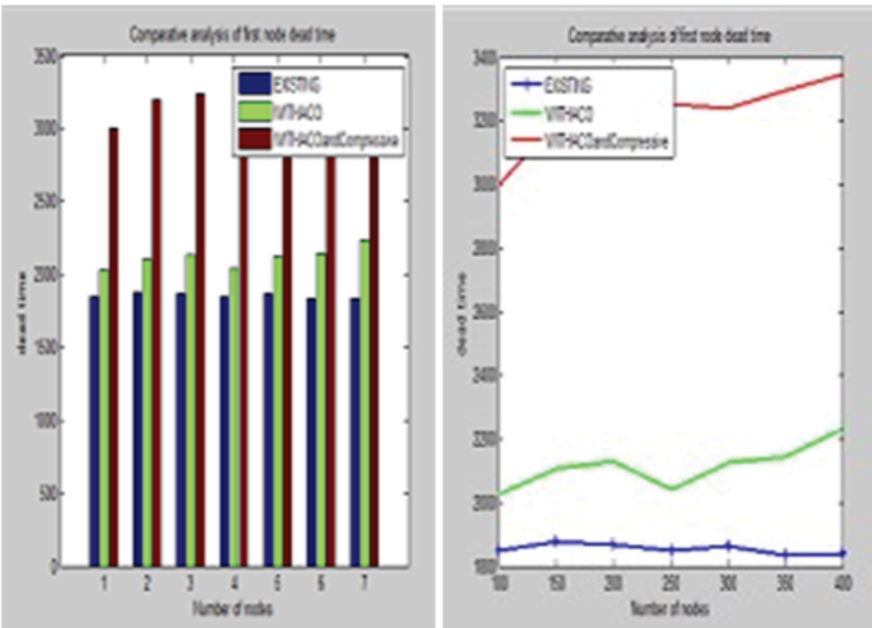
Result in Tabular and graphs

First node dead time (Stable Period Evaluation)

Table1. FIRST NODE DEAD (in sec)

Node	Existing	With ACO	With ACO& Comp.
100	1848	2027	3002
150	1879	2107	3196
200	1867	2132	3242
250	1848	2040	3251
300	1864	2127	3237
350	1833	2144	3294
400	1839	2235	3346

Table 1 shows the comparison among Existing GSTEB, Proposed Ant colony optimization technique to build optimum no. of trees on existing GSTEB and then apply compressive sensing on Ant colony optimization with respect to first node dead time. It clearly shows that in case of proposed GSTEB the number of rounds for first node dead is more than the existing GSTEB.



(a) (b)

Fig.4 First Node Dead time

Fig 4 shows the comparison among Existing GSTEB, Proposed Ant colony optimization technique to build optimum no. of trees on existing GSTEB and then apply compressive sensing on Ant colony optimization with respect to first node dead time. Bar graph and Line graph clearly shows that the number of rounds for first node dead in the case of the proposed are more than the existing GSTEB. It is confirmed that the proposed algorithm is comparatively better than the existing techniques.

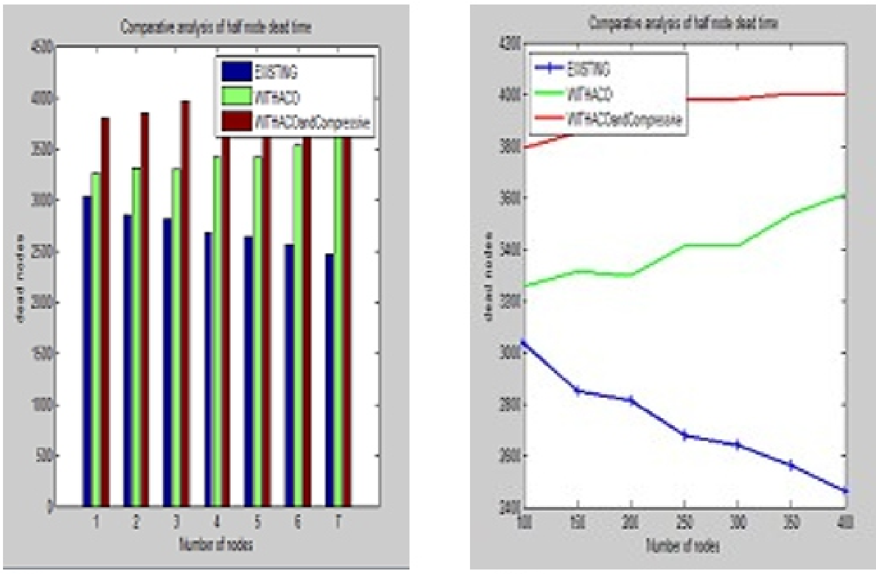
Half node dead time

Table 2 illustrates the comparison among Existing GSTEB, Proposed Ant colony optimization technique to build optimum no. Of trees on existing GSTEB and then apply compressive sensing on Ant colony optimization with respect to half node dead time. It definitely shows that the amount of rounds for half node dead in case of the planned are more compared to Existing GSTEB.

Table2. HALF NODE DEAD (in sec)

Node	Existing	With ACO	With ACO & Comp.
100	3033	3254	3793
150	2848	3311	3851
200	2811	3297	3961
250	2677	3412	3975
300	2639	3415	3982
350	2559	3532	4001
400	2463	3315	3997

Fig 5 displays the comparison among Existing GSTEB, and Proposed Ant colony optimization technique to build optimum no. Of trees on existing GSTEB and then apply compressive sensing on Ant colony optimization with respect to half node dead time. Bar graph and Line graph clearly shows that the number of rounds for half node dead in case of the proposed are more than the Existing GSTEB. It is confirmed that the proposed algorithm is comparatively better than the existing techniques.



(a) (b)

Fig.5 Half Node Dead

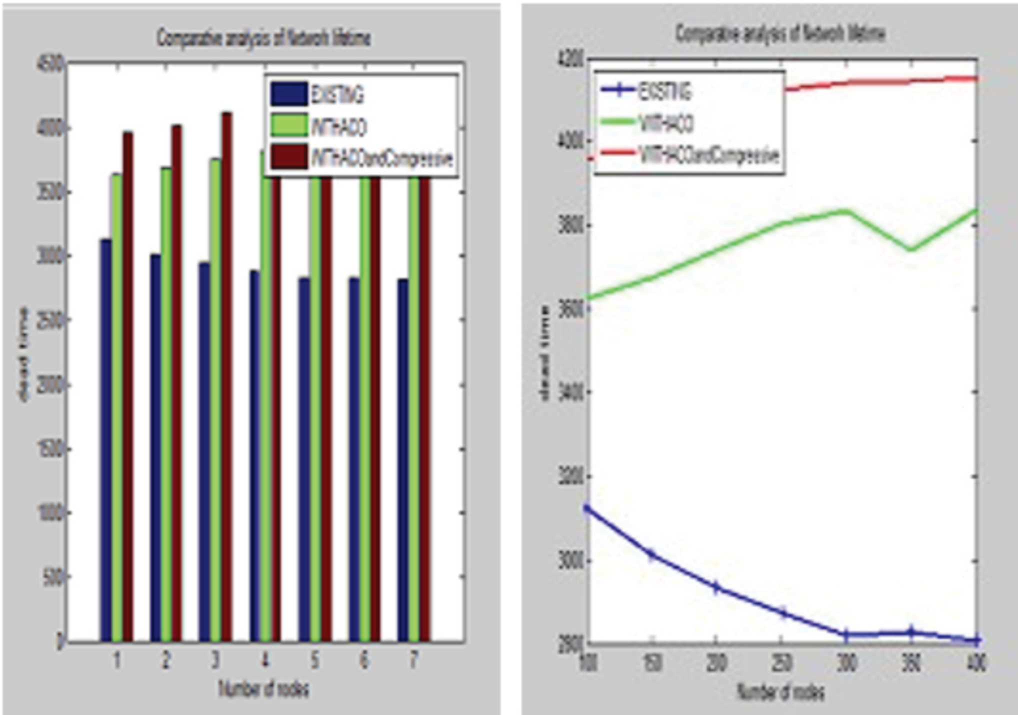
Last node dead time i.e. Network lifetime

Table 3 shows the comparison among Existing GSTEB Proposed Ant colony optimization technique to build optimum no. Of trees on existing GSTEB and then apply compressive sensing on Ant colony optimization with respect to last node dead time. It clearly shows that the numbers of rounds for last node dead in case of the proposed are more than the Existing GSTEB.

Table3. ALL NODES DEAD (in sec)

Node	Existing	With ACO	With ACO& Comp.
100	3121	3263	3958
150	3011	3675	4010
200	2935	3738	4107
250	2873	3807	4123
300	2819	3832	4141
350	2825	3740	4144
400	2807	3839	4151

Fig 10 shows the comparison among Existing GSTEB, Proposed compressive sensing based reactive GSTEB routing protocol and Proposed Ant colony optimization technique to build optimum no. Of trees on existing GSTEB and then apply compressive sensing on Ant colony optimization first node dead time with respect to last node dead time. Bar graph and Line graph clearly displays that the number of rounds for last node dead in case of the proposed are more than the Existing GSTEB. It is confirmed that the proposed algorithm is comparatively better than the existing techniques.



(a) (b)

Fig .6 Last Node Dead

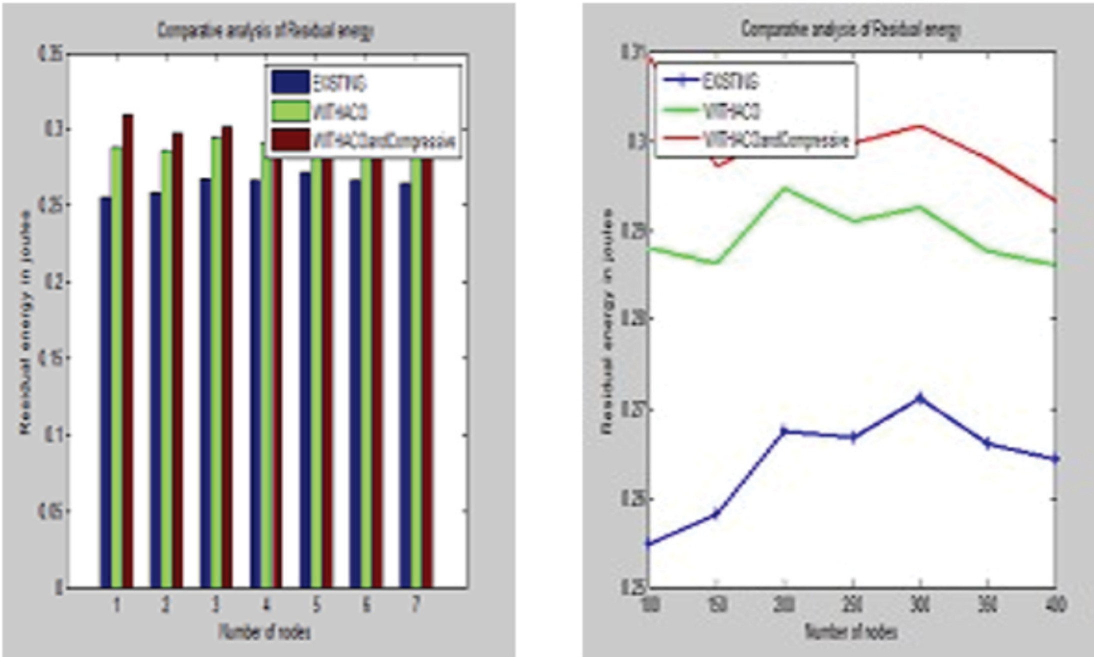
Residual Energy i.e. Remaining Energy

Table 4 shows the comparison among Existing GSTEB, Proposed Ant colony optimization technique to build optimum no. of trees on existing GSTEB and then apply compressive sensing on Ant colony optimization with respect to residual Energy. It shows that in case of proposed GSTEB the number of rounds for residual energy is more than the existing GSTEB.

Table 4. Residual Energy (in sec)

Node	Existing	With ACO	With ACO & Comp.
100	0.2549	0.3762	0.3094
200	0.2674	0.3746	0.301
250	0.2667	0.3985	0.2998
300	0.2712	0.3826	0.3016
350	0.2661	0.2876	0.2979
400	0.2643	0.2861	0.2932

Fig.11 shows the comparison among Existing GSTEB, Proposed compressive sensing based reactive GSTEB routing protocol and Proposed Ant colony optimization technique to build optimum no. Of trees on existing GSTEB and then apply compressive sensing on Ant colony optimization first node dead time with respect to residual energy. Bar graph and Line graph clearly displays that the number of rounds for residual energy in the case of the proposed tend to be more compared to existing GSTEB. It's confirmed that the proposed algorithm is comparatively better than the present techniques.



(a) (b)

Fig. 7 Residual Energy

Packets Sent to Base Station i.e. Throughput

Table 5 shows the comparison among Existing GSTEB, Proposed Ant colony optimization technique to build optimum no. of trees on existing GSTEB and then apply compressive sensing on Ant colony optimization with respect to Throughput. It shows that in case of proposed GSTEB the number of rounds for throughput is more than the existing GSTEB.

Table 5. Throughput (in sec)

Node	Existing	With ACO	With ACO & Comp.
100	8.3315	15.1915	16.2862
150	16.9572	21.9361	24.3588
200	19.483	29.2744	30.8788
250	31.5678	35.9856	40.3475
300	36.1089	42.4967	47.7125
350	49.1355	52.3585	55.5846
400	57.9323	60.4928	63.7146

Fig 12 shows the contrast among Existing GSTEB, Proposed compressive sensing based reactive GSTEB routing protocol and Proposed Ant colony optimization technique to build optimum no. Of trees on existing GSTEB and then apply compressive sensing on Ant colony optimization first node dead time with respect to throughput. Bar graph and Line graph clearly displays that the number of rounds for packets sent to Base Station in case there is the proposed are more compared to existing GSTEB. It's proved that the proposed algorithm is relatively much better than the present techniques.

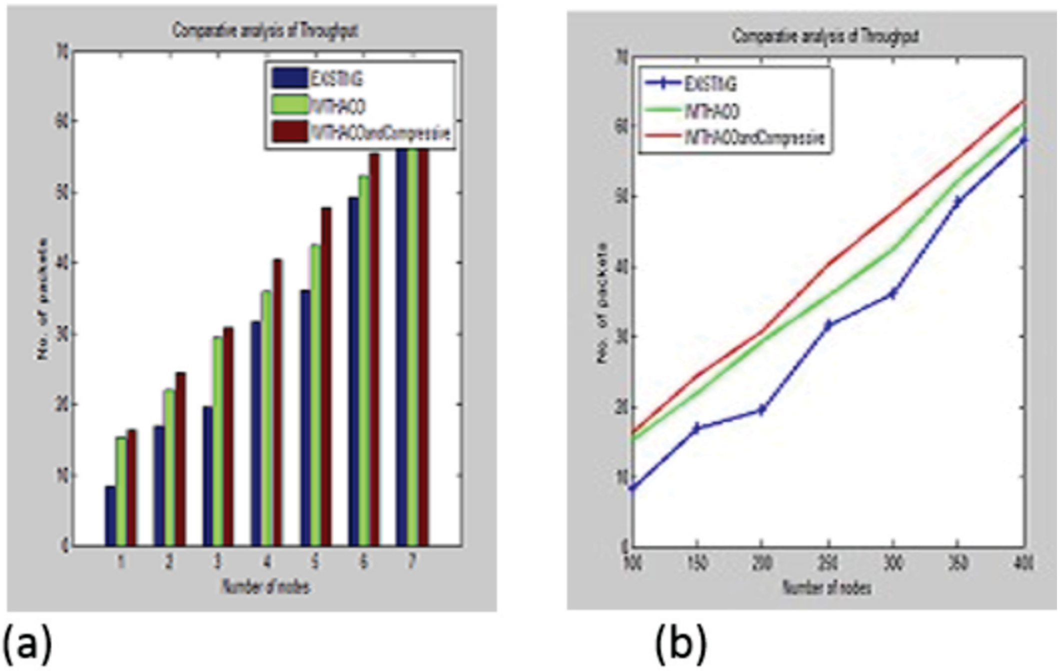


Fig.12 Throughput

E. CONCLUSION

The proposed technique was made and applied in the MATLAB tool. In that report, the ant colony optimization for perfect quantity of trees developing is applied also the aftereffect of the compressive detecting has been revealed by the GSTEB routing protocol. The different metrics will also be used to evaluate the development of the proposed technique around GSTEB.

REFERENCES

[1] Dilip Kumar; 2014; Performance analysis of energy efficient clustering protocols for maximizing lifetime of wireless sensor networks; Wireless Sensor Systems IET; 4; 9-16.

[2] Dutta, Raju, Gupta Shishir, and K.Das Mukul; 2002; Power consumption and maximizing network lifetime during communication of sensor node in WSN; Procedia Technology; 4; 158-162.

[3] Faiza Nawaz and Ahmed Bazaz Shafat; 2010; Lifetime optimization of Wireless Sensor Network through energy efficient clustering for robust data routing; 2nd IEEE International Conference on Computer Technology and Development (ICCTD); 235-239.

[4] Guo, Jianghong, Zhang Haifeng, and Chen Weijun; 2012; Location-based Inner-Cluster Data Aggregation for Wireless Sensor Networks; AASRI Procedia 3; 523-527.

[5] Li, Nan, Li Shangru and Fang Xiaozhou;2010; Adaptive data aggregation mechanism based on leach protocol; International Conference on Advanced Intelligence and Awareness Internet; pp. 131-134.

[6] Lindsey, Stephanie, and S. Raghavendra Cauligi; 2003; PEGASIS: Power-efficient gathering in sensor information systems; Aerospace conference proceedings IEEE; Vol-3.

[7] Lu, Yao, Chen Jianping, Cosma Ioan , kuonen Pierre and Hirsbrunner Beat; 2014; Construction of Data Aggregation Tree for Multi-objectives in Wireless Sensor Networks through Jump Particle Swarm Optimization; Procedia Computer Science 35; 73-82.

[8] Mathapati, S. Basavaraj, Patil Siddarama, and Mytri V.D; 2012; A cluster based Energy Efficient Reliable Routing Protocol for Wireless Sensor Networks; 1st IEEE International Conference on Emerging Technology Trends in Electronics, Communication and Networking; pp. 1-6.

[9] Peng Ji, Li Yupeng, Jiang Jingqi, and Wang Tianbao; 2012; A Clustering Protocol for Data Aggregation in Wireless Sensor Network; Proceedings of the IEEE International Conference on Control Engineering and Communication Technology; 649-652.

[10] Sangolgi, B. Nagaveni, and Khaja Ahmeduddin Zakir Syed; Energy Aware Data Aggregation Technique in WSN; International Journal of Scientific and Research Publications: 376.

[11] Seeniselvi T. Mrs and Shanmugapriya I.; 2014; Artificial Bee Colony Algorithm Based Delay Energy Efficient Sleep Scheduling in WSN; International Journal; 3; 2.

[12] Tan, Ozgur Huseyin, and Korpeoglu Ibrahim; Power efficient data gathering and aggregation in wireless sensor networks; ACM Sigmod Record 32.4; 66-71.

[13] Younis, Ossama, Krunz Marwan, and Ramasubramanian Srinivasan; 2006; Node clustering in wireless sensor networks recent developments and deployment challenges Network; IEEE No. 3; pp. 20-25.

Routing Protocols In Delay Tolerant Network (DTN): A Critical Study And Comparison

Nirbhay K.Chaubey[1],Pooja Mistri[2]
[1]*Department of Computer Science, Institute of Science and Technology for Advanced Studies and Research, VallabhVidyanagar- 388120, Gujarat, India nirbhay@ieee.org*
[2]*Gujarat Technological University, PG School Ahmedabad-382424, Gujarat, India poojamistri1045@gmail.com*

A B S T R A C T

Delay tolerant Network (DTN) became more popular in the research area recently, because of its application. It is a wireless network that communicate with the nodes by storing the message packets in the bundle temporally and whenever relay node or the intermediate node have the chance to send the message to the other node that just encountered by the relay node. The mechanism use for the DTN routing is the store-carry and forward approach. Main challenge for the DTN routing is that it discovers the route through the network without an end to end path so nodes in the network connect to the other nodes instantly. This paper review about DTN, types of routing techniques and its issues, some popular routing protocols and their performance in terms of Delay, message Delivery rate, Overhead, Controlling the number of replications of the node.

Keywords—DTN, Number of Replication, PRoPHET, Spray and wait

I. DELAY TOLERANT NETWORK

In today's world, Due to internet many of devices (computers, Mobiles) are communicating with each other in all around the world. For the humans better and easy life the technologies are increasing everyday communications so networks are emerging that are different and more Massive. The networks (MANETs VANETs, Wireless Sensor Networks (WSN)) have given new opportunities for the different types of applications. There are number of networks used in connecting and communicating with different devices and it is only possible by some set of protocols known as TCP/IP protocol suite. Principle on which TCP/IP works is based on end-to- end data transfer. However, there are many regions where the assumptions of the internet cannot be satisfied. If at any environment where there is no path between the sources to destination, then TCP/IP fails to work properly or might even stop working completely. Because of such circumstances, a newer network has evolved which is independent end to end connectivity between nodes. This network is called as Delay Tolerant Networks (DTN). DTN has different characteristics from the other wireless networks like intermittent connectivity, low error rates or link failure and large delay [1]. In the environments like disaster relief with limited range of radios, sensing the environment, military purpose, deep space communication, underwater sensing, inter vehicle communication.

In the wildlife monitoring the remote areas have to face low density of the nodes. By the type of networks the devices is not able to establish full connected network from source to the destination for routing the data and due to this the thought of the new network DTN is emerging in the mobile network and vehicular network and others according to the application and environment.

Delay Tolerant Network (DTN) is a set of emerging networks that has extremely different characteristics from the other wireless network and internet. E.g. The intermittent connectivity, Large Delays, Low error rates [1] Mostly Large Delay and frequent partitions are there so may be up-to-date information for the stable network is not available so Data transmission is the main issue for the DTN. This is caused by the high mobility and the density of the nodes is very low. This kind of characteristics make the routing difficult in the DTN[1] exist solutions do not work in the environment like DTN networks because assumption is taken for the network is stable and the link failures are infrequent between the nodes. Therefore efficient routing is the still research area in DTN [1].Delay/ Disruption tolerant networks (DTN) also called as intermittently connected mobile networks (ICMN), are wireless networks where the high mobility and low density of the nodes in the network at any given time instance, the probability that there is an end-to-end path from a source to a destination is low[1][2] Delay (or disruption) tolerant networking, provides an alternative approach for a various wireless environments that challenge the limitations of the transport and routing layers in the TCP/IP model. TCP/IP based Internet routing [3] where end-to-end path exists between peers, end-to-end packet drop problem is small and Low delay path between source to destination. DTN routing usually follows store-carry-and- forward; i.e., after receiving some packets, a node stores and carries them around until it contacts another node and then forwards the packets. Since DTN routing relies on mobile nodes to forward packets for each other, the routing performance (e.g., the number of packets delivered to their destinations) depends on whether the nodes come in contact with each other or not.

DTN routing protocols application specific and lacks the support for dynamic situation. There by giving an opportunity to contribute towards building dynamic routing. This raises question:

1. How many copies to be replicated in network?
2. How the message replicate in the network?

An answer to above mentioned questions demands clearly place to efficiency in routing environment. Therefore, dynamic routing protocol is required to satisfy the need and routing objectives.

This paper is organized as follows: - Section II introduces the concept and architecture of DTN. Section III presents classification of routing protocol. Some important routing protocols of DTN are discussed in Section IV. Section V contains routing issues. Table 1analyzed and compared various routing technique proposed by the other researcher to solve routing issues in DTN. Finally, Section VI concludes the paper followed by future work.

II. CONCEPT AND ARCHITECTURE OF DTN

A Delay Tolerant Network can be considered as an enhancement of the existing regional networks. This enhanced feature is called as the bundle layer. This layer is intended to function above the existing protocol layers and provide the function of a gateway when two nodes come in contact with each other. The main advantage of this kind of protocol is flexibility. It can be easily linked with the already existing TCP/IP protocol networks or can be used to link two or more networks together [1-4]. The place of the bundle layer can be seen above the transport layer in the Fig. 1

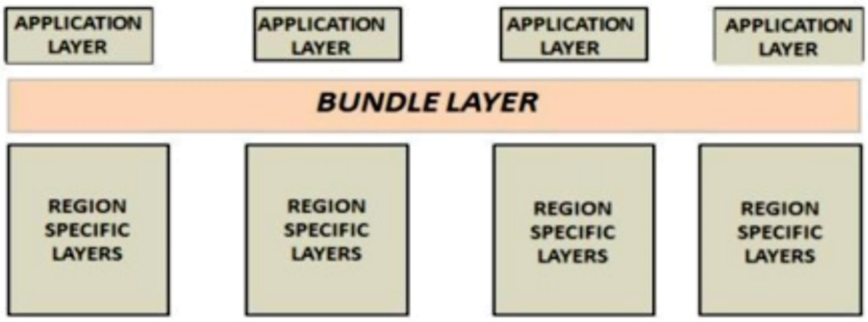


Fig.1The Position of the bundle layer [Thesis 1]

Bundles are the messages of nodes. By storing and forwarding entire bundles between nodes for the transfer of data from one node to another can be made reliable. The bundles contain source node ID and destination node ID, Time to Live-control information (TTL) and a bundle header. Whole bundles stores and transmit by the bundle layer between different nodes. The layers lower the bundle layers are selecting for their correctness to the communication environment of each filed. In DTNs at any given instant, there may not be any route to the next hop. In this case, the node must buffer the message in persistent storage, until a contact becomes available. Once the next hop stores the bundle in persistent storage, it is said to have taken custody of the bundle, and the node that have sent the message can delete its own copy of the bundle. Instead of waiting for the next hop to become available, the DTN gateways may themselves be mobile. Each node is associated with a persistent storage device like hard disk, where it can store the messages. It is called as persistent storage as it can store the message for amount of time. The persistent storage can be useful in situations when the next node is not available for a very long time, or when the rate of incoming messages is far higher than the rate of outgoing messages [4]

III. CLASSIFICATION OF ROUTING PROTOCOLS

The existing routing protocols in DTNs are classified with respect to their strategies for controlling message copies and forwarding decision of message to the destination [5]

Number of destination: According to the number of destinations nodes to forward messages and routing can be classified into the three categories:

1) **Unicast Routing:** Only one destination for the each message.

2) **Multicast Routing:** Destinations node could be one or group of destination nodes for the each message

3) **Broadcast Routing:** All the nodes are the destination for the each message.

Number of copy: Depending on the number of copies utilized in the routing process the routing protocol can be classified into the two categories:

1) **Single-copy routing protocols:** Only a single copy for each message exists in the network at any time.

2) **Multiple-copy routing protocols:** Multiple copies of same message can be generated and distributed into the network. Moreover, multiple copy routing protocols can be further divided into flooding-based and quota based.

a) **Flooding-based routing protocol:** Dissemination or broadcast a copies of each message to as many nodes as possible.

b) **Quota-based routing protocol:** It limits the number of message copies to flood in the network.

Available Network knowledge: Whether the forwarding decision is based on the knowledge derived from the nodes' encounters or not or from their history, protocols can as well be classified into two categories:

1) **Deterministic routing protocol:** Complete knowledge of node history encounter probability of nodes and node meeting times and period to make the forwarding decision

2) **Non-deterministic routing protocols:** Zero knowledge of pre-determined path between source and destination. These algorithms either forward the messages randomly or prediction based.

IV. POPULAR ROUTING PROTOCOL OF DTN

In this section, some important routing protocols and their strategies for their routing in DTN are deliberated.

Earlier in 2000, Vahdat and Becker et al. proposed Epidemic Routing Protocol, a flooding-based forwarding algorithm [4].In this Routing, The node in the network which receives the message then it forward a copy of it to the all the node that node encounters so that the message is spread in the whole network by the moving or mobile nodes and in the all the nodes have the same data. Although, the guarantee of the delivery of the message is not provided. This routing is the best approach to reach to the destination. Each message has the unique identifier which stored in the buffer and list of them is called as the summary vector. When the two proximal nodes get contact with each other then they exchange and summarize the summary vector and compare which message they do not have and after that request for the message to the node. When the counter of the packet reaches to the zero then packet is discarded and other approach is to set the Time- to-live (TTL) for each packet in the routing. The packet would copy from one to the other node till the TTL expires. It is useful when there is lack of information regarding network topology and nodes mobility patterns [6]

Earlier in 2004, A. Lindgren, A. Doriaet.al. proposed probabilistic routing protocol using history of encounter and transitivity (PROPHET). In the routing it assumed that the mobile nodes used to pass to the some locations more than the others so passing through the previously visited location's probability are high than the other so this approach is implied in the routing scheme [7]. So from that approach the node will meet the other node more preferably in the future which they met each other in the past.

The major concern of this routing protocol is to improve the delivery predictability and reduce the wastage of the resources in the epidemic routing. In this scenario, initially in the network it will estimate the probabilistic metric for each known node. Delivery predictability (a,b) $\in$ [0,1] for the node A for the each known destination B. whenever the nodes a node encounters with the other nodes then they exchange summary vectors as same as the epidemic routing .This summary vector contain the delivery predictability values for the destinations for the each node. The calculations of delivery predictabilities of nodes have three parts. Nodes update their delivery predictability metrics whenever meet each other. Visiting more nodes would be that high delivery predictability values. The calculation for that is shown in the equation 1.

$$P(a,b) = P(a,b)_{old} + (1 - P(a,b)_{old}) \times P_{init}. \quad \text{Eq. 1}$$

(Where Pinit is initialization constant)

In the conventional routing protocols that discover the route and forward the packet to the destination on the basis of the shortest path or the lower cost, on the other hand, in the PROPHET whenever the node receives the message there no path to the destination and node carry the message in the buffer and forward it to the encountered node. The limitation of the PROPHET routing is that whenever node meets with the low delivery predictability then there is no guarantee that it would meet the other with higher predictability value during the message life time. The basic difference of Prophet than Epidemic Routing is its forwarding strategy, when two nodes meet, Prophet allows the transfer of a message to the other node only if the delivery predictability of the destination of the message is higher at the other node

Earlier in 2005, T. Spyropoulos, K. Psouniset.al. proposed Spray and Wait (SW) Routing Protocol. This is the replication based routing proposed which control the spreading of messages in the network. The spray and wait protocol assume to have no knowledge of the network topology and mobility of the nodes whether it is random or the repetitive behavior. It just forward the multiple copies of the messages using the flooding [8] The difference between epidemic routing and spray and wait is just that it only spreads the limited number of copy (L)message. This routing consists of two routing:

1) **Spray Phase:** In this phase according to the network limited number of copy (L) of messages are spread over the network by the source and other nodes will receive the copy of the message.

2) **Wait Phase:** After the spreading the copies the all copies of the message is done and the destination node is not encountered with the copy of the message in the spray phase then each of nodes carrying the copies try to send their own copy to destination via direct transmission.

To enhance form of spray and wait is the binary S&W. According to binary spray and wait, the source node creates L copies of the original message and then, whenever the node is encountered, communicate half of them to it and keeping the remained copies. This process is continued with other relay nodes until only one copy of the message is left. When this happens the source node waits to meet the destination directly to carry out the direct transmission.

Different methods limiting the number of distributed messages and reduce resource consumption in intermediate nodes but often better performance result compared to the epidemic routing protocol.

V. ROUTING ISSUES IN DTN

In this section some of the important routing issues of DTN are discussed.

Buffer space: Due to Intermittent connectivity, messages must be buffered for long periods and next node in the communication require enough buffer space to store all the messages that are waiting for future communication opportunities. Hence, intermediate nodes require sufficient buffer space to store all pending messages as per opportunities.

Energy: In DTN, due to the mobility of nodes, energy of the nodes kept wasting this leads to low level of energy. During sending, receiving and storing of messages, nodes required sufficient energy. Therefore, designing energy-efficient routing protocols is one of the challenging issue important to carry our research work.

Processing Power: One of the goals of delay-tolerant networking is to connect devices that overcome the limitation of the traditional networks. These devices may be very small having small processing capability, in terms of CPU and memory. These nodes will not be working for the some routing protocols because of power consumption.

Reliability: Some acknowledgment should be there for reliable delivery of data. If any routing protocol this ensures successful and stable delivery of data. For example, when a message correctly reaches to a destination, some acknowledgement messages should be sent back from destination to sources for confirmation.

Security: Security is always a significant issue. A message may pass through intermediate nodes randomly before reaching its final destination. Depending on the security requirements of applications, users may require secure guarantees about the authenticity of a message. The cryptographic techniques may be beneficial for secure intermediate routing.

Different researchers have come up with different approaches to solve the issues of routing in DTN, but none of the existing approaches offers a concrete solution against these issues. Due to resource limitation, proposed system drawback there is a need for a new routing proposal that provides higher message delivery rate and with minimum resources used and processing overhead.

Table 1.Comparisons analysis of various technique proposed by the researcher to solve Routing Issues in DTN

Researchers	Based on/ Approach	Objective	Replication Control	Advantages	Disadvantages
Eung-Hyup Kim et al. ICOIN 2014 [9]	Based on spray and wait	Copies messages to a node with high probability of data delivery using data delivery probability with PROPHET protocol	Yes	Prevent any unnecessary spray in an existing spray and wait so buffer space is not wasted and message arrival rate is increased	Delay is more than the S&W
TomoakiMiyakawa et al. 2015 29th Inter-national Conference on Advanced Information Networking and Applications Workshops[10]	Based S&W and PRoPHET	Combines S&W and PRoPHET so that S&W restricts the number of replications and PROPHET compare the delivery predictability of the replicated node and destination node	Yes	High message delivery rate can be achieved which raise the performance of the network	Overhead is more than the S&W
PriyankaDaset al. 2012 2nd IEEE International Conference on Parallel, Distributed and Grid Computing[11]	Based on the credit , a value assigned to a node each time it gets connected to another node	Anodethat receives the message earlier will have greater probability of reaching the destination in time with low cost	Yes	-Message delivery rate is greater than the single message method and at the same time reduces the number of replications. -Less costly than other protocols	Delivery capability is less than the EPR.

PhearinSok, KeecheonKim. *Distance-based PRoPHET Routing Protocol in DTN ICTC 2013* [13]	Based on PRoPHET with distance metric	When delivery predictability is equal for the two nodes. It computes the distance of the node from the physical layer and store value in the share registry	No	Bundle delivery ratio is increased and the bundle delay is decreased during delivery	Delay will be more than PRoPHET
Lee and Nam et al. ICOIN 2015[14]	Based on PRoPHET, PRoPHETv 2 with contact duration	If two nodes are encountering frequently then the probability of that nodes increases in the short period of time. PROPHETV2 is there with contact duration consideration.	No	Higher delivery ratio and low overhead then PRoPHET in terms of bandwidth and the average message size.	Number of replication to be is not considered
Samuel C. Nelsonet al. *Encounter–Based Routing in DTNsIEEE INFOCOM 2009[15]*	Encounter-based Routing (EBR), a quota-based DTN routing protocol	Predicts the future rate of node that encounters can be roughly predicted by past data	Yes	Minimize the delay and overhead and message delivery rate is increased also battery consumption is less	Analysis of parameter for variance number of replicas for all nodes is not considered
Wang and Shuet al. 2009 Fifth International Conference on Mobile Ad-hoc and Sensor Networks[16]	Based on Epidemic Routing	ARER counts the forwarding predictability according to the metrics Replication Density based on the quantity of the replications Also assigns the weight function to the message Replication Density ,TTLof the message and delivery predictability	Yes	Message copies send is less and message delivery rate is more than EPR and other routing protocol	Delay would be more than S&W if the number of copies are less

Shou-Chih Lo et al. 2012 9th International Conference on Fuzzy Systems and Knowledge Discovery (FSKD 2012) [17]	Replication routing technique and a message moving technique to provide good Congestion control	Information about Buffer occupancy and delivery probability of node exchange to all nodes to control congestion	Yes	Used in all routing protocols for congestion control	It does not consider the parameter of delivery ratio and delay other than the congestion control and depends upon the integrated protocol
Liu and Tang et al. *2012 International Conference on Computer Science and Service System [18]*	Based on S&W with relay probability (R-ASW)defines from energy and probability of nodes.	If the forwarding probability of the relay node is greater than the current node so relay node carry more packets	Yes	Improves the delivery ratio and reduces the delay and overhead	Compared only with S&W
Xiang FaGuo et al. 2013 IEEE International Conference on Sensing, Communications and Networking (SECON) [19]	Based on link transmission of connection is quality strong or weak	If message sent to the strong link is more deliverable than the weak link. Replication control can substitute over the strong link and how the strong and weak link is defined.	Yes	Much lower overhead is there compared to S&W Transmission latencies is low	Weak links are defined by the assumption that contacts are independent and identically distributed which does not fits in the real world scenario
XinWanget al. Mobile Tendency Based Hybrid Routing for Partially Connected Networks [21]	Based on mutli- hop neighbor discovery mechanism. Find end-to-end path and the partial path in the network.	If end to end path is not found then data will be stored in the buffer and it will replicate the message and send it to the relay according to the opportunities	No	Packet delay and delivery outperforms then the EPR,S&W and DFR	It is not highly modular for DTN system and geographical routing is not considered

Xue and Fan et al. *2009 International Conference on Networks Security, Wireless Communications and Trusted Computing* [22]	Based on S&w and Binary S&W	It counts the average delivery of the nodes and according to that it will send the replication to the n nodes using BSW routing	No	It have slight higher average delivery rate and short average delay	There is not major difference between BSW and if number of copies less

VI. CONCLUSION AND FUTURE WORKS

Several existing routing protocols of DTN and their important issues are studied in this paper. Due to the unique characteristics of DTN, it creates a number of consequential challenges to its efficient routing design. To overcome the challenges, there is a need to design a new routing protocol that can control the number of replication of the message to the encountered node and give better performance than the existing protocols in terms of delay, overhead and increasing the message delivery rate.

Our immediate future plan is to evaluate the existing routing protocols of DTN and then propose a new routing technique which can control the number of replication of the message to the encountered node and give better performance.

VII . REFERENCES

[1] Kevin Fall, "A Delay-Tolerant Network Architecture for Challenged Internets" SIGCOMM'03, August 25-29, 2003, Karlsruhe, Germany. Copyright 2003 ACM

[2] UpendraShevade, Han Hee Song, LiliQiu, Yin Zhang "Incentive-Aware Routing in DTNs" IEEE ICNP 2008

[3] V. Cerf, S. Burleigh, A. Hooke, L. Torgerson, R. Durst, K. Scott, K. Fall, H. Weiss, Delay-Tolerant Network Architecture, DTN Research Group Internet Draft, 2003.

[4] A. Vahdat and D. Becker. Epidemic routing for partially connected ad hoc networks. Technical Report CS-200006, Duke University, April. 2000.

[5] Shally, Harminder Singh Bindra, MamtaGarg," PERFORMANCE EVALUATION OF RAPID AND SPRAY-AND-WAIT DTN ROUTING PROTOCOLS UNDER BLACK HOLE ATTACK" IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163| pISSN: 2321-7308,Jan 2014 , Volume: 03 Issue: 01

[6] R. S. Mangrulkar, Dr. Mohammad Atique, "Routing Protocol for Delay Tolerant Network: A Survey and Comparison" ICCIT- 2010

[7] A. Lindgren, A. Doria, and O. Schelen, "Probabilistic routing in intermittently connected networks," in The First Internation al Workshop on Service Assurance with Partial and Intermittent Resources (SAPIR), 2004.

[8] T. Spyropoulos, K. Psounis, and C. S. Raghavendra, "spray and wait: an efficient routing scheme for intermittently connected mobile networks," in Proc. of the ACM SIGCOMM Workshop on Delay- Tolerant Networking (WDTN), 2005.

[9] Eung-Hyup Kim, Jae-Choong Nam, Jae-In Choi, You-Ze Cho, "Probability-based Spray and Wait Protocol in Delay Tolerant Networks"IEEE Information Networking (ICOIN), 2014 International Conference on,2014

[10] TomoakiMiyakawa and Akio Koyama "A Hybrid Type DTN Routing Method Using Delivery Predictability and Maximum Number of Replication", 2015 29th International Conference on Advanced Information Networking and Applications WorkshopsIEEE,2015
[11] Priyanka Das, KavitaDubey and Tanmay De "Credit Based Routing in Delay Tolerant Networks" 2012 2nd IEEE International Conference on Parallel, Distributed and Grid Computing,IEEE,2012
[12] Priyanka Das, KavitaDubey and Tanmay De "Routing in Delay Tolerant Networks Using Credit Based Spraying" 2012 2nd IEEE International Conference on Parallel, Distributed and Grid Computing,IEEE,2012
[13] PhearinSok, Keecheon Kim "Distance-based PRoPHET Routing Protocol in Disruption Tolerant Network" ICTC 2013,IEEE,2013
[14] Samuel C. Nelson, MehediBakht, and Robin Kravets "Encounter–Based Routing in DTNs"IEEE INFOCOM 2009.
[15] Ho-Jong Lee, Jae-Choong Nam, Won-KyeongSeo, You-Ze Cho, and Soong-Hee Lee, "Enhanced PRoPHET Routing Protocol that Considers Contact Duration in DTNs" , ICOIN 2015,IEEE, 2015
[16] in Wang, YantaiShu, Zhigang Jin, QingfenPan,Bu sung Lee, "Adaptive Randomized Epidemic Routing for Disruption Tolerant Networks" 2009 Fifth International Conference on Mobile Ad-hoc and Sensor NetworksIEEE,2009
[17] Shou-Chih Lo, Chuan-Lung Lu, "A Dynamic Congestion Control Based Routing for Delay-Tolerant Networks" 2012 9th International Conference on Fuzzy Systems and Knowledge Discovery (FSKD 2012),IEEE,2012
[18] Jun Liu, Meisi Tang, Geng Yu, "Adaptive Spray and Wait Routing based on Relay-Probability of Node in DTN"2012,IEEE
[19] Xiang FaGuo, MunChoonChan,"Plankton: An Efficient DTN Routing Algorithm", 2013 IEEE International Conference on Sensing, Communications and Networking (SECON)]
[20] Xin Wang, YantaiShu, Zhigang Jin and Huan Chen, "Directional Forward Routing for Disruption Tolerant Networks", in Proceedings of the 2009 Asia-Pacific Conference on Communications (APCC'09), Shanghai, China, Oct. 2009
[21] Xin Wang, YantaiShu, "Mobile Tendency Based Hybrid Routing for Partially Connected Networks", National Natural Science Foundation of China (NSFC) ,2012,IEEE
[22] JingfengXue, Xiumei Fan, Yuanda Cao, Ji Fang, Jiansheng Li "Spray and Wait Routing Based on Average Delivery Probability in Delay Tolerant Network" 2009 International Conference on Networks Security, Wireless Communications and Trusted Computing,IEEE
[23] Delay Tolerant Networking Research Group: http://www.dtnrg.org/
[24] F.Warthman. Delay Tolerant Networks – A Tutorial. 2003.
[25] Md. RAIYAN ALAM, B.tech Thesis "ROUTING IN DELAY TOLERANT NETWORKS", National Institute of Technology Rourkela

Instructions for Authors

Essentials for Publishing in this Journal

1 Submitted articles should not have been previously published or be currently under consideration for publication elsewhere.

2 Conference papers may only be submitted if the paper has been completely re-written (taken to mean more than 50%) and the author has cleared any necessary permission with the copyright owner if it has been previously copyrighted.

3 All our articles are refereed through a double-blind process.

4 All authors must declare they have read and agreed to the content of the submitted article and must sign a declaration correspond to the originality of the article.

Submission Process

All articles for this journal must be submitted using our online submissions system. http://enrichedpub.com/ . Please use the Submit Your Article link in the Author Service area.

-

Manuscript Guidelines

The instructions to authors about the article preparation for publication in the Manuscripts are submitted online, through the e-Ur (Electronic editing) system, developed by **Enriched Publications Pvt. Ltd**. The article should contain the abstract with keywords, introduction, body, conclusion, references and the summary in English language (without heading and subheading enumeration). The article length should not exceed 16 pages of A4 paper format.

Title

The title should be informative. It is in both Journal's and author's best interest to use terms suitable. For indexing and word search. If there are no such terms in the title, the author is strongly advised to add a subtitle. The title should be given in English as well. The titles precede the abstract and the summary in an appropriate language.

Letterhead Title

The letterhead title is given at a top of each page for easier identification of article copies in an Electronic form in particular. It contains the author's surname and first name initial .article title, journal title and collation (year, volume, and issue, first and last page). The journal and article titles can be given in a shortened form.

Author's Name

Full name(s) of author(s) should be used. It is advisable to give the middle initial. Names are given in their original form.

Contact Details

The postal address or the e-mail address of the author (usually of the first one if there are more Authors) is given in the footnote at the bottom of the first page.

Type of Articles

Classification of articles is a duty of the editorial staff and is of special importance. Referees and the members of the editorial staff, or section editors, can propose a category, but the editor-in-chief has the sole responsibility for their classification. Journal articles are classified as follows:

Scientific articles:

1. Original scientific paper (giving the previously unpublished results of the author's own research based on management methods).

2. Survey paper (giving an original, detailed and critical view of a research problem or an area to which the author has made a contribution visible through his self-citation);

3. Short or preliminary communication (original management paper of full format but of a smaller extent or of a preliminary character);

4. Scientific critique or forum (discussion on a particular scientific topic, based exclusively on management argumentation) and commentaries. Exceptionally, in particular areas, a scientific paper in the Journal can be in a form of a monograph or a critical edition of scientific data (historical, archival, lexicographic, bibliographic, data survey, etc.) which were unknown or hardly accessible for scientific research.

Professional articles:

1. Professional paper (contribution offering experience useful for improvement of professional practice but not necessarily based on scientific methods);
2. Informative contribution (editorial, commentary, etc.);
3. Review (of a book, software, case study, scientific event, etc.)

Language

The article should be in English. The grammar and style of the article should be of good quality. The systematized text should be without abbreviations (except standard ones). All measurements must be in SI units. The sequence of formulae is denoted in Arabic numerals in parentheses on the right-hand side.

Abstract and Summary

An abstract is a concise informative presentation of the article content for fast and accurate Evaluation of its relevance. It is both in the Editorial Office's and the author's best interest for an abstract to contain terms often used for indexing and article search. The abstract describes the purpose of the study and the methods, outlines the findings and state the conclusions. A 100- to 250-Word abstract should be placed between the title and the keywords with the body text to follow. Besides an abstract are advised to have a summary in English, at the end of the article, after the Reference list. The summary should be structured and long up to 1/10 of the article length (it is more extensive than the abstract).

Keywords

Keywords are terms or phrases showing adequately the article content for indexing and search purposes. They should be allocated heaving in mind widely accepted international sources (index, dictionary or thesaurus), such as the Web of Science keyword list for science in general. The higher their usage frequency is the better. Up to 10 keywords immediately follow the abstract and the summary, in respective languages.

Acknowledgements

The name and the number of the project or programmed within which the article was realized is given in a separate note at the bottom of the first page together with the name of the institution which financially supported the project or programmed.

Tables and Illustrations

All the captions should be in the original language as well as in English, together with the texts in illustrations if possible. Tables are typed in the same style as the text and are denoted by numerals at the top. Photographs and drawings, placed appropriately in the text, should be clear, precise and suitable for reproduction. Drawings should be created in Word or Corel.

Citation in the Text

Citation in the text must be uniform. When citing references in the text, use the reference number set in square brackets from the Reference list at the end of the article.

Footnotes

Footnotes are given at the bottom of the page with the text they refer to. They can contain less relevant details, additional explanations or used sources (e.g. scientific material, manuals). They cannot replace the cited literature.

The article should be accompanied with a cover letter with the information about the author(s): surname, middle initial, first name, and citizen personal number, rank, title, e-mail address, and affiliation address, home address including municipality, phone number in the office and at home (or a mobile phone number). The cover letter should state the type of the article and tell which illustrations are original and which are not.

Notes: