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Modeling of Sleep and Awake Scheduling Algorithm for Packet Replication in Smart Grid Computing Networks

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Abstract: In recent days, digital application related smart grid system is used in electricity network. A smart grid is used to supply electricity to consumers via two-way digital communication monitoring, analysis, control and communication within the supply chain is enabled to improve efficiency, reduce energy consumption, cost and maximize the transparency and reliability of the energy supply chain. A dedicated enhancement of future power systems, greatly through renewable energy resources along with distributed communication and demand response in terms of increased efficiency and reliability is meant by smart grid system. The critical issue is that inspite of several advanced features of smart grid system, the reliability of smart grid communication system has a direct or immediate impact on the reliability of the entire power infrastructure wherein millions of smart devices are interconnected throughout critical power facilities via communication networks sleep scheduling is a technique proposal where all the nodes are not awake all the time, hence only less amount of energy is consumed during the transmission of packet at the time of execution. Sleep scheduling is a process where the nodes wake up only during packet transmission and reception time where it increases the network lifetime, else it opts sleep time.

Key words: Smart grid computing, scheduling, sleep schedule, energy and power, critical issue

INTRODUCTION

The communication gap between smart grid Wide Area Network (WAN) and Home Area Network (HAN) is fulfilled by Neighbouring Area Network (NAN) in smart grid communication networks which offers distribution of power with capability of controlling delivery of electricity to each household and frequent monitoring (Yuan *et al*., 2011; Yan *et al*., 2012). The smart grid also introduces a new level of communication between the consumer and the power suppliers.To design a highly advanced system in smart grid, reliability is one of the basic yet improved requirements of its features.The imminent depending on information networking produces the smart grid to a number of potential reliability issues that are associated with both networking and communication systems while transporting a flow, the set of service requirements to be met by the network is termed Quality of Service (QoS) where this flow may be a packet stream from host to destination (unicast or multicast) with associate in nursing quality of service (Niyato *et al*., 2013). The QoS support capability of hybrid network is enhanced by a QoS Oriented Distributed routing protocol (QOD) resulting in enhanced QoS oriented routing protocol (EQOD) which is mobility resilient than QOD. This model proves that the overall through put can be increased thus by decreasing the overhead and EQOD provides better quality on service in terms of packet overhead, throughput and transmission delay (Kong, 2015; Kounev *et al*., 2015).

Literature review: The communication among electric utilities and substations called heterogeneous communication technologies which is the comprehensive design in the smart grid system infrastructure. Modern intelligent digital equipments are employed to control and collect data from nearby data point in networks such as WAN where a large number of distributed substations consisting of the bulk electric power generation plants are present. The information of power usage is delivered by NAN that inhibits two-way communication between NAN concentrator and smart meters (Kumar and Rajesh, 2009; Chen *et al*., 2012). Only disadvantage in existing system is large energy consumption, maximum time delay and maximum packet delivery ratio.

Gungor *et al*. (2010) proposed the concept of smart power grid that has been used to enhance the output and reliability through auto motive applications, sensing and

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large power converter metering technologies are dependent on the optimal demand of available energy and network. This proposal specially concentrates on remotes and timely information gathering during failure of equipment, capacity limitation and accidents that occur naturally. In spite of its analysis is diagnosing all the possible failures in smart grids, this method fail to analyze the characteristics and architectural properties of the grid ineffectively.

Yang *et al.* (2011) proposal describes the technique dealing with power distribution networks with distributed generator, analyzing the mesh and radial topologies at fluctuating levels of voltage (33 and 11kV). This study focuses on the telecommunication provision when upgraded and deployed by distributive control solutions as a part of the future ANM system. The distributed power to all the nodes are equally controlled which is the main advantage of this system. The only disadvantage is that the researcher did not describe the security, latency and error detection and corruption of data on ANM control algorithms.

Zhang and Chow (2011) proposed the Incremental Cost Consensus (ICC) algorithm solves the conventional centralized economic dispatch problem in a distributed manner based on selecting the cost of increment of all generation unit as a variable under consensus. This technique minimizes the cost of operation and demonstrates the efficiency and reliability of ICC algorithms even if there is no valid centralized control centre. The convergence rate of EDP algorithms are affected by a variety of system configurations which are summed up such as signal transmission delay, sampling rate of the system, the power grid topology and generator inertia (synchronous).

Acampora and Loia (2007) described the rise of modern technique for ubiquitous computing to initiate unusual tasks and activities that are seam less is especially due to the improvement of the IC (Integrated Circuits) industry, associated with the cost reduction and development of efficiency. There are many complicated problems to be faced and this study, as a solution to these problems has taken an attempt to provide a flexible band solution. First of all, Fuzzy Make up Language (FML), proposed by Extensive Makeup Language (XML) derived technologies is started foe defining the structure of fuzzy control logic in details independent from its legacy representation. FML constitutes of 3 layers:

- XML which creates a new makeup language for fuzzy logic control
- Defining legal building blocks through document type definition
- Conversion of fuzzy controller description to a specific modern programming language by an extensible style sheet language transformations

Main advantages of this method are extremely intelligent user friendly interfacing device. The different choice finds a way to high cost management of configuring and distributing control tasks in a dynamic computer networks.

Di Bisceglie *et al.* (2009) proposed one of the main issues to address in smart grid content is optimal voltage regulation. This disadvantage of this method is that hinder the application of traditional hierarchical control paradigms in smart grids where the grid complexity constant growth and the massive pervasion of generation systems expect more flexible and scalable regulation paradigm. The researchers present a proposal to the concept of a decentralized and non-hierarchical voltage regulation architecture based on smart entities that are co-operative and intelligent. This study, contributes to two main things: The first one is the decentralized architecture that is aimed at calculating the real value of cost function and its gradient without requiring a central fusion centre to acquire and process all the sensor acquisitions. The second one is co-operative optimization strategy aimed at identification of the optimal asset of voltage controllers. But, this method has no experimental activity is aimed at testing and validating the regularity architecture on a real power network.

A promising analysis approach is proposed to handle voltage control problem in smart grids fuzzy logic and fuzzy agent (Menon *et al.*, 2013). This technique proposes non-hierarchical voltage control architecture based on co-operative fuzzy agents. This method has advantages of conceptualizing self-organizing voltage control architecture on the basis of co-operative fuzzy agents. Intensive experimental testing is aiming at characterizing the real working performances of the solution that is proposed on real time power systems are not yet completed. The development of such application is currently ongoing process.

Whereas a variety of power grid stability and security problems are solved, its detected that the quality of smart grid security has been diluted and the knowledge of this is all of from comprehensive (Vaiman *et al.*, 2012). For example, however the cascading impact forced by completing different failures propagates in numerous systems isn't sure or exactly approximated by any model contingencies that initiate cascading failure," Power Systems, IEEE Transactions on (Eppstein and Hines, 2012). More queries for example, however attackers aiming at higher impact to the grid at the rich bottom value by simply taking down solely many elements, might utilize the structural vulnerability and also the potential access to key elements within the grid. And also, the way sensible grid and its operators ought to respond to those

attacks, still stay unclear to each the trade still because the analysis community. Hence, the quality of cascading failure and also the procedure value to simulate these events still require simpler and economic modeling, simulating and analyzing tools. It will be essential to produce a comprehensive and study assessment for call support and defense strategy enhancement to safeguard the smart grid against the smart attacks (Li *et al*., 2012).

In the above proposal, sleep scheduling algorithm is implemented to improve the efficiency of packet transmission. The source node sends packets through a dedicated routing path to the neighboring node. The nodes are going to be stable and are going to awake only at communication time in the network. Hence, the energy consumption is to be minimized and nodes transmit or receive packets only at the time of wake up and after the process is finished the nodes will enter sleep state, so that transmission will be efficient. This proposed scheduling algorithm increases packet delivery ratio reduces time delay and consumes less energy.

MATERIALS AND METHODS

Sleep scheduling: Scheduling is important for rising up the life time of network that save the time and energy that the network becomes additional study versatile and economical. A scheduling in WSN is named the packet scheduling that is employed for managing the sequence of packets in wireless sensing element network of the transmit and receive queues of the wireless network interface controller that is employed as circular data buffer. The routing protocol is meant for WSN during which sensing element nodes square measure static. Besides, the applications are running within the WSNs need that the knowledge gathered by the sensing element nodes has to be completed and to be transmitted straight off to the sink. Moreover, it's additionally assumed that every node includes a distinctive Id and therefore, the communication between neighbor nodes is symmetric and bidirectional. Assumption is made that the sensor nodes clocks in the WSNs are synchronized and the nodes are triggered at the same movement and its proposed algorithm is executed. The objectives of the proposed routing algorithm with sleep scheduling are as follows:

- Most sensor nodes should be in sleep mode most of the time so that the energy consumption by each node is reduced
- Consumption of energy by all the sensor nodes remains balanced, i.e., at any time, every node should have consumed nearly the same amount of energy
- Load shared by each node must be same so, that no node is over used
- Time required to transmit data from a sensor node to the sink is as minimum as possible

In this algorithm, a broadcast tree is constructed using the approach given in. During the construction of the tree number of broadcast is kept as minimum as possible to ensure minimum energy consumption during tree construction. After the completion of tree construction, each node determines their parent node. Now each node is put into sleep mode. Whenever, a node detects an event it transit in active mode and transmit their data to their parent node and after transmission they again transit into sleep mode. This way data is transmitted from source to sink node whenever, a source node wants to send its data to sink node. The tree is reconstructed periodically to ensure balanced consumption of energy by all the nodes. As outlined above, the proposed routing algorithm with sleep scheduling consists of the following:

- Construction of the broadcast tree at the beginning of the every period
- Transmission of the data from source to sink whenever required

Procedure: The main aim of the proposed algorithm is:

- Many sensor nodes must be in sleep mode much of the time and that the energy usages by each node are minimized
- Energy consumption by all sensor nodes is equal that is at any instant the node must have taken the equal amount of energy
- Load shared by every node should be equal to that of no node is over used
- Transmitting the data time should minimum

In this algorithm, a broadcast tree made victimization the approach given in it. Through put, the development of the quantity of broadcast is unbroken as minimum as potential to make sure minimum energy consumption throughput tree construction. After finishing the construction every node identifies its parent node. Currently every node is placed into the sleep mode. Whenever, a node detects an occasion it transmits in active mode and transmit their knowledge to parent node and once transmission is finished they once more transmit into sleep mode. Like this the data is transmitted from source to sink node. To make sure the balanced consumption of energy, the tree is constructed once in a while all the nodes.

The following steps are followed with above mentioned details of the proposed algorithm:

- Building of the broadcast tree at the basis of each period
- Transmitting data from source to sink when needed

Procedure:
Step 1: Every node will have a sleep and listen schedule and maintain a sequence of schedules of neighbor nodes.

Step 2: Node listens to the period of time before choosing a schedule. If it has a schedule broadcast, it chooses that schedule and retransmits that after a varied delay. Or else it chooses a schedule and broadcast it.

Step 3: If a node gets a different schedule after choosing its schedule, it appears both schedules. Requires important degree of synchronization.

Step 4: Inside a listen phase, senders opposing to send messages to the same receiver uses 802.11.

Step 5: Whenever, a node listen an RTS (Request To Send) or CTS (Clear To Send) packet then it will move to sleep mode.

Step 6: All acquaintance of a sender and receiver sleep until the present transmission finishes.

Block diagram: Grid computing interact the packets and it is sent to the end to end communication. Analytical expressions for received packets are derived and the packet delivery ratio is computed. This technique reduces the energy used by packets and also calculates the delivery cost.

To represent the power grid as a topological network, few supposals are to be specified: In Fig. 1, part of the transmission network, a station in our facility cascading model is spoken as a node, despite its kind as a generator, a load or just go through transmission station. A transmission line which join one station at the end will be considered as a part in the network. Therefore, power grid is known as bidirectional un weighted graph which helps the computational cost at high level.

We should assign the load, on whom the failures depend on high level. From theory of high level power grid model, it is exposed that the load of a considered node is mainly affiliated to the connectivity or centrality of its neighbors. That is a node which is linked to more neighbor nodes or the nodes having direct neighbors with higher connectivity will be entertained to carry higher portion of load in the power delivery. Hence, the load of a node is described as the product of its degree and addition of all its neighbors. The procedure of the proposed method is given in flow chart Fig. 2.

Let F(x) be the degree of a node 'x' and 'Nr(x)' is the set of neighboring nodes of 'x' respectively, then the load for each nodes 'x' is denoted by G(x) is calculated follows:

$$G(x) = F(X)\sum F(d), n \in Nr(x) \quad (1)$$

Next, we should narrate the redistribution plan in the topological model when the target node (node 'x') is assailfcxed by attackers or cut by the cascading failures, the load will partly distributed to its neighbor nodes 'v_2Nr(x)' and the load of every active node (d) of the target is updated by the following Eq.:

$$\Delta G(d) = \frac{G(d)}{\sum_{v \in Nr(u)} G(v)} G(x) \quad (2)$$

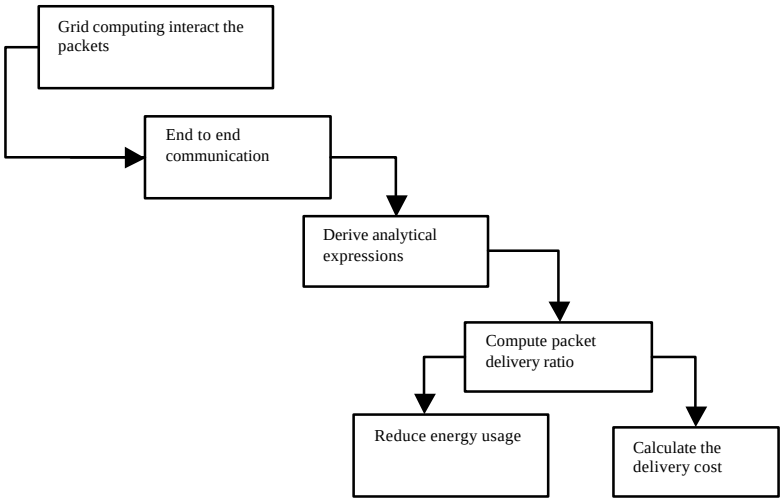

Fig. 1: Block diagram of the proposed algorithm

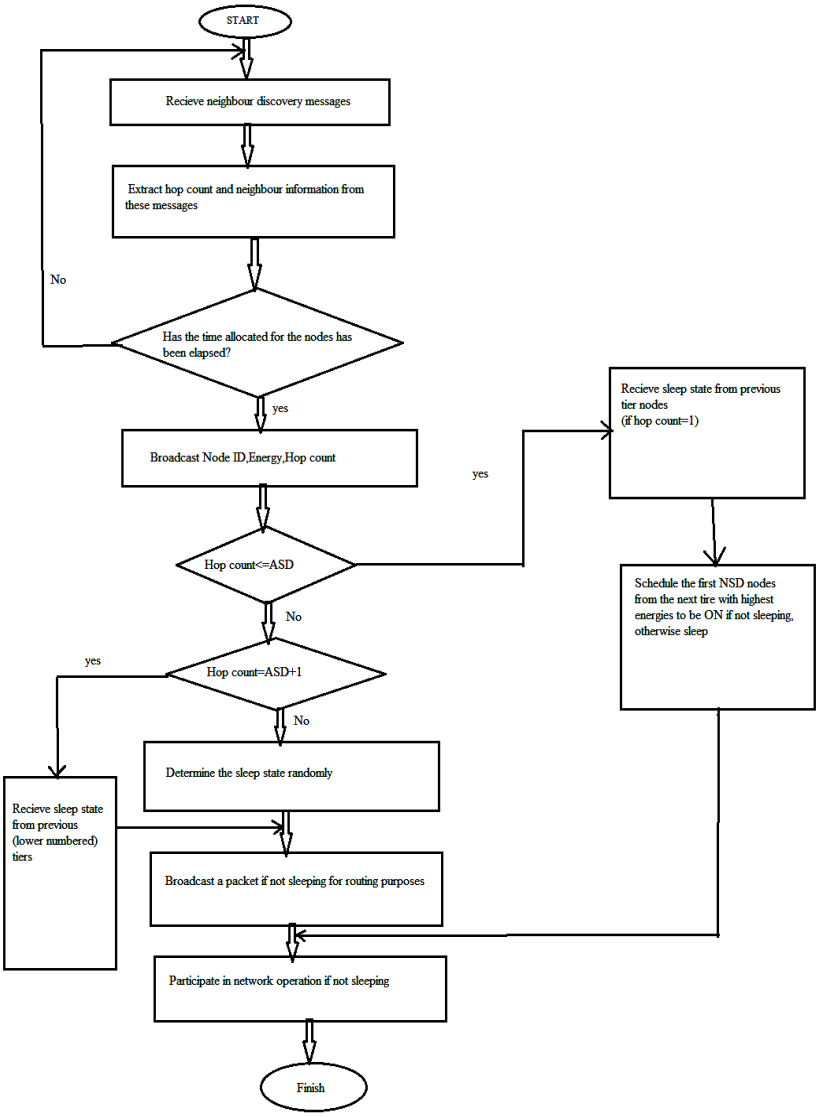

Fig. 2: Flow chart of the proposed design

RESULTS AND DISCUSSION

The Network Simulator (NS2) tool is used for the proposed algorithm testing and simulation purpose. The testing scenario, the nodes coverage area is specified within the limit of 1000 m x1000 m. The coverage is region the nodes movement is simulated time is 58 sec. The communication area of the nodes is 500 m. The following existing algorithms are considered for the comparison of the proposed method:

- QOD; QoS-Oriented Distributed routing protocol
- EQOD; Enhanced QoS-Oriented Distributed routing protocol
- IDEA; The International Data Encryption algorithm
- RSA; Rivest, Shamir and Adleman algorithm
- QOS; Quality of service-Oriented Security

The presented results are proved that the proposed method achieved the expected output and minimize the energy consumption. Cost for each edge has three components:

- Energy consumption for transmission
- Energy already consumed at each endpoint
- A suitable weighted combination of both

Table 1: Parameter comparison

	Proposed method		Existing method			
Simulation parameters	Sleep and awake	QOD	EQOD	QoS	RSA	IDEA
Efficiency (%)	95	90	85	80	80	70
Packet delivery ratio (%)	95	85	85	85	80	70
Power management	Maximum	Limited	Limited	Limited	Limited	Limited
Mobility	Fixed Base Station	Fixed Base Station	Fixed Base Station	Limited	Limited	Limited
Delay (sec)	0.20	0.40	0.60	0.65	0.70	0.70
Network lifetime	Very Good	Good	Good	Good	Less	Less

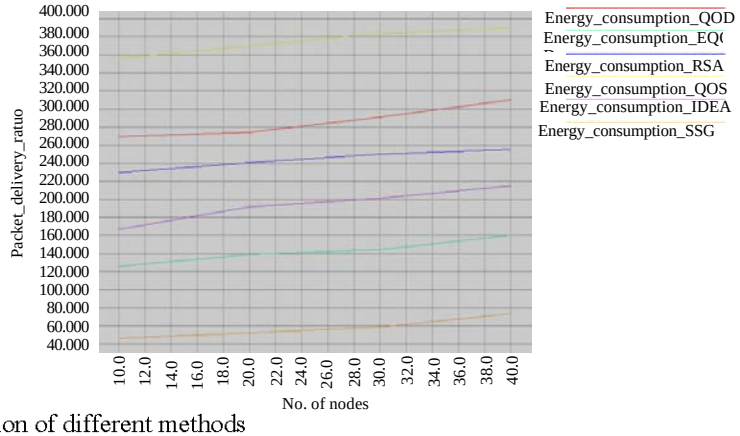

Fig. 3: Energy consumption of different methods

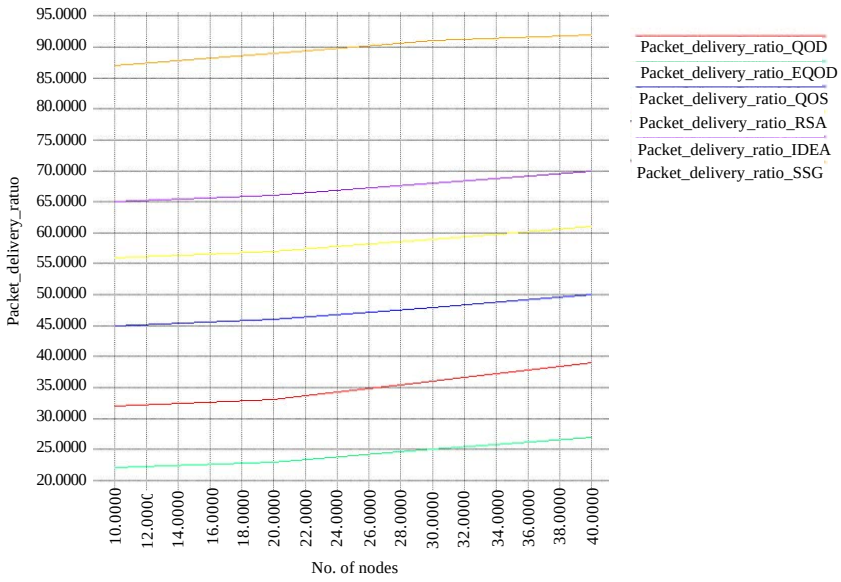

Fig. 4: Packet delivery ratio of different methods

Table 1 is shown the advantages of the proposed technique with existing methods. The performance of proposed method is analyzed by the following parameters with the existing different algorithms:

- Energy consumption
- Packet delivery ratio
- Packet loss
- Retransmission rate
- Delay
- Network lifetime and efficiency.

The results are clearly proved that the proposed method is performed better in all aspects (Show in Fig. 3-8).

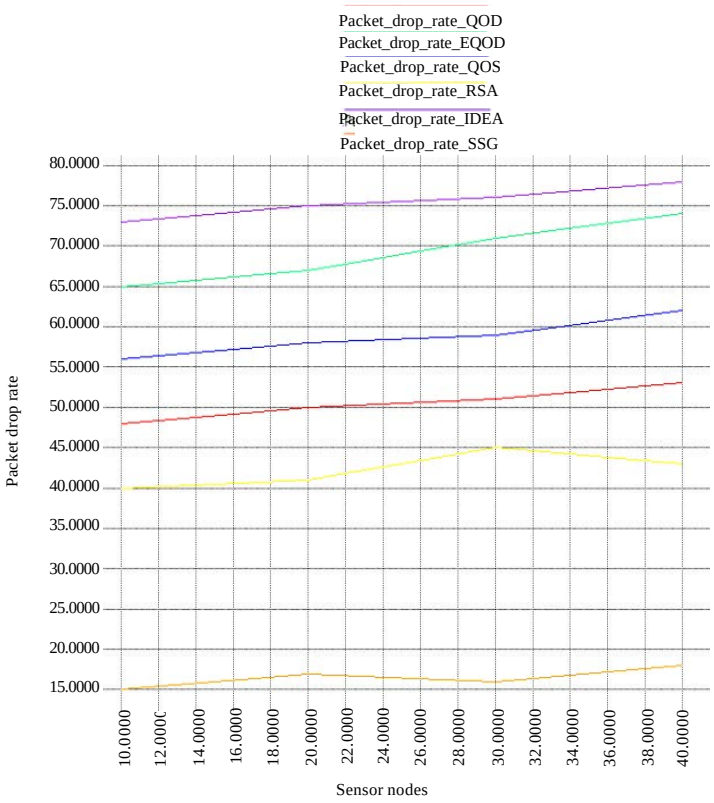

Fig. 5: Packet drop rate of different methods

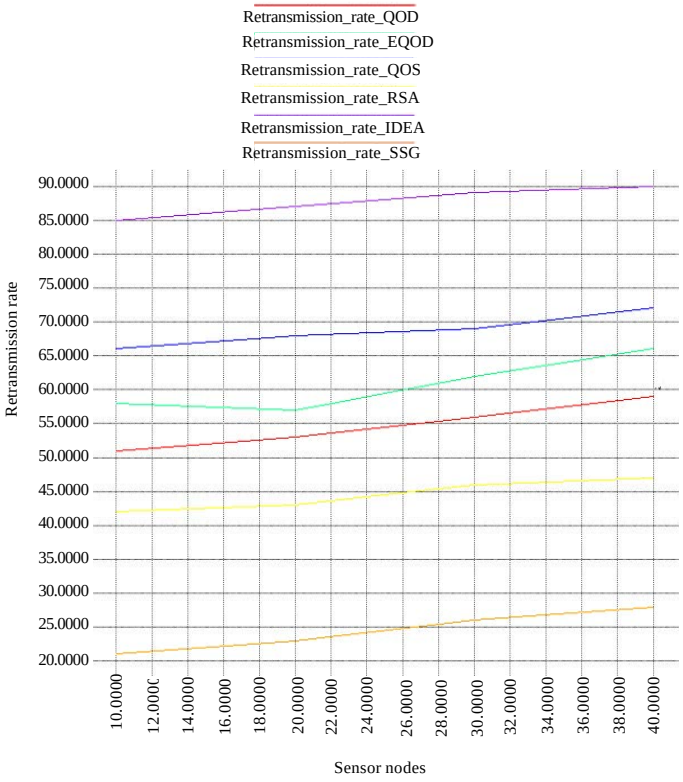

Fig. 6: Retransmission rate of different methods

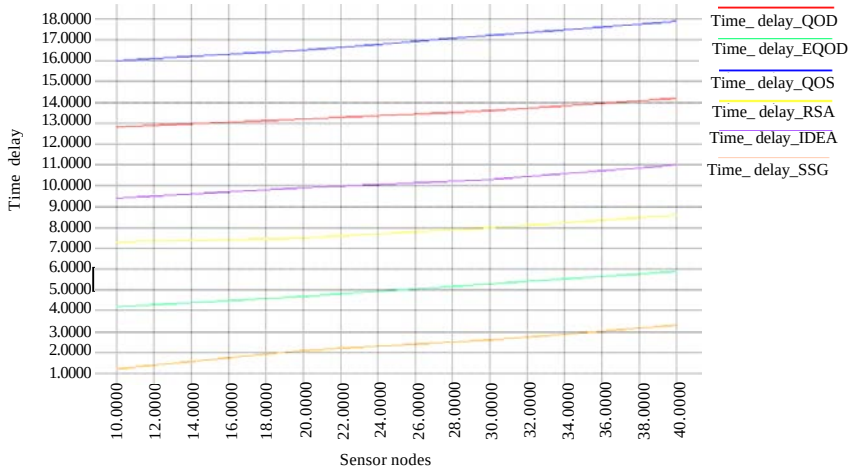

Fig. 7: Time delay analysis of different methods

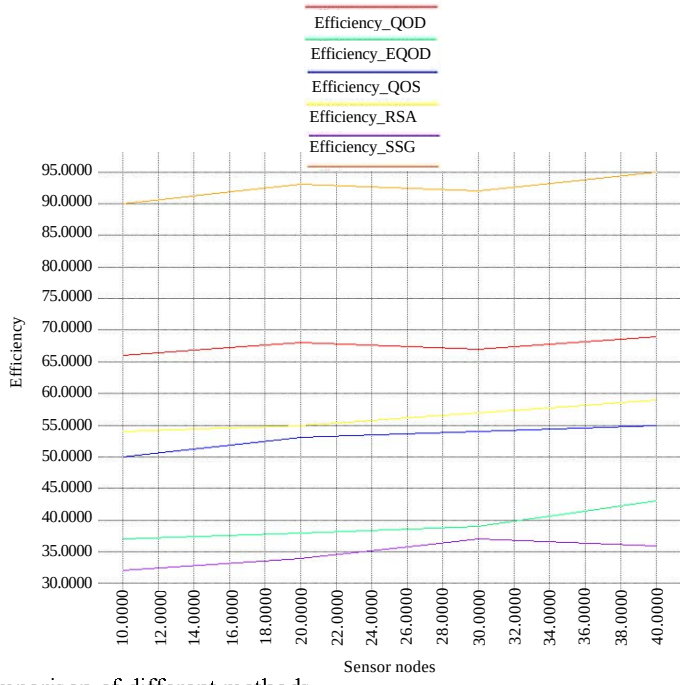

Fig. 8: Efficiency comparison of different methods

CONCLUSION

In the aggregation of data using sleep schedule, securely collect the information in grid to share information all over network upload to sink in smart grid. To control congestion reduces the time delay and improves Packet delivery ratio. In future, may propose a multi hop technique packet transmission up to reach target point. Every mobile collector gets information from sensor node, In movable mobile collector for dynamic network finally reach the target and upload that particular information to sink node.

REFERENCES

Acampora, G. and V. Loia, 2007. A Proposal of an Open Ubiquitous Fuzzy Computing System for Ambient Intelligence. In: Computational Intelligence for Agent-Based Systems, Lee, R.S.T. and V. Loia (Eds.). Springer, New York, USA., ISBN: 9783540731771, pp: 1-27.

Chen, P.Y., S.M. Cheng and K.C. Chen, 2012. Smart attacks in smart grid communication networks. IEEE Commun. Mag., 50: 24-29.

Di Bisceglie, M., C. Galdi, A. Vaccaro and D. Villacci, 2009. Cooperative sensor networks for voltage quality monitoring in smart grids. Proceedings of the IEEE PowerTech Conference, June 28-July 2, 2009, Bucharest, Romania, pp: 1-6.

Eppstein, M.J. and P.D.H. Hines, 2012. A random chemistry algorithm for identifying collections of multiple contingencies that initiate cascading failure. IEEE Trans. Power Syst., 27: 1698-1705.

Gungor, V.C., B. Lu and G.P. Hancke, 2010. Opportunities and challenges of wireless sensor networks in smart grid. IEEE Trans. Ind. Electr., 57: 3557-3564.

Kong, P.Y., 2015. Wireless neighborhood area networks with QoS support for demand response in smart grid. IEEE Trans. Smart Grid, Vol. 99. 10.1109/TSG.2015.2421991

Kounev, V., M. Levesque, D. Tipper and T. Gomes, 2015. On smart grid communications reliability. Proceedings of the 2015 11th International Conference on the Design of Reliable Communication Networks, March 24-27, 2015, Kansas City, pp: 33-40.

Kumar, M.K.J. and R.S. Rajesh, 2009. Energy-aware qos routing protocol for ad hoc wireless sensor networks: A survey. Int. J. Soft Comput., 4: 49-55.

Li, X., X. Liang, R. Lu, X. Shen, X. Lin and H. Zhu, 2012. Securing smart grid: Cyber attacks, countermeasures and challenges. IEEE Commun. Maga., 50: 38-45.

Menon, R.B., S.B. Menon, D. Srinivasan and L. Jain, 2013. Fuzzy logic decision-making in multi-agent systems for smart grids. Proceedings of the IEEE Symposium on Computational Intelligence Applications in Smart Grid, April 16-19, 2013, Singapore, pp: 44-50.

Niyato, D., Q. Dong, P. Wang and E. Hossain, 2013. Optimizations of power consumption and supply in the smart grid: Analysis of the impact of data communication reliability. IEEE Trans. Smart Grid, 4: 21-35.

Vaiman, M., K. Bell, Y. Chen, B. Chowdhury and I. Dobson *et al*., 2012. Risk assessment of cascading outages: Methodologies and challenges. IEEE Trans. Power Syst., 27: 631-641.

Yan, Y., Y. Qian, H. Sharif and D. Tipper, 2012. A survey on cyber security for smart grid communications. IEEE Commun. Surveys Tutorials, 14: 998-1010.

Yang, Q., J.A. Barria and T.C. Green, 2011. Communication infrastructures for distributed control of power distribution networks. IEEE Trans. Ind. Inf., 7: 316-327.

Yuan, Z., L. Wang, L. Shu, T. Hara and Z. Qin, 2011. A balanced energy consumption sleep scheduling algorithm in wireless sensor networks. Proceeding of the 7th International Wireless Communications and Mobile Computing Conference, July 4-8, 2011, Istanbul, pp: 831-835.

Zhang, Z. and M.Y. Chow, 2011. Incremental cost consensus algorithm ina smart grid environment. Proceedings of the 2011 IEEE Power and Energy Society General Meeting, July 24-29, 2011, San Diego, CA., pp: 1-6.