A STUDY ON AVAILABILITY OF ENERGY AND LINK CLARITY FOR IOT

Kuldeep Singh Kaswan, Associate Professor, Department of Computer Science & Engineering, Galgotias University

ABSTRACT

Many people are enthusiastic about the Internet of Things (IoT) because of its wide range of applications, such as medical monitoring, environmental monitoring, and intelligent buildings. Internet of Things technology makes it possible for smart devices to connect at all times, everywhere, and about anything. An significant role of WSNs in facilitating widespread networks of smart devices, particularly low-cost and simple to instal, is presented in this context. Although sensor nodes are limited in terms of energy, computing, and memory, they're practical for limited tasks. Another contributing factor is the sensitivity of low-power radios to noise, interference, and multipath distortions. The paper discusses a routing system designed for IoT devices that leverages Routing by Energy and Link Quality (REL). The link quality estimator (REL) uses route selection algorithms based on the performance of an end-to-end link quality estimator mechanism, residual energy, and hop count to provide a reliable and energy-efficient system. Additionally, REL suggests using an event-driven approach to improve network and node load balancing, which helps to extend the lifetime of the network. The effects and advantages of REL were shown via simulations and testbed experiments that simulated and assessed networks on small and large scales.

Keywords: IOT, REL, Network.

Introduction

More wireless and sensor technologies are becoming more common, and in tandem with this, new IoT applications are taking off. The IoT consists of a collection of technologies that make it possible to be connected everywhere, all the time, and to everything. IoT is built on the notion that items or items interact and collaborate via wireless communication. Many types of embedded devices might be included, including sensor nodes, actuators, and mobile phones. When referring to ubiquitous computing, the purpose of Wireless Sensor Networks (WSNs) [2,3] is twofold: first, they link the real and virtual worlds; and second, they enhance real-world information access by sending data over long distances.

The overall effect of WSNs/IoT applications is considerable, including both societal advantages and financial gains. So in short, IoT/WSNs are finding academic, industrial, and government interest in offering solutions for next-generation technologies, such as more pleasant homes and workplaces, improved healthcare, environmental monitoring, and smart cities. Examples of these approaches to the food supply chain include ubiquitous systems and wireless sensor technology. Patients might carry sensors for vital signs including body temperature, blood pressure, ECG (electrocardiogram) and respiration in the event of an application for healthcare. Remote monitoring of patients will enable medical facilities to do enhanced monitoring for use in assessment [6]. SmartSantander is a Madrid-based experiment facility that supports a variety of municipal services and applications via real-world experiments, specifically in the Smart Cities sector. More than 20,000 IoT devices, organised into topologies with tens or hundreds of nodes, are present.

The detected data is often transferred to the Base Station (BS) for subsequent operations in many IoT applications. To make WSNs more energy-efficient, robust, and scalable, efficient routing protocols must be developed. However, a number of significant issues emerge because of the inherent properties of WSNs/IoT. For instance, the properties of WSNs/IoT make it difficult to create effective communication protocols, given the limited resources and the unreliability of low-power wireless links that tend to be lacking in terms of Quality of Service (QoS) requirements. At the same time, a multi-track routing protocol is needed which guarantees low-time data transfer, latency, loss rates and low energy consumption for diverse IoT applications[9].

In the context of routing protocols, the quality evaluation of communications between nodes is an essential factor in the routing discovery process. This is frequently assessed as a quality

Link Quality Indicator

A single number, such as the RSSI or the Link Quality Indicator (LQI)[10]. However, LQI/RSSI just offers a snapshot for one link between two nodes at a certain moment and has no further information regarding remaining energy, hop count and end-to-end connection quality.. There is therefore an urgent need for a reliable system to estimate the quality of the end-to-end link based on information from different layers (cross-layer)[11] and it is important to enable nodes that are able to transmit packets with a high level of trustworthiness while improving network life and support for IoT applications in general.

According to Rocha et al.[12], processor and memory restrictions in embedded systems likely to decrease due to recent technical developments. The energy limitation problem remains, nevertheless, a crucial one. In addition, an external energy source is frequently unavailable and battery replacement is not practical in large-scale networks as envisioned with IoT devices. Thus, both of WSN/key IoT's design aims are to minimise energy consumption and to extend the network's life.

Key Challenges

Another key challenge for WSN/IoT applications is how to reduce the power hole or hot-spot problem[13], in which nodes that are closest to the BS or in the most often used pathways tend to make premature use of their energy resources[14]. This creates a loss of connection between a node near BS and packets that are delivered but not received at BS, which causes energy and wireless resources to be inefficient. In order to minimise energy holes, the road selection strategy must take into consideration the residual energy and final connection quality while at the same time ensuring a load balance and equitable allocation for the restricted network resources.

Gived the above-mentioned qualities, a routing protocol for WSN/IoT scenarios must reduce the overhead signalling that increases computation and energy consumption in the nodes, as well as the packet loss and network latency. In addition, trustworthy routes need to be identified using a system for estimating the end-to-end connection quality based on cross-layer information, such network conditions, energy and hop counting. However, present IoT routing protocols do not take these crucial factors into consideration and new solutions must be designed.

The challenge of assuring reliability, energy efficiency and load balancing in the flat-based (homogenous) WSN/IoT systems is dealt with in this paper by presenting an expanded version of a routing protocol based on energy quality information (EI) [15]. REL seeks to overcome the disadvantages discussed earlier and enhance the data transfer for various flat-based IoT applications, including smart parking, intrusion detection and river-flux monitoring with low latency, packet loss and high reliabilty, as well as fair distribution of wireless resources. while increasing network life.

REL presents a cross-cutting information-based end-to-end route selection system with low overheads. To improve energy efficiency, nodes use an on-demand piggyback method to distribute their remaining energy to surrounding nodes. Furthermore, REL employs an event-driven mechanism to balance loads and avoid the issue of energy hole.

The following work [15] is extended in this article: I optimises the selection process using end-to-end quality assessment and energy information; (ii) applies a novel approach to smooth the link quality estimate; and (iii) performs an in-depth study of the suggested solution; Flat-based, large-scale networks. It includes novel simulation and test bed tests to demonstrate the impact and advantages of REL for IoT Systems. Compared to other well-known routing protocols, the findings reveal that REL boosts network life, promotes service availability and provides QoS support for IoT applications and reduces packet loss rates and overhead signage.

Conclusion

This article presents a routing protocol with an energy- and link-grade (REL) load balancing scheme for IoT applications, such as home automation and office automation, medical care, environmental monitoring and smart parking [16-19]. REL combines a dependable route finding and load balancing mechanism that offers great dependability, quality awareness and energy economy. In addition, it presents a route selection technique based on cross-layer data using a minimal overhead. Minimal overhead. Nodes become energy-efficient by delivering leftover power via a piggyback and On-Demand mechanism to their surrounding nodes. Furthermore, REL employs an event-driven technique to offer load balancing to increase system performance and prevent energy trouble.

References

1. Al-Shaqi, R., Mourshed, M., & Rezgui, Y. (2016). Progress in ambient assisted systems for independent living by the elderly. *SpringerPlus*, *5*(1). https://doi.org/10.1186/s40064-016-2272-8

2. Alirezaie, M., Renoux, J., Köckemann, U., Kristoffersson, A., Karlsson, L., Blomqvist, E., Tsiftes, N., Voigt, T., & Loutfi, A. (2017). An ontology-based context-aware system for smart homes: E-care@home. *Sensors (Switzerland)*, *17*(7). https://doi.org/10.3390/s17071586

3. Anthopoulos, L., Janssen, M., & Weerakkody, V. (2016). A Unified Smart City Model (USCM) for smart city conceptualization and benchmarking. *International Journal of Electronic Government Research*, *12*(2), 77–93. https://doi.org/10.4018/IJEGR.2016040105

4. Azariadi, D., Tsoutsouras, V., Xydis, S., & Soudris, D. (2016). ECG signal analysis and arrhythmia detection on IoT wearable medical devices. *2016 5th International Conference on Modern Circuits and Systems Technologies, MOCAST 2016*. https://doi.org/10.1109/MOCAST.2016.7495143

5. Canhoto, A. I., & Arp, S. (2017). Exploring the factors that support adoption and sustained use of health and fitness wearables. *Journal of Marketing Management*, *33*(1–2), 32–60. https://doi.org/10.1080/0267257X.2016.1234505

6. Cune, M. S., de Putter, C., & Hoogstraten, J. (1994). Treatment outcome with implant-retained overdentures: Part II-Patient satisfaction and predictability of subjective treatment outcome. *The Journal of Prosthetic Dentistry*, *72*(2), 152–158. https://doi.org/10.1016/0022-3913(94)90073-6

7. Fernandez, F., & Pallis, G. C. (2015). Opportunities and challenges of the Internet of Things for healthcare: Systems engineering perspective. *Proceedings of the 2014 4th International Conference on Wireless Mobile Communication and Healthcare - "Transforming Healthcare Through Innovations in Mobile and Wireless Technologies", MOBIHEALTH 2014*, 263–266. https://doi.org/10.1109/MOBIHEALTH.2014.7015961

8. Han, C., Jornet, J. M., Fadel, E., & Akyildiz, I. F. (2013). A cross-layer communication module for the Internet of Things. *Computer Networks*, *57*(3), 622–633. https://doi.org/10.1016/j.comnet.2012.10.003

9. Hu, F., Xie, D., & Shen, S. (2013). On the application of the internet of things in the field of medical and health care. *Proceedings - 2013 IEEE International Conference on Green Computing and Communications and IEEE Internet of Things and IEEE Cyber, Physical and Social Computing, GreenCom-IThings-CPSCom 2013*, 2053–2058. https://doi.org/10.1109/GreenCom-iThings-CPSCom.2013.384

10. Kim, S., & Kim, S. (2016). A multi-criteria approach toward discovering killer IoT application in Korea. *Technological Forecasting and Social Change*, *102*, 143–155. https://doi.org/10.1016/j.techfore.2015.05.007

11. Li, C.-T., Wu, T.-Y., Chen, C.-L., Lee, C.-C., & Chen, C.-M. (2017). An efficient user authentication and user anonymity scheme with provably security for IoT-based medical care system. *Sensors (Switzerland)*, *17*(7). https://doi.org/10.3390/s17071482

12. Petäjäjärvi, J., Mikhaylov, K., Yasmin, R., Hämäläinen, M., & Iinatti, J. (2017). Evaluation of LoRa LPWAN Technology for Indoor Remote Health and Wellbeing Monitoring. *International Journal of Wireless Information Networks*, *24*(2), 153–165. https://doi.org/10.1007/s10776-017-0341-8

13. Rathore, M. M., Ahmad, A., Paul, A., Wan, J., & Zhang, D. (2016). Real-time Medical Emergency Response System: Exploiting IoT and Big Data for Public Health. *Journal of Medical Systems*, *40*(12). https://doi.org/10.1007/s10916-016-0647-6

14. Ray, P. P. (2014). Home Health Hub Internet of Things (H3IoT): An architectural framework for monitoring health of elderly people. *2014 International Conference on Science Engineering and Management Research, ICSEMR 2014*. https://doi.org/10.1109/ICSEMR.2014.7043542

15. Shi, Y., Ding, G., Wang, H., Eduardo Roman, H., & Lu, S. (2015). The fog computing service for healthcare. *2015 2nd International Symposium on Future Information and Communication Technologies for Ubiquitous HealthCare, Ubi-HealthTech 2015*, 70–74. https://doi.org/10.1109/Ubi-HealthTech.2015.7203325

16. Thibaud, M., Chi, H., Zhou, W., & Piramuthu, S. (2018). Internet of Things (IoT) in high-risk Environment, Health and Safety (EHS) industries: A comprehensive review. *Decision Support Systems*, *108*, 79–95. https://doi.org/10.1016/j.dss.2018.02.005

17. Tyagi, S., Agarwal, A., & Maheshwari, P. (2016). A conceptual framework for IoT-based healthcare system using cloud computing. In S. A. Bansal A. (Ed.), *Proceedings of the 2016 6th International Conference - Cloud System and Big Data Engineering, Confluence 2016* (pp. 503–507). Institute of Electrical and Electronics Engineers Inc. https://doi.org/10.1109/CONFLUENCE.2016.7508172

18. Ukil, A., Bandyoapdhyay, S., Puri, C., & Pal, A. (2016). IoT healthcare analytics: The importance of anomaly detection. In T. M. J. A. J. B. Y. Barolli L. Enokido T. (Ed.), *Proceedings - International Conference on Advanced Information Networking and Applications, AINA* (Vols. 2016-May, pp. 994–997). Institute of Electrical and Electronics Engineers Inc. https://doi.org/10.1109/AINA.2016.158

19. Wang, X., Yang, C., & Mao, S. (2017). TensorBeat: Tensor Decomposition for Monitoring Multiperson Breathing Beats with Commodity WiFi. *ACM Transactions on Intelligent Systems and Technology*, *9*(1). https://doi.org/10.1145/3078855