International Journal of Computer Science
Oddity...Probe...Reviste...

http://www.ijcsjournal.com Volume 2, Issue 2, No 3, 2014. ISSN: 2348-6600
Reference ID: IJCS-062 PAGE NO: 358-363.

QOS-AWARE ROUTING FOR IMPROVING PERFORMANCE IN COGNITIVE RADIO WIRELESS SENSOR NETWORKS

.PRADEEPAA[#1], S.UMAMAHESWARI[*2]
[#]RESEARCH SCHOLAR
Dr.GRD COLLEGE OF SCIENCE
SCHOOL OF IT & SCIENCE, INDIA
[1]pradee.venu@gmail.com
*ASSISTANT PROFESSOR
Dr.GRD COLLEGE OF SCIENCE
SCHOOL OF IT & SCIENCE, INDIA
[2]umamaheswari.s@grd.edu.in

***Abstract*— The Industrial Cognitive Radio wireless Sensor Network (ICRSN's) is one of the candidate areas wherever cognitive techniques are often used for opportunist spectrum access. In the cognitive radio sensor networks, the throughput and end-to-end delay is an important consideration. To perform high performance new technology has been introduced, known as QoS-aware clustering (QAC) for cognitive radio sensor networks. QoS (Quality of Service) is the idea that communication rates, lapse rates, and other characteristics can be measured and, improved. So, based on the four factors such as throughput, delay, energy, Packet delivery ratio the path is to be selected and the data can be forwarded through the ultimate optimal path. An experimental result shows that the system achieves less delay, high Packet delivery ratio.**

Keywords: Industrial Cognitive Radio wireless Sensor Network, Quality of Service, Delay, Energy, Packet delivery ratio.

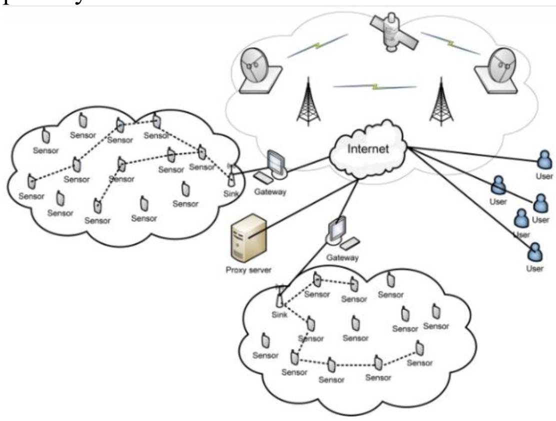
1. INTRODUCTION

Radio spectrum resources and regulation of radio transmission are coordinated by government agencies. Generally, a management body allocates spectrum to licensed holders called as primary users to exploit. However a large part of the assigned spectrum is not being used. By using cognitive radio technology [1], secondary users who have no spectrum license can access licensed bands without affecting the primary networks. There are two main challenges in cognitive radio networks:

- Spectrum sensing and analysis;
- Dynamic spectrum access.

The four sensing techniques [2] that can be applied to cognitive radio networks:

Matched filter energy detection, feature detection, and interference temperature techniques. The matched filter technique facilitates quick and accurate sensing. The energy detection technique requires simple hardware, but a long sensing time, which causes inefficient energy dissipation. Feature detection is utilized when certain features of the primary user's transmission are known in advance.



The interference temperature technique, allows a node to estimate how much interference it causes at the primary user. Therefore, energy detection is the main approach used for channel sensing in cognitive radio sensor networks. The concept of cognitive radio sensor networks was considered [3] and improved through recent literature. The main reason is to apply cognitive radio into wireless sensor networks are:

International Journal of Computer Science
Oddity...Probe...Reviste...
http://www.ijcsjournal.com Volume 2, Issue 2, No 3, 2014. ISSN: 2348-6600
Reference ID: IJCS-062 PAGE NO: 358-363.

1) The ISM band becomes too crowded. A number of wireless technologies share the industrial, scientific, and medical (ISM) band: IEEE 802.11[15] WLANs, Bluetooth/IEEE 802.15.1, or IEEE 802.15.4.
2) The sensor nodes do not generate data frequently so it can exploit the unused period from primary users.

3) The cognitive radio sensor nodes can operate over lower frequency bands, the sensor nodes can achieve better communication range and energy efficiency.

2. RELATED WORK

An energy-efficient packet size optimization problem for cognitive radio sensor networks (CRSN),[7]It is to determine the optimum packet size for CRSN that maximizes energy-efficiency whereas maintaining acceptable interference level for commissioned users and remaining beneath most allowed distortion level between the caterpillar-tracked event signal and its estimation at the sink[14][16][17] node. The energy- efficiency is the most significant for sensor networks, it chose's the optimized packet for its required size. Performance [9] bandwidth is available to the system in the form of system requirements it's used to solve the problem of ad-hoc network that formulates with use of available bandwidth in order to save energy. LEACH (Low-Energy accommodative cluster Hierarchy), [4] a clustering-based protocol that utilizes irregular rotation of native cluster base stations (cluster-heads) to equally distribute the energy load among the sensors within the network. It uses localized coordination to change measurability and strength for dynamic networks, and incorporates knowledge fusion into the routing protocol to scale back the number of information that has got to be transmitted to the bottom station. LEACH may be a self-organizing, accommodative cluster protocol that uses organization to distribute the energy load equally among the sensors within the network. In LEACH, the nodes can organize themselves into native clusters, with one node acting because the native base station or cluster-head. If the cluster heads were chosen a priori and stuck throughout the system life, as in conventional cluster algorithms, it's straightforward to visualize that the unfortunate sensors chosen to be cluster-heads would die quickly, ending the helpful lifetime of all nodes happiness to those clusters. The psychological feature radio device network (CRSN) and analyzes [6] its performance for supporting time traffic. The network opportunistically accesses vacant channels within the accredited spectrum. Once this channel becomes unprocurable, the devices will switch to a different obtainable channel. 2 varieties of channel change square measure considered; in periodic change (PS) the devices will switch to a new channel solely at the start of every channel change (CS) interval, whereas in triggered change (TS) the devices will switch to a brand new channel as before long because the current channel is lost. The property analysis, neighborhood management [10], and routing on dense device networks simple, low-power radios and restricted storage. It shows that link quality estimation and neighborhood management square measure essential to and tightly coupled with reliable routing in device networks. WMEWMA may be a easy, memory economical link figurer that reacts quickly however is stable enough for path characterization in cost-based routing. The FREQUENCY rule performs well in maintaining a set of excellent neighbors during an affected neighbor table notwithstanding cell density. Minimum expected transmissions is a good metric for cost-based routing, it doesn't need a predefined link quality threshold and is powerful below varied property characteristics. the mix of those techniques has been shown by trial and error to yield high end-to-end success rate in sizable networks on a resource-constrained platform.

3. EXISTING SYSTEM

The cluster theme outlined [5] so that it will reduce traffic in the networks and enhance network lifetime. The main obstacle in clustering schemes is inter-cluster interference that can limit the throughput in networks. In the existing method different techniques are suggested for improving the throughput.

- Code-division multiple access [10] (CDMA) or frequency-division multiple access [11] (FDMA) approaches. It allows clusters to operate simultaneously; so that end-to-end delay can be guaranteed. However, they require more frequency resources which are limited in ISM radio bands.
- The self-reorganizing slot allocation [11] (SRSA) scheme to minimize inter-cluster interference was introduced. SRSA can reduce inter-cluster interference without using as much of the spectrum as CDMA or FDMA.
- Throughput-Aware Routing method is suggested in the Industrial wireless Sensor Networks [8]. This routing formula is targeted at giant scale networks wherever knowledge square measure forwarded through totally different clusters on their thanks to the sink. By estimating the most output for every

International Journal of Computer Science
Oddity...Probe...Reviste...

http://www.ijcsjournal.com Volume 2, Issue 2, No 3, 2014. ISSN: 2348-6600
Reference ID: IJCS-062 PAGE NO: 358-363.

path, the data are often forwarded through the foremost best path.

4. PROPOSED SYSTEM

To improve the system performance new technique is introduced which is known as QoS-aware clustering (QAC) for cognitive radio sensor networks. This proposed method including the throughput the additional parameters such as

(1) *Packet delivery ratio:* The ratio of the quantity of delivered data packet to the destination. This illustrates the extent of delivered knowledge.

(2) *End-to-end delay:* The common time taken by a knowledge packet to arrive within the destination. It additionally includes the delay caused by route discovery method and the queue in knowledge packet transmission. Solely the info packets that with success delivered to destinations that counted.

(3) *Energy:* Energy will be consumed by its power.

To overcome the existing problem QOS-Aware Routing Algorithm is used in ICRSN's.

Algorithm: QOS- Aware Routing algorithm for industrial cognitive radio sensor networks

1. Initialize the nodes in the cognitive radio sensor network
2. Select the cluster head in the network
3. Cluster head estimate the status of the channels
4. $T_r = \frac{-\ln(1-p_i)}{\lambda}$ // Where T_r = length of the super frame, p_i = collision probability, λ=arrival rate of primary networks
5. Probability of a channel available is calculated as, $p_{i,k} = \frac{\hat{T}_{on}^{i,k}}{\hat{T}_{on}^{i,k}+\hat{T}_{off}^{i,k}}$ // where $\hat{T}_{on}^{i,k}$=average idle interval, $\hat{T}_{off}^{i,k}$ = average busy interval
6. Probability of the CH selecting channel I to communicate is $\theta_{i,k} = \frac{\hat{T}_{on}^{i,k}}{\sum_{j\epsilon A_i}\hat{T}_{on}^{i,j}}$ //A_i=set of available channels of cluster
7. // Channel set constraints
8. Reuse distance $d_{ru} = d_{tx}\sqrt{3C}$ //d_{tx}=transmission range, C=number of available channels
9. Reuse distance must satisfy $d_{ru} \geq d_{tx\,max} + 1.78 * d_{tx\,max}$ //$d_{tx\,max}$=maximum transmission range of the nodes
10. Selected the channel
11. // QoS –aware routing
12. Compute probability of two clusters communicate $P_c^{i\rightarrow j}(\Delta\tau) = \Pr\{T_{on}^{j,k} \geq \Delta\tau + t_{sa}^{i\rightarrow j} - t_0^j\} \times \hat{p}_{on}^{i,k}$
13. $\Pr\{T_{on}^{i,k} \geq \Delta\tau + t_{sa}^{i\rightarrow j}$ // where $\hat{p}_{on}^{i,k}$=estimated probability of channel, t_0^j=start time of time-slice
14. QoS factors for selecting optimal path
15. Maximum throughput from CH i to CH j can be given by, $T_{i\rightarrow j}^{max} = \int_0^{\infty}\varphi(\Delta\tau_{max})P_c^{i\rightarrow j}(\Delta\tau_{max})$
16. Maximum packet delivery ratio from CH i to CH j can be given by, $PD_{i\rightarrow j}^{max} = \int_0^{\infty}\varphi(\Delta\tau_{max})P_c^{i\rightarrow j}(\Delta\tau_{max})$
17. Minimum delay from CH i to CH j can be given by, $D_{i\rightarrow j}^{min} = \int_0^{\infty}\varphi(\Delta\tau_{max})P_c^{i\rightarrow j}(\Delta\tau_{max})$
18. Minimum Energy consumption from CH i to CH j can be given by, $E_{i\rightarrow j}^{min} = \int_0^{\infty}\varphi(\Delta\tau_{max})P_c^{i\rightarrow j}(\Delta\tau_{max})$
19. Joint metric of Maximum throughput, Maximum packet delivery ratio, Minimum delay, Minimum Energy consumption and inverse of queue length is computed as, $\eta_i^j = C \times \frac{T_{i\rightarrow j}^{max}}{\sum_{k\epsilon P} T_{i\rightarrow k}^{max}} + C \times \frac{PD_{i\rightarrow j}^{max}}{\sum_{k\epsilon P} PD_{i\rightarrow k}^{max}} + (1 - C$
20. $\frac{D_{i\rightarrow j}^{min}}{\sum_{k\epsilon P} D_{i\rightarrow k}^{min}} + (1-C) \times (1-C) \times \frac{L_j^{-1}}{\sum_{k\epsilon P} L_k^{-1}}$
21. Based on this the optimal path is selected.

5. PROCEDURE FOR SYSTEM IMPLEMENTATION

A. QOS-Aware Routing

In the proposed algorithm [12] [13], each CH can provide routing function. We assume that the topology of

International Journal of Computer Science
Oddity...Probe...Reviste...
http://www.ijcsjournal.com Volume 2, Issue 2, No 3, 2014. ISSN: 2348-6600
Reference ID: IJCS-062 PAGE NO: 358-363.

the CHs is a mesh network and that each CH is aware of its parents. CH j is the parent of CH if the distance or the number of hops to the gateway (the sink) of CH is smaller than that to CH. CH starts and ends inter cluster communication at and respectively. CH j starts and ends inter-cluster communication at and respectively. We denote and are the start time and stop time for exchanging data between CH i and CH j. The value of and can be determined as follows:

$$t_{sa}^{i\to j} = \max\{t_{sa}^{i}, t_{sa}^{j}\}$$
$$t_{so}^{i\to j} = \min\{t_{so}^{i}, t_{so}^{j}\}$$

CH will transmit to CH on the channel chosen by CH j. The parent and the child can communicate in seconds on channel when the idle period of channel in cluster j is the channel k in cluster i is available and the idle period of channel in cluster i is The probability of the parent and child can communicate in seconds can be determined as follows:

$$P_c^{i\to j}(\Delta\tau) = \Pr\{T_{on}^{j,k} \geq \Delta\tau + t_{sa}^{i\to j} - t_0^j\} \times \hat{p}_{on}^{i,k} \times \Pr\{T_{on}^{i,k} \geq \Delta\tau + t_{sa}^{i\to j}\}$$

Where is the estimated probability of channel being available in cluster i, is the start time of TS1 of cluster j , and k is the channel used in cluster j. The value of can be determined by,

$$\hat{p}_{on}^{i,k} = \frac{\hat{T}_{on}^{i,k}}{\hat{T}_{on}^{i,k} + \hat{T}_{off}^{i,k}}$$

If the idle periods of the primary channels are exponential distributions, we have

$$\Pr\{T_{i,k}^{on} \geq x\} = e^{-\lambda_{i,k}x}$$

The child can achieve maximum throughput when the inter-cluster communication interval is $\Delta\tau = \Delta\tau_{max}$. The throughput from CH to CH is given by

$$R_{i\to j} = \int_0^{\infty} \varphi(\Delta\tau) P_c^{i\to j}(\Delta\tau)$$

Where is a function of the available communication time and can be determined from

$$\varphi(\Delta\tau) = \begin{cases} \Delta\tau & if\ \Delta\tau \leq \Delta\tau_{max} \\ \Delta\tau_{max} & if\ \Delta\tau > \Delta\tau_{max} \end{cases}$$

the maximum throughput from CH i to CH j can be given by,

$$T_{i\to j}^{max} = \int_0^{\infty} \varphi(\Delta\tau_{max}) P_c^{i}.$$

The maximum packet delivery ratio from CH i to CH j can be given by,

$$PD_{i\to j}^{max} = \int_0^{\infty} \varphi(\Delta\tau_{max}) P_c^{i\to j}(\Delta\tau_{max})$$

The minimum delay from CH i to CH j can be given by,

$$D_{i\to j}^{min} = \int_0^{\infty} \varphi(\Delta\tau_{max}) P_c^{i\to j}(\Delta\tau_{max})$$

The minimum Energy consumption from CH i to CH j can be given by,

$$E_{i\to j}^{min} = \int_0^{\infty} \varphi(\Delta\tau_{max}) P_c^{j}$$

Joint metric of Maximum throughput, Maximum packet delivery ratio, Minimum delay, Minimum Energy consumption and inverse of queue length is computed as,

$$\eta_i^j = C \times \frac{T_{i\to j}^{max}}{\sum_{k\epsilon P} T_{i\to k}^{max}} + C \times \frac{PD_{i\to j}^{max}}{\sum_{k\epsilon P} PD_{i\to k}^{max}} + (1-C) \times \frac{D_{i\to j}^{min}}{\sum_{k\epsilon P} D_{i\to k}^{min}} + (1-C) \times (1-C) \times \frac{L_j^{-1}}{\sum_{k\epsilon P} L_k^{-1}}$$

Based on this the optimal path is selected.

B. Performance Evaluation

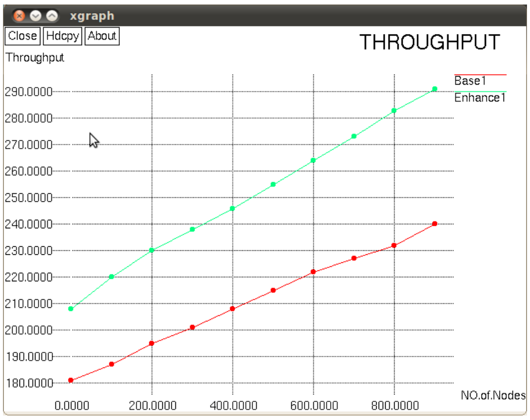
The performance is evaluated for the existing and proposed system. In the existing system, the maximum throughput for each path is estimated the data can be forwarded through the ultimate optimal path. In the proposed system, QoS-aware clustering (QAC) is proposed for cognitive radio sensor networks.

Throughput

In communication networks, such as Ethernet or packet radio, throughput or Network throughput is the rate of successful message delivery over a communication channel. The data may be delivered by a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot.

International Journal of Computer Science
Oddity...Probe...Reviste...

http://www.ijcsjournal.com Volume 2, Issue 2, No 3, 2014. ISSN: 2348-6600
Reference ID: IJCS-062 PAGE NO: 358-363.

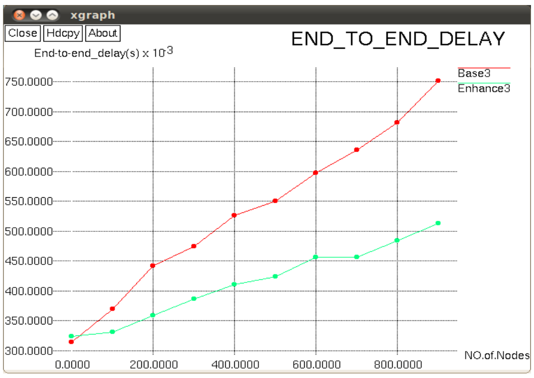


The throughput is shown are: The X-axis number of nodes is taken. Y-axis throughputs are taken. In this existing work, a routing algorithm to enhance throughput and end-to-end delay in ICRSNs is proposed. In the proposed system, QoS-aware clustering (QAC) is proposed for cognitive radio sensor networks. This graph clearly shows that if the number of nodes is increases the throughput is decreased in the existing system. But in the proposed system, there is throughput is increased.

End-to-end delay

It is defined as the average time taken by an information packet to arrive within the destination. It conjointly includes the delay caused by route discovery method and therefore the queue in information packet transmission. Solely the info packets that with success delivered to destinations that counted.

∑ (arrive time – send time) / ∑ Number of connections

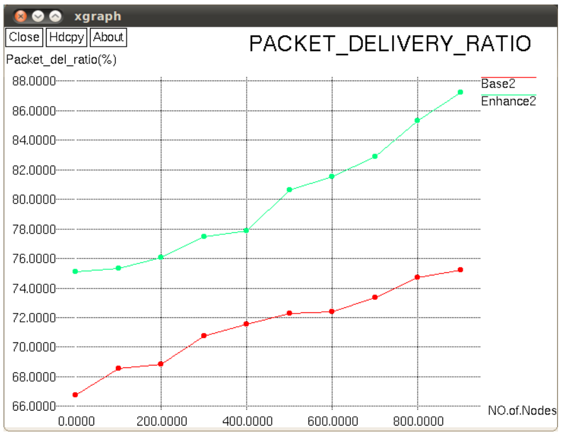


The end-to-end delay is shown during this graph. Within the coordinate axis variety of nodes is taken. The coordinate axis end-to-end delay is taken. In this existing work, a routing algorithm to enhance throughput and end-to-end delay in ICRSNs is proposed. In the proposed system, QoS-aware clustering (QAC) is proposed for cognitive radio sensor networks. This graph clearly shows that if the number of nodes is increases the end-to-end delay is increased in the existing system. But in the proposed system, there is end-to-end delay is decreased.

Packet delivery ratio

It is defined as the magnitude relation of the quantity of delivered knowledge packet to the destination. This illustrates the amount of delivered data to the destination.

∑ (Number of packet receive) / ∑ (Number of packet send



The packet delivery magnitude relation is shown during this graph. Within the coordinate axis number of nodes is taken. The coordinate axis packet delivery magnitude relation is taken. In this existing work, a routing algorithm to enhance throughput and end-to-end delay in ICRSNs is proposed. In the proposed system, QoS-aware clustering (QAC) is proposed for cognitive radio sensor networks. This graph clearly shows that if the number of nodes is increased the packet delivery ratio is decreased in the existing system. But in the proposed system, there is packet delivery ratio is increased.

6. CONCLUSION AND FUTURE WORK

The routing algorithm to enhance throughput and end-to-end delay in ICRSNs has been proposed. On the basis of the stochastic characteristics of primary channels, the proposed algorithm can select the optimal path to forward packets to sinks. Moreover, this scheme does not require synchronization between the sinks and every node in the

International Journal of Computer Science
Oddity...Probe...Reviste...
http://www.ijcsjournal.com Volume 2, Issue 2, No 3, 2014. ISSN: 2348-6600
Reference ID: IJCS-062 PAGE NO: 358-363.

network, which is practically difficult to achieve in a large-scale network. But this method only considers the throughput to select the optimal path. So, there are some other parameters like delay, packet delivery ratio, energy consumption. So, in the proposed system based on these parameters also the best path is selected to communicate the data in the network. In future cognitive radio network some of the secondary users are behave as the attackers to occupy the spectrum in the network. So, there is degradation in the network performance. So, to mitigate the attacks in the network is an important concern.

REFERENCES

[1]I. F. Akyildiz, W.-Y. Lee, M. C. Vuran, and S. Mohanty, "Next generation/ dynamic spectrum access/cognitive radio wireless networks: A survey," Comput. Netw., vol. 50, pp. 2127–2159, 2006.

[2]O. Akan, O. Karli, and O. Ergul, "Cognitive radio device networks," IEEE Network, vol. 23, no. 4, pp. 34–40, Jul.–Aug. 2009

[3] S. Haykin, "Cognitive radio: Brain-empowered wireless communications," IEEE J. Sel. Areas Commun., vol. 23, no. 2, pp. 201–220, Feb. 2005

[4] W. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "An application-specific protocol design for wireless microsensor networks," IEEE Trans. Wireless Commun., vol. 1, no. 4, pp. 660–670, Oct. 2002

[5] W. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy-efficient communication protocol for wireless microsensor networks," in Proc. 33rd Annu. Hawaii Int. Conf. Syst. Sci., Jan. 2000, pp. 3005–3014

[6] Z. Liang, S. Feng, D. Zhao, and X. Shen, "Delay performance analysis for supporting period traffic during a psychological feature radio device network," IEEE Trans. Wireless Commun., vol. 10, no. 1, pp. 325–335, Jan. 2011

[7] M. Oto and O. Akan, "Energy-efficient packet size optimisation for psychological feature radio device networks," IEEE Trans. Wireless Commun., vol. 11, no. 4, pp. 1544–1553, Apr. 2012.

[8] Pham Tran Anh Quang and Dong-Seong Kim, "Throughput-Aware Routing for Industrial device Networks: Application to ISA100.11a IEEE Trans. INDUSTRIAL scientific discipline, vol. 10, no. 1, Feb. 2014

[9]K. Sohrabi and G. Pottie, "Performance of a completely unique organisation protocol for wireless impromptu device networks," in Proc. IEEE VTC Fall, 1999, vol. 2, pp. 1222–1226.

[10]A.Woo, T. Tong, and D. Culler, "Taming the underlying challenges of reliable multihop routing in device networks," in Proc. ACM SenSys, 2003, pp. 14–27

[11]T. Wu and S. Biswas, "Minimizing inter-cluster interference by selfreorganizing raincoat allocation in device networks,"Wireless Netw., vol. 13, pp. 691–703, Oct. 2007.

[12]Wang H., Gao Z., Guo Y., Huang Y. A Survey of Range-Based Localization Algorithms for psychological feature Radio Networks. Proceedings of the Second International Conference on client physics, Communications and Networks (CECNet); Hubei, China. 21–23 Gregorian calendar month 2012; pp. 844–847.

[13] Wang H., Qin H., Zhu L. A Survey on raincoat Protocols for timeserving Spectrum Access in psychological feature Radio Networks. Proceedings of the IEEE International Conference on engineering science and computer code Engineering; Hubei, China. 12–14 December 2008; pp. 214–218.

[14] Weifa Liang, Jun Luo, Xu Xu , Prolonging Network life via a Controlled Mobile Sink in Wireless device Networks

[15]Yang D., Xu Y., Gidlund M. Wireless being between IEEE 802.11 and IEEE 802.15.4-based networks: A survey. Int. J. Distr. Sens. Netw. 2011;2011:1–17.

[16]YoungSang Yun and Ye Xia, increasing the life of Wireless device Networks with Mobile Sink in Delay-Tolerant Applications

[17]Yanzhong Bi, Limin Sun, Jian Ma, Imran Ali Khan, and Canfeng bird genus, HUMS: Associate in Nursing Autonomous Moving Strategy for Mobile Sinks in Data-Gathering device Networks.