on the ring-based hierarchical aggregation algorithms. To address the problem of false aggregate, they presented a lightweight verification algorithm which would enable the base station (BS) to verify whether the computed aggregate was valid [6].

The author described that the packets from different applications cannot be aggregated. To make data aggregation more efficient, author introduced the concept of packet attribute, defined as the identifier of the data sampled by different kinds of sensors or applications, and then propose an attribute-aware data aggregation (ADA) scheme consisting of a packet-driven timing algorithm and a special dynamic routing protocol [7].

The authors proposed a novel Data Routing for In- Network Aggregation, called DRINA, that has some key aspects such as a reduced number of message for setting up a routing tree, maximized number of overlapping routes, high aggregation rate, and reliable data aggregation and transmission. But here next node is selected by considering hop count which increases the transmission time and delay [8].

A Hybrid Routing Protocol (GHRP) based on Genetic Algorithm (GA) is proposed to support the metrics such as end-to-end delay, bandwidth and hop count. Through the simulation results, it has been showed that GHRP fabricates better performance than hybrid routing protocols ZRP (Zone Routing Protocol) [9].

3. Proposed Work

Modified Data Routing for in-Network Aggregation For Wsns

The algorithm is used to build a routing tree with the shortest paths that connect all source nodes to the sink while maximizing data aggregation. The model has certain terms which are as follows:

- **Collaborator:** A node that detects an event and reports the gathered data to a coordinator node.
- **Coordinator:** A node that also detects an event and is responsible for gathering all the gathered data sent by collaborator nodes, aggregating them and sending the result toward the sink node.
- **Sink:** A node interested in receiving data from a set of coordinator and collaborator nodes.
- **Relay:** A node that forwards data toward the sink.

The working of model is divided into following phases:

1. First step is to calculate the distance from the sink node to other nodes of the network.
2. At the first event, cluster head is selected which is closer to sink node and it is called as coordinator and the remaining node that detect the same event are named as collaborator.
3. The routes are created by choosing the best neighbor which is at minimum distance from sink node and accordingly distance from sink node is updated
4. Route repair mechanism: Here if the sender node receives ACK from the node within the pre-determined timeout, it will assume that the node is alive else new node is selected.

4. Calculating the Distance from Sensor Node to Sink Node

In this phase, the distance from the sink to each node is computed using distance formula. This phase is started by the sink node sending, by means of a flooding, the Hop Configuration Message (HCM) to all network nodes. The HCM message contains two fields: ID and HopToTree, where ID is node identifier that started or retransmitted the HCM message and HopToTree is the distance, in hops, by which an HCM message has passed. Also distance from sink node to other nodes of network is calculated using distance formula.

5. Cluster Setup Phase

For this election, all sensing nodes are eligible. If this is the first event, the leader node will be the one that is closest to the sink node. Otherwise, the leader will be the node that is closest to an already established route. In case, two or more concurrent nodes have the same distance to the sink, the node with the smallest ID maintains eligibility. Another possibility is to use the energy level as a tiebreak criterion. At the end of the election algorithm only one node in the group will be declared as the leader (Coordinator). The remaining nodes that detected the same event will be the Collaborators.

6. Inter Cluster Routing and Hop Tree Update

The routes are created by choosing the best neighbor at each hop. The selection for the best neighbor is classified in two ways firstly when the first event occurs, the node that leads to the shortest path to the sink is chosen figure 1(a)[8], and secondly after the occurrence of subsequent events, the best neighbor is the one that leads to the closest node that is already part of an established route figure 1(c) [8]. This process tends to increase the aggregation points, ensuring that they occur as close as possible to the events. The resulting route is a tree that connects the Coordinator nodes to the sink. When the route is established, the hop tree updating phase is started.

7. Route Repair Mechanism

It is responsible for both setting up a new route for the reliable delivering of packets and updating the hop tree. It consists of detection of failure node and selection of a new Node. When a node needs to forward data to the sink, it simply sends the data packet, sets a timeout, and waits for the ACK message. If the sender node receives ACK from the node within the pre-determined timeout, it will assume that the node is alive .If not, it considers the node as offline and another New node selected. After this repair mechanism, a newly reconstructed path is created & proceeding with forwarding aggregated data towards sink. This mechanism also provides secured data aggregation.

Extensive simulations in Network-Simulator 2 show that our protocol outperforms the existing protocol Shortest path tree (SPT) & Information Fusion-based Role Assignment (InFRA) in terms of various performance metrics. These graphs shows the variation of y-axis with respect to x-axis & it is observed that as the number of node increases throughput, lifetime, & overhead increases and simultaneously delay, energy consumption, and tree cost decreases.

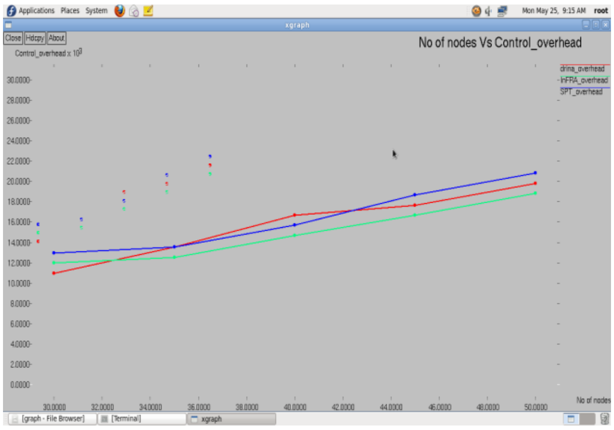

Figure 6: No. of Nodes vs Control Overhead

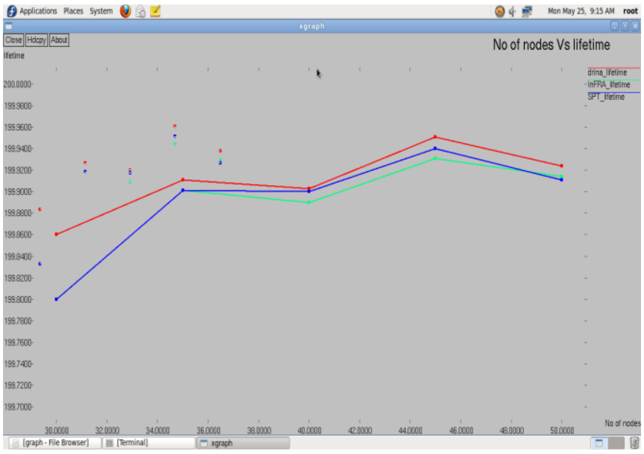

Figure 7: No. of Nodes vs Lifetime

9. Conclusion

The key aspect of the algorithm is to reduced number of messages for setting up a routing tree, high aggregation rate, and reliable data aggregation and transmission. In the modified DRINA algorithm cluster head is responsible for aggregating the data of all its neighbour nodes and transmit it through the shortest and energy efficient reliable path, which results increase in throughput, lifetime, and control overhead. Thus modified DRINA provides the reliable routing, with increased throughput, lifetime and decreased delay, energy consumption, tree cost.

10. Acknowledgment

I would like to express my sincere gratitude to my guide Prof. (Dr). Mrs. P. Malathi & PG coordinator Prof. (Dr). Mr. Manish Sharma for their valuable insight, guidance and inspiration throughout the work.

References

[1] E. Fasolo, M. Rossi, J. Widmer and M. Zorzi, "In-Network Aggregation Techniques for Wireless Sensor Networks: A Survey", IEEE Wireless Communications on vol 6, no. 2, pp. 70-87, 2007.

[2] R. Roustaei, E. Zohrevandi, K. Hassani, A. Movaghar, "A New Approach to Improve Quality of Service in SPEED Routing Protocol in Wireless Sensor Network through Data Aggregation", In Environmental and Computer Science, Second International Conference on vol 4, no.11, pp. 393-397, 2009.

[3] L. Villas, A. Boukerchel, R. B. de Araujo and Antonio A. F. Loureiro, "Highly Dynamic Routing Protocol for Data Aggregation in Sensor Networks", ISCC IEEE Symposium on vol 6, no. 2, pp. 496-502, 2010.

[4] D. Luo, X. Zhu, X. Wu and G. Chen, "Maximizing Lifetime for the Shortest Path Aggregation Tree in Wireless Sensor Networks", In INFOCOM, 2011 Proceedings IEEE, vol 5, no. 2, pp. 1566-1574, 2011.

[5] L. A. Villas, A. Boukerche, D. Guidoni, Regina B. Araujo and A. A. F. Loureiro, "An Energy-Aware Spatial Correlation Mechanism to Perform Efficient Data Collection in WSNs", 36th IEEE International Conference on vol 36, no. 7, pp. 882-889, 2011.

[6] S. Roy, M. Conti, S. Setia and S. Jajodia, "Secure Data Aggregation in Wireless Sensor Networks", IEEE Transactions On Information Forensics And Security, vol 7, no. 3, pp. 501-510, 2012.

[7] F. Ren, J. Zhang, Y. Wu, Tao He, C. Chen and C. Lin, "Attribute-Aware Data Aggregation Using Potential-Based Dynamic Routing in Wireless Sensor Networks", IEEE Transactions On Parallel And Distributed Systems, vol 24, no. 5, pp. 423-436, 2013.

[8] L. A. Villas, A. Boukerche, H. S. Ramos, Horacio ABF de Oliveira, R. B. Araujo and A. A. F. Loureiro, "DRINA: A Lightweight and Reliable Routing Approach for In-Network Aggregation in Wireless Sensor Networks", IEEE Transaction on computers, vol 62, no. 4, pp. 986-995, 2013.

[9] S. K. Nivetha and Dr. R. Asokan, "Ga-Based Hybrid Routing Protocol To Support Multiple Quality Of Service Metrics In Mobile Ad Hoc Networks", International Journal of Computer Engineering and Applications, ISSN 23213469, Volume V, Issue III, March 2014.