Volume 5, Issue 1, January 2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Need of Enhancement in the Routing Metrics of WSN

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Abstract: The Network performance is directly linked to the routing protocol in place and the metric it uses to optimize specific network performance aspects [2]. The widely used applications that are based on the Wireless Sensor Networks make the use of WSN generated data which has led to the design of WSN architectures and systems. Different Quality of Service requirements by applications focus on the use of appropriate routing metrics to decide the optimized data path [13].

Routing effectively and efficiently is an important task for all networks, especially for wireless networks. WSNs are still not affective due to lack of affective routing and shortage of power backups. Development of affective routing protocols will help in more affective WSN networks leading to more useful information system. Routing protocol metrics discussed in base paper are basic protocols metrics that help in identifying routing effectiveness of a protocol. However, there might be more enhanced metrics required for developing effective protocols. Review of papers states that in future more appropriate routing metric can be identify which satisfy future requirement. Routing metrics would be enhanced by using different approaches like lexical and additive combination approach.

Keywords— Routing metrics, WSN, sensor node, combination approaches, Routing protocols

I. INTRODUCTION

WSN

A wireless sensor network is a collection of nodes organized into a cooperative network. Each node consists of processing capability (one or more microcontrollers, CPUs or DSP chips), may contain multiple types of memory (program, data and flash memories), have a RF transceiver (usually with a single omni-directional antenna), have a power source (e.g., batteries and solar cells), and accommodate various sensors and actuators. The nodes communicate wirelessly and often self-organize after being deployed in an ad hoc fashion [9].

WSN is spatially dispersed sensor nodes for monitoring and recording the physical conditions of the environment and organizing the collected data at a central location. WSN measure environmental conditions like temperature, sound, pollution levels, humidity, wind speed and direction, pressure, etc.

The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

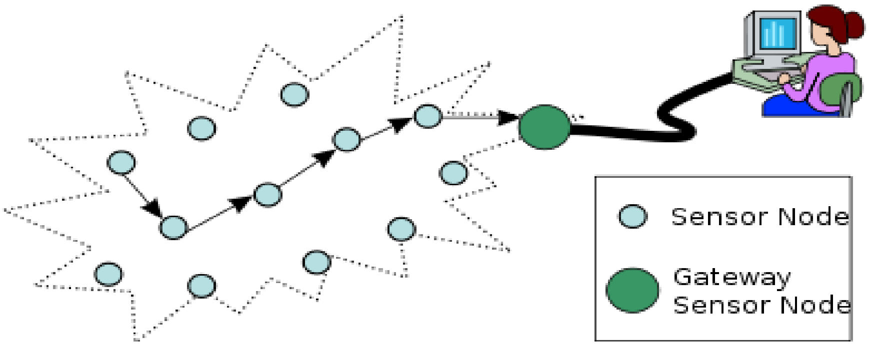

Figure 1. Typical multi-hop wireless sensor network architecture

The WSN is built of "sensor nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. As said above each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. There are mainly two kinds of sensor nodes used in the sensor network. First is the normal sensor node deployed to sense the phenomena and the second is gateway node that interfaces sensor network to the external world [16].

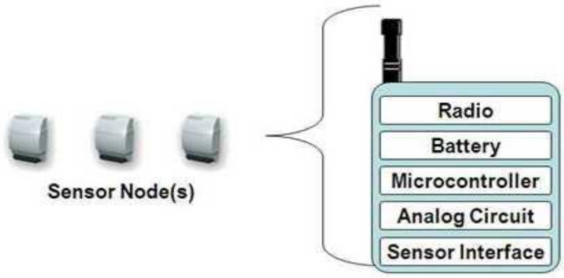

Figure 2. Components of WSN

Routing protocol is a special set of rules that end points in a telecommunication/internet connection use when they communicate and route the data packets to the destination where it should be transmitted**.**

Routing metrics are parameters used by a router to make routing decisions and find the appropriate data path. It is typically one of many fields in a routing table. Metrics are used to determine whether one particular route should be chosen or not over another. Various types of routing metric which are used are as follows [17].

1. Measuring link utilization (using SNMP)
2. Number of hops (hop count)
3. Speed of the path
4. Packet loss (router congestion/conditions)
5. Latency (delay)
6. Path reliability
7. Path bandwidth
8. Throughput [SNMP - query routers]
9. Load
10. MTU

II. REVIEW

There are some brief reviews of newly introduced metrics which help to upgrade the performance of routing protocol for computer networks.

ETX metric

A new metric i.e expected transmission count metric (ETX) is introduced, which finds high-throughput paths on multi-hop wireless networks. ETX minimizes the expected total number of packet transmissions (including re-transmissions) required to successfully deliver a packet to the ultimate destination. ETX is introduced for multi-hop wireless networks.The selection of Route using ETX accounts for link loss ratios, the asymmetry of the loss ratios in the two directions of each link, and the reduction of throughput due to interference among the successive hops of a route. Measurements on a wireless test-bed show that ETX finds routes with significantly higher throughputs than a minimum hop-count metric, particularly for path with two or more hops. But still there are also some shortcomings in this metric.

- ETX does not attempt to route around congested links, and thus should not suffer from the oscillations that sometimes plague load adaptive routing metrics such as end-to-end delay.
- ETX do not reflect how busy a link is; a busy link may cause a probe broadcast to be deferred, but won't ordinarily cause it to be lost.
- If the highest-throughput path has three or fewer hops, ETX is likely to choose it: If the best path has four or more hops, ETX may choose a slower path that has fewer hops.

Several aspects of ETX can be improved in the future like: its predictions of loss ratios for different packet sizes, its handling of network with links that run at a variety of bit-rates; and the robustness of ETX [1].

ETT metric

It is a new metric for routing in multi-radio, multi-hop wireless network. The focus is on wireless networks with stationary nodes, such as community wireless networks. The goal of the metric is to choose a high-throughput path between a source and a destination. This metric assigns weights to individual links based on the Expected Transmission Time (ETT) of a packet over the link. The ETT is a function of the loss rate and the bandwidth of the link. The individual link weights are combined into a path metric called Weighted Cumulative ETT (WCETT) that explicitly accounts for the interference among links that use the same channel. The WCETT metric is incorporated into a routing protocol that we call Multi-Radio Link-Quality Source Routing. The performance of this metric is studied by implementing it in a wireless test-bed consisting of 23 nodes, each equipped with two 802.11 wireless cards.

In the future, plan to expand our test-bed by adding more nodes. This will allow us to better explore the performance of WCETT for multiple simultaneous transfers. Also plan to investigate whether with different hardware, and effectively use two 802.11a or two 802.11g radios simultaneously. Finally, there is hope to investigate the performance of WCETT in mobile scenarios [14].

DBETX metric

In this the enhancement of routing metrics is propose through a more complete view of the physical channel. Using cross-layer optimizations, we develop the Distribution Based Expected Transmission Count (DBETX), which improves the performance of the network in the presence of varying channels.

The use of the DBETX, compared to the conventional ETX, avoids the selection of links whose worst case situation can dominate the link cost. The DBETX metric outperforms the conventional ETX metric, and its improvement increases with the network density. As density increases, the network becomes more connected, the average distances become smaller, and more routing choices are available. Thus, the improvement of DBETX over ETX becomes more significant. The proposed metric also reduces the average number of transmissions per link as compared to the conventional ETX metric.

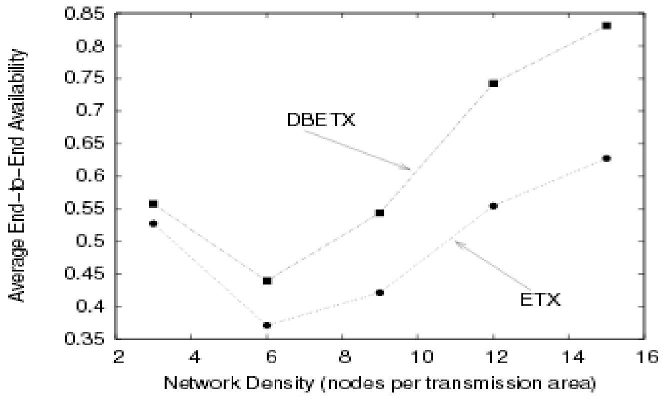

Figure 3. Average number of hops per communication.

This shows (Fig 3) that the DBETX metric always results in a higher end-to-end availability than the ETX metric. Moreover, the improvement increases with the network density. The improvement of DBETX over ETX is already 18% when the density is equal to 6 nodes per transmission area and it reaches 32% when the density is 15 nodes per transmission area.

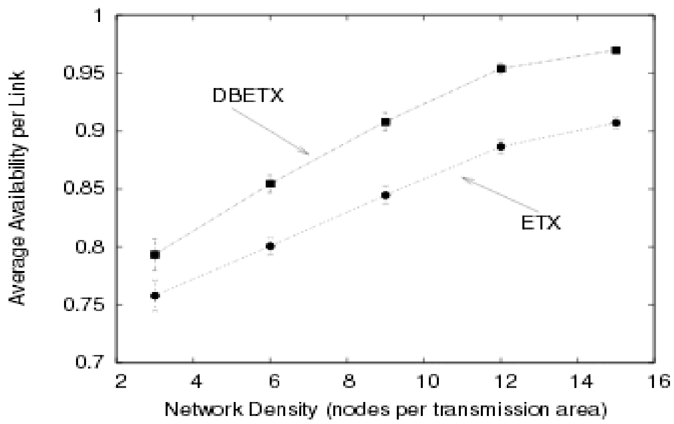

Figure 4. Average number of transmissions per link.

In this (Fig 4), It is observe that the availability grows with the density. For very low densities, the average link availability achieved by ETX is around 0.76 and DBETX results in an average availability 5% higher.

As future works, it is intend to analyse the effects of imperfect channel estimations in the DBETX metric and the number of samples needed to correctly estimate the probability density function of the received power. Moreover, it is intend to extend our work to multi-rate networks [15].

Enhanced DSDV Protocol

An ad hoc wireless network is a collection of mobile nodes establishing an instant network without any fixed topology. Furthermore, each node acts as both router and host concurrently, and can travel out or link up in the network freely. In such a network, designing of routing protocol is a significant and important issue.The focus and analysis is through network simulation (NS2) which compares the performance metrics like End to End Delay, Packet Delivery Ratio, Routing Overhead and Throughput with respect to energy constrained of both regular DSDV (destination sequenced distance vector) and modified DSDV i.e Multicost Parameters Based DSDV (MPB-DSDV) protocols. The cost parameters of Hop count (h), total interference (I), node link delay (d), residual energy of a node (R) and the node transmission power (T) are the cost parameters assigned for link and path of the ad hoc networks.

These parameters are combined in different optimization function with respect to DSDV routing algorithm and MAX/MIN Energy-Half-Interference-Half Hop multi-cost algorithm for selecting the optimal path. The simulation result shows that the MPB-DSDV performs well in significant metrics of wireless network performance [7].

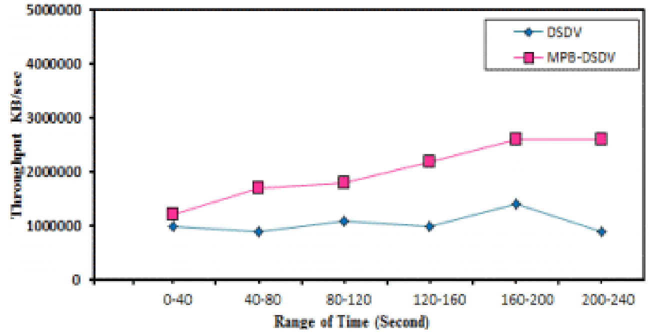

Figure 5**.** Shows the Throughput for the two protocols as a function time range on UDP.

The fig 5 shows that the maximum throughput in the time interval of 160 to 200 for both and throughput is increased due to node density, less traffic and free of channel. The throughput is measured in the bits per second (bit/s or bps).The overall performance with respect to UDP, the proposed MPB-DSDV routing shows the better outcome than regular DSDV.

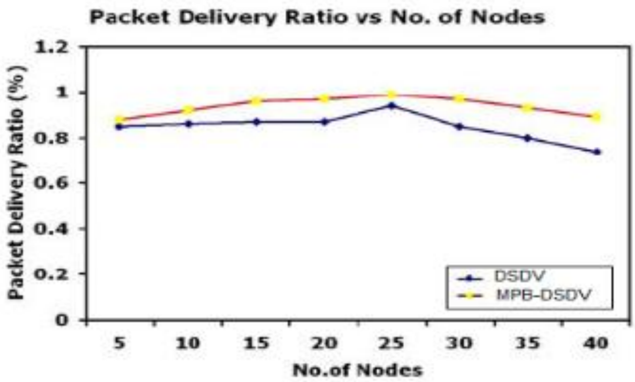

Figure 6. Shows the protocols as a function of the number of nodes of Packet delivery ratio

The graph shows that the better performance of MPB-DSDV than the regular DSDV in both the states. It may also be detected that the packet delivery ratio of DSDV falls to nearly 75% for 50 nodes and mobility speed of 20 m/s. However for MPB-DSDV, it is more than 90% for the same state shows in Fig 6.

However, the proposed Multi-cost Parameters Based DSDV protocol is better because of it has adjustable transmission power in high mobility so as to enhance the network energy and network lifetime [7].

Multi-Purpose WSN

The Wireless Sensor Networks are widely used along with the applications that are used for monitoring, measuring and recording the environmental condition, industrial process, battlefield surveillance etc. Different applications impose the use of appropriate routing metrics to decide the better data routing path. The theoretical framework of the routing algebra by authors proves that to satisfy the routing properties of routing protocol that path should be optimal, convergence and loop-free. In this they consider the routing algebra formalism, as well as the wide literature on routing metric definition to reach its goal which is to provide a routing metrics selection and composition framework. Based on this framework, prospective WSN system designers and users may choose the routing metric best-fitted to the needs of application(s) at hand and guarantees convergence, optimality, loop-freeness and efficiency for any type of routing protocol used in multi-hop wireless network deployment.

After the analysis authors proves that lexical metric composition approach is less demanding compared to additive metric composition approach. For the lexical metric composition approach it has been proved that that if two routing metrics are monotonic and isotonic (the first metric must be strictly isotonic), then the composite metric is also monotonic and isotonic and thus ensures the routing protocols requirements. Whereas for additive metric composition routing metrics are proved monotonic and isotonic, if the primary routing metrics are monotonic and isotonic and are additive over the path in specific metrics cases. Future work will look on identifying composite routing metrics suitable for the emerging dense WSN deployments that satisfy the required properties and can be used with state-of the-art routing protocols. Also focus on exploring the achieved performance and on investigating the possibility of altering (e.g. through re-configuration) the used metric [13].

III. CONCLUSIONS

Here we make the internal review of the above said papers in which routing metrics are enhanced to improve the throughput of the routing protocols used in the WSN's. Where routing metrics can not effectively improve the throughput of WSN based applications so far due to inefficiency in routing metrics. So it is conclude that WSN based applications can be more effective and efficient if we are able to find appropriate metrics in such a way that they can make routing protocols more efficient and effective.

IV. PROPOSED WORK

Finally, we would try to identify more suitable routing metric for the emerging dense WSN deployments that satisfy the required properties and focus on exploring the achieved performance and then by improving the efficiency of the routing protocol the wireless sensor network (WSN) based applications get more enhanced. There will be two distinct approaches to follow, regarding the combination of multiple routing metrics into one composite routing metric, namely the lexical metric composition and the additive metric composition.

First, we try to enhance the existing routing metrics by making composite routing metric from primary metrics in different way from the base paper. Otherwise secondly, we will design new routing metric if needed. For network simulation we will use MATLAB as working platform. It would be ensure that the composite routing metric also satisfy/ensure the property of monotonicity and isotonicity after enhancing them by combination approaches or by some other means. We will use LEACH and SPIN routing protocol to check the evaluation of the enhanced routing metrics.

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