ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 9, March 2013

Wireless Ad-Hoc and Sensor Networks: Tcp Enhancement (TCP-MANET) For Wireless Ad-Hoc Networks and Data Dissemination Protocol (Spin-G) In Wireless Sensor Networks

Pankaj Singh Parihar

Abstract-- ***In computing and telecommunications, a protocol or communications protocol is a formal description of message formats and the rules for exchanging those messages. Protocols may include signaling, authentication and error detection and correction capabilities. In its simplest form, a protocol can be defined as the rules governing the syntax, semantics, and synchronization of communication. Protocols may be implemented by hardware, software, or a combination of the two. At the lowest level, a protocol defines the behavior of a hardware connection. The need for protocols also applies to network devices. Computers have no way of learning protocols, so network engineers have written rules for communication that must be strictly followed for successful host-to-host communication. These rules apply to different layers of sophistication such as which physical connections to use, how hosts listen, how to interrupt, how to say good-bye, and in short how to communicate, what language to use and many others. The widespread use and expansion of communications protocols is both a prerequisite for the Internet, and a major contributor to its power and success. The pair of Internet Protocol (or IP) and Transmission Control Protocol (or TCP) are the most important of these, and the term TCP/IP refers to a collection (a "protocol suite") of its most used protocols. Most of the Internet's communication protocols are described in the RFC documents of the Internet Engineering Task Force (or IETF).Wireless sensors networks are ad hoc networks comprised mainly of small sensor nodes with limited resources, and are rapidly emerging as a technology for large-scale, low cost, automated sensing and monitoring of different environments of interest. Cluster-based communication has been proposed for these networks for various reasons such as scalability and energy efficiency.***

Keywords- **Telecommunication, Protocol, Aunthentication, Ad hoc network, TCP/IP.**

I. INTRODUCTION

The creation of wireless communications appeared as early as the beginning of the 20th century. Initial applications for wireless communications were focused on voice communications (i.e. cellular phone). As wireless technology matures, more and more people are enjoying the benefits of wireless networks, such as lower cost and increased mobility for users. As the technology gains popularity, users are developing more reliance on wireless access for data communications. In addition, users demand high performance from the wireless network Although the increasing popularity of wireless networks indicates that wireless links will play an important role in future inter-networks wireless communication has two unique resource limitations bandwidth and energy - as compared to current wired networks. This resource limitation constrains the application of wireless networks. Therefore, it requires innovative communication techniques to increase bandwidth utilization and innovative design techniques and protocols enable efficient energy utilization. Furthermore, wireless channels are inherently error-prone and time varying. These characteristics make it difficult to consistently obtain desired performance, which adds more challenges to the communication protocols designed for this dynamic environment This study addresses these wireless networking challenges by providing two communication protocols, one that provides improved TCP performance over lossy links and one that provides energy efficient data distribution. The two protocols presented in this study include the following:

1. TCP-Manet: A TCP enhancement for wireless ad-hoc networks
2. SPIN-G: An energy-aware data dissemination protocol in wireless sensor networks.

A. Wireless Ad-Hoc and Sensor Networks

A mobile ad-hoc network (MANET) is a self configuring network made up exclusively of mobile hosts connected by wireless links to form an arbitrary topology. The network has no access points (AP5) and operates in peer-to-peer operating mode. The mobile hosts are free to move randomly and organize themselves arbitrarily; therefore the network's topology may change rapidly and unpredictably. Ad-hoc networks may operate in a standalone fashion, or may be connected to the larger Internet. The mobile hosts in ad-hoc networks usually have the entire protocol stack as the fixed hosts in wired network to provide inter-operative and compatibility with the Internet. As a consequence, solutions to any new protocols should consider the inter-operativity with the current Internet. Wireless sensor networks can be considered as a subset of ad-hoc networks (MANETs). However, there are inherent differences between the two. For example, MANETs are associated with a high degree of mobility, unlike sensor networks which are stationary. Unlike in MANETs, addressing in a sensor network is not as important as data gathering. More importantly, sensor networks are usually application specific. Such applications may monitor a variety of environments that include home security, machine failure diagnosis, chemical/biological detection, medical monitoring, and surveillance. Therefore, rather than using a general- purpose protocol architecture, most sensor

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 9, March 2013

networks deploy application specific protocols that can exploit features of the application to achieve greater performance.

B. TCP Enhancement (TCP-Manet) for Wireless Ad-Hoc Networks

Transport layer is an essential part of the protocol hierarchy that provides reliable, cost-effective data transport from the source machine to the destination machine In. theory, transport layer protocols should be independent of the technology of the underlying protocols. However, in practice, the transmission control protocol (TCP) is a transport protocol that is tuned primarily for wired networks. Typically, the TCP congestion control mechanism is triggered when packet loss occurs, which is detected based on a timeout mechanism or upon receipt of duplicate acknowledgements (ACKs). Because TCP assumes all packet drops are due to congestion, the sender reduces the congestion window size, thus reducing the sending rate. This mechanism works well in wired networks due to the low packet error rate. However, it can perform quite poorly when used over wireless links, especially in wireless ad hoc networks.

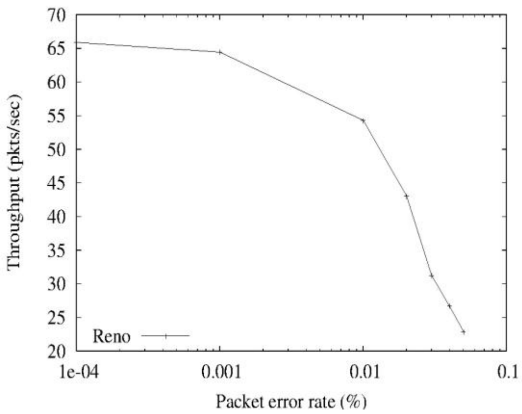

Fig .1: Performance of TCP-Reno over Wireless Network.

Figure .1 shows how TCP-Reno performs in an ad-hoc network while the packet error rate increases from 0% to 5%. The TCP throughput reduces by approximately 65%. This degradation occurs since the packet losses could be due to different reasons. Depending on the reason for the packet loss, the system should trigger different recovery tactics:

• Congestion: To keep connections in equilibrium, TCP uses congestion avoidance to probe the bandwidth available for the connection. Once the TCP sending rate is higher than the available bandwidth along the path, packet loss may occur. In a wired network, TCP periodically experiences packet losses that are assumed to be due to congestion. In this case, the TCP sender should adjust its congestion window size to reduce the sending rate, thereby reducing the network load and alleviating the congestion condition in the network.

• **Wireless Link Error:** Packets can also be lost due to a transient random loss. For this kind of packet loss, TCP should have a different recovery strategy rather than slowing down the sending rate.

• **Broken Link Error due to Node Mobility**: A mobile ad-hoc network (MANET) is infrastructure less. Any host in the network is free to join and leave, thereby resulting in a highly dynamic network topology. The broken link errors due to node mobility in ad-hoc networks can cause route errors. In this case, the sender should freeze the window and timeout and suspend data transmission until the route recovered, and then retransmit the packet as soon as possible.

II. DESIGN GOALS FOR TRANSPORT LAYER PROTOCOLS IN WIRELESS AD-HOC NETWORKS

The new TCP enhancement should provide reliable and efficient data transfer in wireless ad-hoc networks with the following features:

• **Improved Throughput:** Traditional TCP is tuned for wired networks and suffers throughput degradation in wireless networks. TCP-Manet should provide better throughput than traditional TCP with the new enhancements.

• **Sender Side Only Modifications:** Since an ad-hoc network is a highly dynamic system, it is important to design an algorithm that does not require additional modifications to the nodes in the network.

• **Cross Layer Design:** In conjunction with the network layer, TCP-Manet should be able to gain more information about connection status. With this information, it can determine the nature of the packet loss, thereby triggering different recovery actics.

A. Challenge: Meeting the Design Goals

Traditional TCP is designed for wired networks that are characterized with a low error rate. It detects packet loss by observing duplicate ACKs and timeouts, and assumes all packet losses are due to congestion error. However, when the wireless link comes into the picture in data communication, the error detection and correction does not meet the transmission requirement any more. The network suffers from high packet loss rate due to its relatively dynamic nature (fading channel, prolonged and frequent burst errors). This leads to some undesirable patterns of behavior for TCP protocols, resulting in a performance degradation of the throughput. For example, when there are random or short bursts of link errors that lead to packet losses, TCP invariably interprets these events as resulting from congestion. TCP then reduces the window size, hence reducing the sending rate. Subsequently, the sender applies a conservatively gradual increase to its window size. During this phase, bandwidth and opportunities for error-free transmissions are wasted and the throughput is reduced. In addition, since an ad-hoc network has no fixed infrastructure to establish communication, the nodes can move freely, and each node can act as a host and a forwarding node. It is a highly dynamic and unpredictable network, and node mobility may trigger exponential back-off in the TCP protocol. However, the purpose of the timeout and exponential back-off scheme is only for avoiding major transmission errors at the cost of

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 9, March 2013

significantly degraded throughput. The TCP sender will be unnecessarily frozen due to packet drops for reasons other than congestion summary, the central problem is that TCP suffers from degraded performance in wireless networks. This degradation occurs due to TCP's inability to correctly detect the nature of the error, and to respond in an appropriate manner In addition, the traditional scheme of congestion control, which shrinks the congestion window in the event of a retransmission or timeout, does not necessarily suffice for wired wireless networks. Although it has the merits of simplicity, it degrades the ability to rapidly detect error conditions and recover immediately.

B. Solution: TCP-Manet

Like TCP, TCP-Manet detects packet losses by observing duplicate ACKs and timeouts. Besides that, TCP Manet tries to determine the nature of the packet losses based on the current connection status, and then invokes the corresponding recovery strategy. These packet losses may be due to congestion loss, wireless link error, and network misbehavior etc. Since we consider more types of errors, TCP alone can not handle all these packet loss errors, because TCP protocol has limited information about the network. The only information which it has access to is RTT (Round Trip Time) and the acknowledgement. Hence, TCP Manet uses cross layer design strategy that asks for more information from the lower layer. TCP-Manet and the lower layer interact to enable higher layer to obtain network information such as routing message, and to provide reliable data transfer. TCP-Manet "monitors the trend of the power" metric that is defined as the ratio of throughput and delay. When a packet loss is detected by duplicate ACKs, if the "power" is in an increasing trend that means the network link is underutilized. The sender will only retransmit the packet without reducing the congestion window size. Otherwise the sender will trigger a new congestion avoidance algorithm designed in TCP-Manet. If a packet loss is detected by a timeout, TCP-Manet retransmits the packet while holding the congestion window size unchanged. If the sender gets a new acknowledgement, which means it is a congestion error, the TCP sender will set the congestion window size to 1. After four timeouts, TCP sender starts to send probe messages to the destination to identify if there is a selfish node in the connection. In addition, we present a theoretical model for TCP Manet in terms of the throughput, and compare it with simulation results. In the simulation evaluation of the TCP-Manet, we study the throughput, drop rate, fairness, backward compatibility etc. We also compare our results with TCP-Reno. The simulation results show that TCP-Manet has better performance than traditional TCP over wireless ad hoc networks.

C. Data Dissemination Protocol (SPIN-G) in Wireless Sensor Networks

Rapid technological advances in wireless communication have made it possible to network low cost, low complexity miniature sensor devices to capture environmental and tactical data and disseminate them around the network. This brings the new application of wireless communication networks - sensor networks. The sensors are equipped with a wireless communication transceiver and a reasonably powerful processor which is capable of signal processing and complex computations. The main functionality of these sensors is to monitor a variety of environmental events. In a sensor network that consists of a number of sensor nodes, the sensor nodes gather data and disseminate them throughout the sensing area via a wireless channel. Data dissemination occurs when sensor nodes (source node), which detects an environment events (stimulus), distributes its observations to other sensors (sink nodes) that are interested in collecting this data It has many potential applications in military and surveillance. For example, several hundred sensors can be scattered in a battle area to form a wireless sensor network. Sensors in the network detect the existence of enemies and disseminate their observations to other sensors. When soldiers enter this area, they can obtain this information from any sensor in the network.

D. Design Goals for Data Dissemination Protocols in Wireless Sensor Networks

The objective of this study is to present an energy-efficient data dissemination protocol (SPIN-G) for wireless sensor networks. This effort aims to meet the following requirements:

- Energy efficient to extend the network lifetime,
- Scalable to enable a large number of nodes in the system.
- Allow timely distribution of information throughout the network with an acceptable latency.

E. Challenge: Meeting the Design Goals

The design and implementation of a data dissemination protocol poses several significant and interesting challenges:

• **Energy Efficiency:** Sensor nodes are characterized by limited computation, memory storage, communication bandwidth, and battery power capability. In some scenarios, the sensors cannot be recharged once their energy is drained. Hence, the lifetime of the network depends heavily on how efficiently the nodes are able to perform its duties of gathering, processing, and distributing information. This means that the data dissemination protocol should consume as little energy as possible, thereby extending the network lifetime.

• **Scalability:** The sensor network is usually densely deployed which consists of hundreds or even thousands of sensor nodes in the field. Blindly broadcasting data to other sensor nodes would generate a high network overhead. Avoiding flooding storm while designing a network protocols is also an important challenge.

• **Timeliness:** Data gathered from sensor nodes are typically time-sensitive. It is essential to receive the data in a timely manner. In addition, increased latency typically lead to data retransmission which leads to unnecessary power wastage. Hence, it is imperative to develop a protocol that has acceptable latency.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 9, March 2013

F.Solution: SPJJV-G

We designed the SPIN-G protocol that is motivated by SPIN protocol (Sensor Protocol for Information via Negotiation) It employs meta-data negotiation before initializing the real data operation to minimize the redundant data transmission to save energy over classical flooding. However, in SPIN, metadata exchange is based on flooding, which introduces network overhead of meta-data exchange and could incur flooding storm problem that deteriorates performance in a high density network. To further reduce the energy consumption of SPIN, SPIN-G employs a randomized algorithmic "gossip" and data aggregation scheme to reduce the network overhead. Like SPIN, SPIN-G is a meta-data negotiation based protocol. That is before transmitting data, the sensor nodes will advertise its data using meta-data wait for request from other sensor nodes, and then send data to the requesting node. Unlike SPIN, which uses flooding for data advertising, SPIN-G employs a gossip algorithm in which each sensor node only advertises data to a randomly chosen neighboring node. Gossiping, which informs only one neighbor instead of all neighbors, has the slowest distribution rate of data dissemination and introduces a latency penalty. To alleviate this penalty, we utilize a data aggregation scheme, in which each sensor aggregates old data with new data for advertising. Data aggregation not only can fasten the timeliness of the protocol, but also deal with packet losses in the network. Hence, combining gossip and a data aggregation scheme, we can achieve energy conservation at the expense of slightly increased latency, and improve the robustness of the protocol as well. Energy efficient data dissemination not only means a low energy consumption level, but also means balanced energy consumption distribution throughout the network. This leads to the benefits of enhancing the networks ability to remain connected and extending the network functionality. To reach this goal, instead of responding with a data request packet immediately after receiving an advertisement as in SPIN, sensor nodes (upon receiving multiple data advertisement messages (ADV5) for the same data) in SPIN-G select advertising neighbor with the highest energy level. Finally, from an energy savings point of view, an efficient mechanism is to place sensor nodes in sleep mode However, putting all nodes in sleep mode will reduce the responsiveness of the protocol. Specifically, it will increase the data dissemination protocol convergence time. SPIN-G only applies the sleep mode to the sensor nodes whose battery power levels are below a threshold, hence, preventing battery poor nodes in the network from dying faster which can lead to network partition. The sensor node will sleep and wake up periodically during a sleeping-active cycle. This scheme aids by minimizing the need for nodes to participate in the dissemination process, thereby leading to an improvement in the life expectancy of a battery impoverished sensor device. We conducted analytical and simulation-based analysis of proposed protocol, and compare with SPIN protocol The results show that although SPIN-G has a slightly higher protocol convergence time than SPIN, it consumes about 20% less energy than SPIN. With the increase of the network density, our protocol reduces the energy consumption by about 50%. Introducing a sleep cycle in SPIN-G may also substantially increase the network lifetime.

III. DATA DISSEMINATION PROTOCOL (SPIN-G) IN WIRELESS SENSOR NETWORK

Advances in embedded system technologies made it possible to deploy a large number of sensor nodes into a sensor network. These sensor nodes are typically equipped with an embedded processor, one or more sensors, memory, and a low-power radio communication facility. Usually, sensor networks are used for sensing the environmental events, gathering data, and disseminating them throughout the sensing area via the w ireless channel. Several critical requirements that influence design and implementation of data dissemination protocols exist:

- **Resource Limitations:** Low-cost and low-power sensor nodes are characterized by limited computation, memory storage, communication, and battery power capabilities. Once sensor nodes are deployed, it is difficult to replace or recharge their battery. Hence, designing power-conserving data dissemination protocol to extend their limited lifetime is a key consideration in sensor networks.
- **Scalability:** The sensor network usually consists of hundreds or even thousands of sensor nodes in the field. Designing a scalable communication protocol is also an important challenge.

A. SPIN-G Protocol

This section describes an all-to-all data dissemination protocol SPIN-G using gossip. We will first give a brief overview of SPIN and then introduce the mechanisms of SPIN-G.

SPIN (Sensor protocols for Information via Negotiation)

SPIN (Sensor Protocol for Information via Negotiation) is an adaptive protocol handling all-to- all information dissemination in wireless sensor networks. It uses negotiation and resource-adaptation to overcome the implosion, overlap, and resource blindness problems of the conventional protocols, such as flooding or gossiping. In negotiation, sensor nodes use high-level descriptors meta-data to describe or name the data. It works in three stages (ADV-REQ-DATA) to eliminate unnecessary data transfers in the network. A sensor node, in disseminating data. First sends an advertisement (ADV message) describing the new data available with the meta-data to its neighbors. The neighboring nodes, if have not received this data, request such data (with a REQ message). Upon such a request, the sensor node responds with data (DATA message). The overhead of meta-data, ADV and REQ exchange is compensated by the reduction in the duplicate data reception. Since meta-data exchange is based on flooding mechanism, the redundant meta-data messages still exist.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 9, March 2013

SPIN is resource-adaptive in the sense that each sensor nodes can poll its system resources to find out how much energy is available to them, and determine its activity in terms of energy. However, SPIN sensor nodes are insensitive to the resource capabilities of their neighboring nodes. That is sensor nodes may keep asking for DATA from some particular neighbor without considering how much energy is left at that node. Some nodes may drain energy faster than others, which lead to network partition, thereby reducing network lifetime.

B. SPIN-G

The purpose of SPIN-G is to overcome the two deficiencies of SPIN described: (i) reduce the overhead of meta-data negotiation, (ii) achieve balanced energy consumption distribution across the network and extend its lifetime. To achieve the first goal, we employ randomized gossip" and combine it with data aggregation. To attain the second goal, we developed a data-requisition strategy to make the sensor nodes choose the advertising neighbor with the most energy to ask for data.

C. Meta-data Negotiation using Gossiping

SPIN-G is also a 3 stage handshake protocol like SPIN. The protocol starts when a node obtains new data and advertises the data by sending an ADV message to one of its randomly selected neighbors. The neighboring node, upon receiving the ADV, checks to see whether it has already received or requested the advertised data. If not, instead of responding right away, sensor node waits for a predefined fixed interval. During this waiting period of time, if the sensor node receives multiple ADVs for the same data from its neighbors, it will use a data requisition strategy (section 4.1.2) to select the most energetic of its advertising neighbors, then responds with a REQ message. The node then responds with a REQ to obtain the DATA message.

D. Data Aggregation and Retransmission

Employing gossip in negotiation will reduce the data dissemination rate. To alleviate this problem, we use data aggregation and retransmission scheme. When sensor node has new data for advertising, it will aggregate new data with the data it already has and send advertisements of the aggregated data to one of its selected neighbor. Because the sensor node randomly chooses a neighbor for advertising, it has high probability that the sensor nodes will choose a different neighbor from the previous advertisement. Hence, unlike traditional gossip, there are more copies of data flow s in the network, speeding up the dissemination rate. In addition, SPIN-G has an ADV retransmission scheme. We predetermine a fixed timeout value, for each node if there is no data arrived for this interval, the node will re-advertise the data it has to a randomly selected neighbor. Data aggregation and retransmission has the advantage of compensating for link failures. If an ADV of the data is lost in a transmission, the lost data will be aggregated in a new ADV and sent to some other neighbor at a later time.

E. Resource Adaptation

In SPIN protocol, sensor nodes can only poll their own energy level and then determine whether or not to participate in data dissemination based on their energy level. However, these sensor nodes are resource blind about their neighboring nodes: they may request data from impoverished neighbors further depleting their resources. Instead, in SPIN-G, sensor nodes not only know their own energy levels, but also keep track of the energy levels of their neighbors. With this knowledge, a sensor node can request data from a neighbor with highest energy and hence be able to balance the energy dissipation across the network. To accomplish this goal, each sensor node will periodically broadcast its energy level to its neighbors. This could be done in two ways: to broadcast a specific EGY message to the neighbors. or to piggyback the energy level in its advertisement (ADV). When the sensor node receives multiple ADVs for the same data from its neighbors, it will select its advertising neighbor with the most energy to ask for the DATA. This kind of data requisition from a selective neighbor can lead to an improvement in the life expectancy of the network, and exploit the energy savings possible with fewer transmitted messages. In our data requisition strategy, the node chooses the neighbor with highest energy level, and asks for DATA with REQ message. Each node maintains a table that keeps the data and energy information of all its neighbors.

Table 2: Data and Energy Information for Node 4

Neighbor	Meta-data	Energy level
1	A, B, C, D	40J
2	B, C, E	20J
3	C, D	30J
4	E	30J

For example, 4.1 (a) shows the topology of a 5-node network, and Table 4.1 is an example of the neighbor table at node 4. For meta-data A, B, C, and D, since the neighbor node 1 has highest energy of 40J, node 4 will send REQ asking for DATA of A, B, C, and D from node 1. For meta-data E, the neighbor node 5 has the highest energy of 30J and node 4 will send REQ for E to node 5. Figure 4.1 (b) illustrates this requisitioning strategy.

F. Sleeping-active Cycle for Battery-poor Nodes

The most important way to save energy in a sensor network is to power-down (put to sleep) the sensor node when necessary. To save battery poor nodes in the network and extend the lifetime of the network, we introduce sleeping-active mode for sensor node that has low battery power. Each sensor has three states: active, sleep and dead. In active state, the nodes is completely functional and can transmit receive data, in sleep state, the sensor's transceiver is powered off and can not take part in the network activity, and in dead state, sensor node has depleted its battery power. If sensor has abundant energy, it keeps in active mode and takes part in the data dissemination process.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 9, March 2013

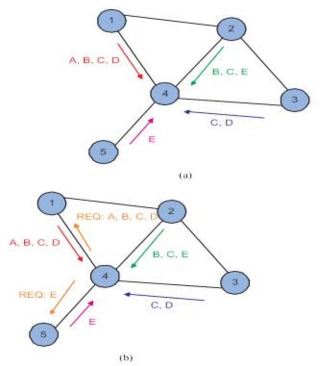

Fig 2: Data Requisition Strategy. (A) Advs in a 5-Node Network, (B) Reqs in a 5-Node Network

However, when its power level falls below a threshold (25% of its initial energy level), the sensor node enters in sleep cycle, in which the node sleeps and wakes up periodically. When the node wakes up, it can join in the dissemination process as usual. The purpose of using sleep cycle for battery poor node is to reduce their participation in data dissemination, protecting them from depleting their energy, and thus extending the network lifetime.

G. Performance Evaluation

This section presents the performance analysis of SPIN-G protocol in terms of protocol convergence time and energy consumption, and compares them to SPIN and traditional gossiping. The network and protocols was modeled using N52 simulator.

H.System Model

The following assumptions are made in the system model, consistent with modeling in literature.

- The nodes are deployed in rectangle area.
- All nodes are homogeneous and battery-powered.
- Each node has a limited transmission range i.
- Each node only sends packets to the nodes that are in its transmission range.
- The network is a broadcast network, where only one single, unreliable, broadcast channel is available for all communication.
- The packets can be lost due to collisions or buffer overflow.

Table 2: Summarizes The System Parameters Used In The Simulation: These Parameters Are Same As The Ones Reported For SPIN For Direct And Easy Comparison.

Parameters	Values
Number of nodes (n)	10-70
Topology (Γ)	Random, regular
DATA packet size (DATA) (Sd)	500 bytes
Meta-data size (ADV,REQ)(S m)	16 bytes
Network loss	Yes
Simulation area	40*40m2
Transmission range (r)	10 m
Initial Energy (J)	10- 100J
MAC protocol	802.11
Bandwidth (B)	2 Mbps
Transmit Power (ET)	5.0023mw
Receive Power (ER)	5mw
Idle Power	0.0W
Number of data (d)	1data/ node Without overlapping
Propagation delay (T prop)	0s
Processing delay (Tp)	0.01s
ADV s timeout (Tout)	0.18s

I. Vary Network Topology

We studied the effect of network topology on SPIN, SPIN-G and Gossip. We consider two sensor network deployment strategies: regular and random. We first study regular deployment strategy, where sensors are distributed as a mesh of 25 nodes in the network, as shown in Figure 4.2(a). We then study random deployment, where sensors are placed at random on a two-dimensional area with the additional constraint that the network be connected. This type of random graph is appropriate for modeling a number of applications such as battle-field, surveillance, etc. We created a 25-node randomly generated network, which is a connected network with 60 edges and an average degree of 4.8., as shown in Figure 4.2(b). For each data point shown, we conducted 10 experiments with different seeds for the simulation and used the average. Figure 4.3(a) shows the percentage of the total data received (Dp) by all sensor nodes in a mesh network over time for SPIN, SPIN-G, and gossip protocol. SPIN converges fastest at about 1.72 seconds; SPIN-G at 7.11 seconds; and gossip converges slowest at about 24.44 seconds. SPIN converges fastest, as expected, because it is based on flooding for meta-data negotiation and converge in O(d) rounds, where d is the diameter of the network. Traditional gossip protocol converges much slower than SPIN protocol, because optimistic dissemination rate of traditional gossip is at most 1 node round as there is only one copy of data flowing in the network at any given time. Similar to the traditional gossip protocol SPIN-G only forwards meta-data to one randomly selected neighbor. Hence, the number of meta-data advertisements received at any node should decrease - thus controlling the implosion problem in meta-data negotiation at the expense of convergence time. SPIN-G converges slightly slower than SPIN, but much faster than gossip protocol. That is, we did not see much increase in convergence time like gossip protocol. This is because we utilize data aggregation and retransmission scheme in SPIN-G, where a sensor sends advertisement of new data aggregated with other data that it already has. In addition, this aggregation is not only helpful for network to cope with link losses, but also speeds up convergence with less energy consumption. This scheme makes our algorithm “gossiping” problem instead of “random walk”. As we described in section 4.3, the cover time decreases to O (logn) from possible O(n3). Figure 4.3(b) shows the energy consumption of (8) of these three protocols in mesh network. SPIN consumes the highest energy, about 0.046J; Gossip consumes the lowest energy, about 0.028J; and

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 9, March 2013

SPIN-G consumes 0.037J energy. SPIN-G spends 24% less energy than SPIN and 24% more energy than gossip.

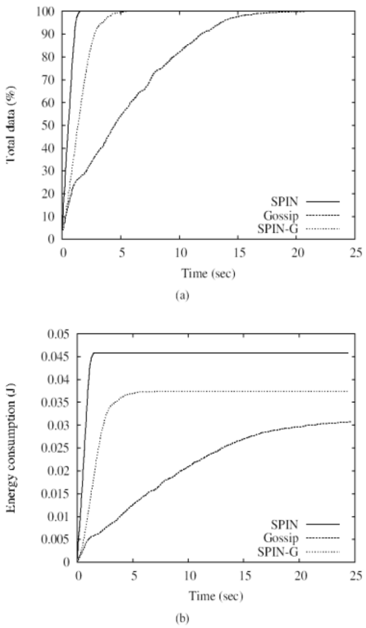

Fig 3: Performance of SPIN, SPIN-G, and Gossip in a 25-Node Random Network.

(a) Percent of the total data received(Dp) by the network over time,

(b) Energy consumption (ε_A) by the network over time.

IV. CONCLUSION

The use of wireless channel is growing at an amazing speed. With the advances in wireless communication techniques, we can envision that some day we can achieve the goal of "anytime and anywhere" communication among and between users and devices. However, bandwidth and energy limitation in wireless ad-hoc and sensor networks can affect the ease of the communication among them. In addition, time-varying and dynamic condition of the system may influence the performance of the protocol. Therefore, it is important to design new communication protocols that can operate efficiently in such a challenging environment. In this two communication protocols are proposed and discussed: (i) TCP-Manet (TCP Enhancement) for wireless ad-hoc networks, and (ii) SPIN-G (Energy-Aware Data Dissemination Protocol) for wireless sensor networks.

REFERENCES

[1] R. Jam and K. K. Ramakrishna, "Congestion Avoidance in Computer Networks with a Connectionless Network Layer: Concepts, Goals, and Methodology," in Proceedings of the Computer Networking Symposium, IEEE, pp. 134 143, April 1988.

[2] P. Rysavy, "The Road to a Wireless Future," Network Computing, October 2005.

[3] H. Balakrishnan, V. N. Padmanabhan, S. Seshan, and R. H. Katz, "A Comparison of Mechanisms for Improving TCP Performance over Wireless Links," IEEE/ACM Transactions on Networking, vol. 5, no. 6, pp. 756 769, 1997.

[4] A. S. Tanenbaum, Computer Networks. fourth edition Prentice Hall PTR, 2003.

[5] A. Chock lingam, M. Zorzi, and R. Rao, "Performance of TCP on Wireless Fading Links with Memory," in Proceedings of the IEEE ICC '98, June 1998.

[6] V. Tsaossidis, H. Badr, X. Ge, and K. Pentikousis, "Energy/Throughput Tradeoffs of TCP Error Control Strategies," in Proceedings of the 5th IEEE Symposium on Computers and Communications USCC), 2000.

[7] T. Lakshman and U. Madhow, "The Performance of TCP IP for Networks with High Bandwidth-Delay Products and Random Loss," IEEE/ACM Transactions on Networking, pp. 336 350, June 1997.

[8] G. Khanna and Y.-S. Wu, "Data Dissemination Protocol in Sensor Networks to Tolerate and Link Failures. http: dynamo.ecn.purdue.edu / sbagchi /Research /Papers /spms-dsn03fastabls.pdf.

[9] D. Khanna, S. Bagchi, and Y.-S. Wu, "Fault Tolerant Energy Aware Data Dissemination Protocol in Sensor Networks," in Proceedings of 2004 international conference on dependable systems and networks (DSN'04,.), (Florence, Italy), pp. 795 804, Jun. 28 - Jul. 1 2004.

[10] J. Kulik, W. heinzelman, and H. Balakrishanan, "Negotiation-Based Protocols for Dissemination Information in Wireless Sensor Networks," Wireless Networks, 2002.

[11] J. Kulik, W. Rabiner, and H. Balakrishanan, "Adaptive Protocols for Information Dissemination in Wireless Sensor Networks," in Proceedings of 5th annual ACM IEEE international conference on mobile computing and networking (MOBICOM'99}, (Seattle, WA, USA), pp. 174 185, 1999.