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A Survey for Software Defined Wireless Sensor Network in Fragmentation Based Distributed Control System

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ABSTRACT

The software defined wireless sensor networks model is a new networking paradigm that arises as a result of applying software defined network into wireless sensor network. The controller, as in other software defined network based systems, holds the intelligence of the entire network. The software defined networking (SDN) is a new emerging networking and computing paradigm earmarked as a potential resolve of most of the above-mentioned challenges. Software defined network advocates for a common standardized protocol to avoid the challenge of vendor locking. In this paper we discuss various issues and challenges regarding software-defined networking in wireless sensor networks and in future want to provide the solution for the mentioned challenges or issues.

Keywords: Software Defined Networking, Cognitive Radio Networks, Wireless Sensor Network, Software Defined Wireless Sensor Networks, Industrial Internet of Things.

INTRODUCTION

The software-defined networking (SDN) is a new emerging networking and computing paradigm earmarked as a potential resolve of most of the above-mentioned challenges. SDN advocates for a common standardized protocol to avoid the challenge of vendor locking. The SDN model separates the control and data forwarding on the networking elements; thus, it removes the control logic from the network devices and centralizes it on a controller [1]. Software-defined wireless sensor networks (SDWSNs) are an emerging model formed by applying the SDN model in WSNs.

A distributed control system in SDWSN seeks to address the challenges of a centralized controller in order to achieve reliability, scalability, and efficient performance. There are different ways and forms of distribution mainly determined by the nature of the network or the data concerned. It presents an efficient distribution technique suitable for SDWSN control system. SDN addresses the shortcoming of the previous technologies by separating the data plane and the control plane. Particularly, switching elements in SDN involve data plane functionality (forwarding) since they are controlled and configured by a centralized controller. Then, controllers serve as central points to gather network view and network information to configure instructions and decisions on how the network resources should behave. Wireless sensor networks (WSN) is a self-organizing network composed of a set of sensor nodes [3].

The nodes perceive and collect the sensing objects' information in the monitoring area, and then transfer them to the user. However, the development and application of traditional network architecture are more and more difficult

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with the rapid development of computers and Internet technology. Traditional TCP/IP protocol in the new form of network environment cannot give full play to its advantages, which restricts the development for computer network technology.
Due to the event-driven nature of WSNs, resource constraints, many-to-one communications, number of deployed sensors and the high traffic of sensor nodes lead to the creation of congestion in the wireless sensor networks.

In WSNs, network congestion occurs when the offered traffic load exceeds the available capacity at any point in the network. Indeed, it can be mentioned that congestion is one of the highly critical challenges in WSN sand it has a profound impact on QoS parameters and the energy efficiency of sensor nodes. Moreover; congestion increases packet loss and degrades the throughput or wireless channels.

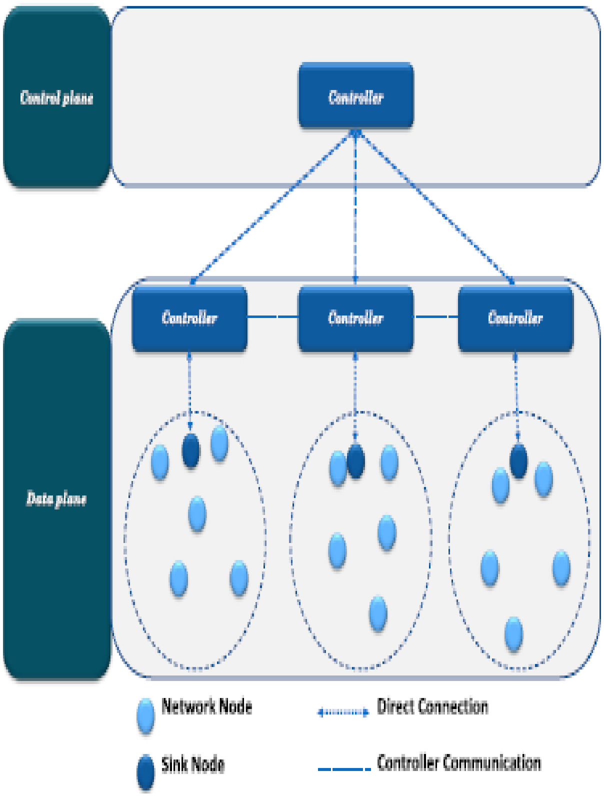

Figure 1: **Distributed control system with fragmentation [1].**

The main weakness of wireless sensor networks is related to the resource limitations of the sensor hardware namely processing, memory, energy and communication capabilities, although they are widely used due to the increased number of embedded devices available making deployment easier. However, other issues associated with management of large-scale WSNs arise with the increased node deployment such as meeting the necessary Quality of Service (QoS) for satisfactory operation even as nodes scale up to very large numbers. This is an important factor to consider especially in medical and industrial applications where quality and reliability are critical [4].

A Software Defined Wireless Sensor Network (SDWSN) is a new emerging paradigm for Low-Rate Wireless Personal Area Networks (LR-WPAN). It is realized by infusing the SDN model into a WSN. The SDN model has been applied in a variety of enterprise solutions i.e. data centers, network function virtualization (NFV) and enterprise networks. NFV is another concept closely related to SDN which virtualizes network functionalities for flexible provisioning, deployment and management. For developing an optimization programming formulation of the Fragmentation-based Multipath Routing (FMR) problem, to enable resilient data transmission, multipath routing has been proposed for several core and edge networks like the Internet, wireless sensor networks to address various network issues like energy balancing, maximizing throughput, minimizing end-to-end delay, load balancing and other traffic engineering issues .However none of these works consider a fragment routing problem to enable network resilience towards attacks by maximizing the route reliability.

The rest of this paper is organized as follows in the first section we describe an introduction of about the software defined wireless sensor network and fragmentation. In section II we discuss about the Software defined networking, In section III we discuss about the related work, their comparative study. Finally in section IV we conclude and discuss the future scope.

II SOFTWARE DEFINED NETWORKING

SDN is a concept developed to meet the demands of more flexibility in the networking implementations on Internet routers. In SDN, there is a decoupling defined between the control plane and the data plane with OpenFlow being the currently most successful standard. New network control and management solutions can easily be deployed by replacing the control plane functionality. OpenFlow is based on TCP, which means that the control function could run locally on the router or somewhere else, such as at a central server. Through the interface, the controller application can configure the forwarding tables of the router (or network switch). The task of the controller is to provide a coherent image of the entire network and provide it as one single entity towards the SDN applications. Typical SDN applications could be routing, but also other functions, such as access control and software-based traffic analysis, are possible.

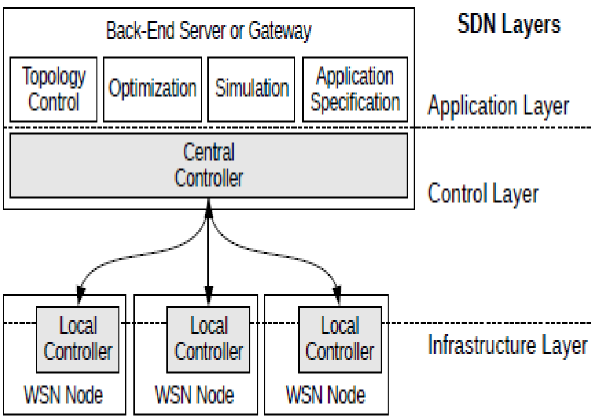

Figure 2: **Overall SDN architecture for a WSN [11].**

Above figure shows the overall architecture of our proposal with the SDN layers indicated. Each WSN node is equipped with a local controller, whose functionality can be as simple as just receiving and executing the commands from the central controller. The central controller communicates over the network with either the used routing protocol if it is running or simple networking principles, such as network-wide flooding. On top of this, message formats between the controller and the WSN nodes must be defined. On top of the central controller, there are one or more SDN applications. These applications can be related purely to the networking of the WSN, such as topology control and routing. In this architecture, some SDN applications may be directed towards the network operator staff with a user interface, while others are completely automated. SDN applications may use optimization solvers, simulators, specifically made algorithms, or a combination.

III RELATED WORK

[1] A distributed control system is proposed in this paper to address issues arising from and pertaining to the centralized controller. Fragmentation is proposed as a method of distribution, which entails a two-level control structure consisting of local controllers closer to the infrastructure elements and a global controller, which has a global view of the entire network. A distributed controller system brings several advantages and the experiments carried out show that it performs better than a central controller. Furthermore, the results also show that fragmentation improves the performance and thus have a potential to have major impact in the Internet of things. [2] This paper presents a comprehensive survey of major congestion control mechanisms used in WSNs and classifies the available methods into four categories i.e. traffic control protocols, resource control protocols, queue assisted protocols and priority-aware protocols. This review paper compares the important techniques with each other in terms of congestion detection, congestion notification and congestion mitigation as well as directions for future researches and works. [3] In order to improve the performance of wireless sensor networks and adapt the development of network technology, they proposed software defined wireless sensor network model which had hierarchy architecture and based on OpenFlow protocol under the software defined network architecture. Added the information fusion layer to the model, the Sink-nodes forwarded the link

information after the sensor-nodes had collected information. Fused and fragmented logically the node data information using network virtualization technology of the OpenFlow protocol. Managed centrally the path forward strategy by the controller, and then improved the network information forward mechanism under the new architecture. On that basis, simulated the new architecture model and contrasted traditional wireless sensor routing protocols. The experiment results show that the new architecture can extend the life cycle of network and improve network.

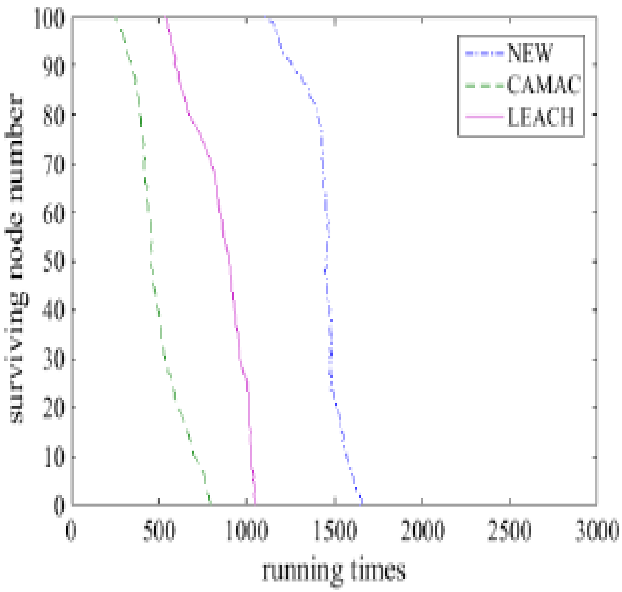

Figure 3: **Change of surviving nodes [3].**

[4] In this paper they have focused on some of the recent work on traditional WSN management in brief and reviews SDN-based management techniques for WSNs in greater detail while drawing attention to the advantages that SDN brings to traditional WSN management. This paper also investigates open research challenges in coming up with mechanisms for flexible and easier SDN-based WSN configuration and management. To ensure proper working order and network efficiency of such a network of sensor nodes, an effective WSN management system has to be integrated. However, the inherent challenges of WSNs such as sensor/actuator heterogeneity, application dependency and resource constraints have led to challenges in implementing effective traditional WSN management. This difficulty in management increases as the WSN becomes larger. Software Defined Networking (SDN) provides a promising solution in flexible management WSNs by allowing the separation of the control logic from the sensor nodes/actuators. [6] In this paper they have presented a wireless sensor networks topology optimization model based on complex network theory and cyber-physical systems using software-defined wireless sensor network architecture. The multiple-factor-driven virtual force field and network division–oriented particle swarm algorithm are introduced into the deployment strategy of super-node for the implementation in wireless sensor networks topology initialization, which help to rationally allocate heterogeneous network resources and balance the energy consumption in wireless sensor networks. Furthermore, the preferential attachment scheme guided by corresponding priority of crucial sensors is added into scale-free structure for optimization in topology evolution process and for protection of vulnerable nodes in wireless sensor networks. Software defined wireless sensor network based functional architecture is adopted to optimize the network evolution rules and algorithm parameters using information cognition and flow-table configure mode. The theoretical analysis and experimental results demonstrate that the proposed wireless sensor networks topology optimization model possesses both the small-world effect and the scale-free property, which can contribute to extend the lifetime of wireless sensor networks with energy efficiency and improve the robustness of wireless sensor networks with structure invulnerability. [7] In this paper, they have explained basics of WSN and SDN, describe fundamentals of SD-WSNs and how SDN can improve the operation of WSN. Furthermore, they have outlined the open challenges that need to be investigated in more detail and discussed lessons learned during the preparation. They also gave an introduction to SDN in wire line networks and to non-SDN WSN, they describe the architecture of

SD-WSNs, illustrate their operation, point out advances and research challenges. They also compare SDN-based and non SDN-based WSNs. General Requirements for deploying SDN. They provided a survey on the application of SDN in wireless networks. [8] In this paper they developed an optimization programming formulation of the problem to choose reliable paths that provide resilience to attacks. Using FMR, the SDN controller dynamically routes the data fragments along a set of most reliable paths to achieve multipath diversity and hence improve data availability at the destination even in the presence of an attack. They carried out performance studies and demonstrate the effectiveness of their approach in terms of weighted path reliability and blocking performance. Multipath routing has been proposed for several core and edge networks like the Internet, wireless sensor networks to address various network issues like energy balancing, maximizing throughput, and minimizing end-to-end delay, load balancing and other traffic engineering issues. [9] In this paper, they proposed a solution based on SDN that optimizes the energy use in MWSN. The network intelligence is placed in a controller that can be accessed through different controller gateways within a MWSN. This network intelligence runs a Topology Control (TC) mechanism to build a backbone of coordinator nodes. Therefore, nodes only need to perform forwarding task, they reduce message retransmissions and CPU usage. This results in an improvement of the network lifetime. The performance of the proposed solution is evaluated and compared with a distributed approach using the OMNeT++ simulation framework. Results show that the network lifetime increases when 2 or more controller gateways are used. [10] In this paper, they have suggested an energy model for wireless sensor networks that is based on the first issue; it can be called Coverage and Energy Strategy for wireless sensor networks (CESS). The scheme will attempt to achieve optimal coverage of the sensing area and energy balanced scheduling for all sensors. It can reduce redundancy of working sensor nodes by defining minimal number of active nodes in a sensing area. Thus the network lifetime will be maximized by reducing redundancy power consumption. With fault-tolerance, the highly dense nodes can increase the precision and collision of information, thus decreasing the lifetime of the networks. Reducing the unnecessary working nodes in dense deployment by efficient scheduling is a promising approach and a key factor for extending the network lifetime. The maximization of the network lifetime with limited battery capacity" and how to maximize the sleeping motes to conserve energy while maintaining coverage are important factors and fundamental challenges that have been the focus of many researchers and projects. [11] In this paper, they proposed architecture based on software-defined networking (SDN) for wireless sensor networks. Ideas of how to design and make use of the flexibility that SDN offers are presented. They discussed how SDN principles can lead to the use of commodity hardware in a wider range of WSN deployments and then tailor the software only to meet the requirements of the specific deployments and their applications. A few examples are introduced that demonstrate how the architecture can be used for networking, in-network processing, and performance predictions.

IV CONCLUSION AND FUTURE SCOPE

Wireless Sensor Networks are formed by interconnected nodes that are able to sense characteristics from the real world, to process this information and to exchange it with other nodes into the network. Software Defined Networking (SDN) is a paradigm that separates the control plane from the data plane. In order to accomplish this separation, it has a programmable controller which is in charge of control logic decisions and the network devices become forwarding devices. Applying the SDN paradigm into WSN is known as Software Defined Wireless Sensor Networks (SDWSN), and it has been seen as a solution for inherent problems. In this paper we present the comparative study for the software defined network in wireless sensor network and discuss about the improvement of the network.

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REFERENCES:-

[1] Hlabishi Isaac Kobo ,Adnan M. Abu-Mahfouz, Gerhard Petrus Hancke," Fragmentation-Based Distributed Control System for Software-Defined Wireless Sensor Networks ", IEEE Transactions On Industrial Informatics, February 2019, pp 901-910.

[2]Ali Ghaffari,"Congestion control mechanisms in wireless sensor networks: A survey", ELSEVIER, March 2015, pp 101-115.

[3] Tian He, Zhao Hai, Shao Shi-liang, "WSN Architecture Design Based on Software Defined Networks", ICACIE 2017, pp 154-157.

[4] Musa Ndiaye, Gerhard P. Hancke and Adnan M. Abu-Mahfouz," Software Defined Networking for Improved Wireless Sensor Network Management: A Survey", MDPI, May 2017, pp1-32.

[5] HLABISHI I. KOBO, ADNAN M. ABU-MAHFOUZ, AND GERHARD P. HANCKE," A Survey on Software-Defined Wireless Sensor Networks: Challenges and Design Requirements", IEEE Access, March 2017, pp 1872-1899.

[6] Ru Huang, Xiaoli Chu, Jie Zhang and Yu Hen Hu," Scale-free topology optimization for software-defined wireless sensor networks:A cyber-physical system", International Journal of Distributed Sensor Networks, May 2017, pp 1-12.

[7] Habib Mostafaei, Michael Menth," Software-Defined Wireless Sensor Networks: A Survey", Journal of Network and Computer Applications, June 2018, pp 1-18.

[8] Purnima Murali Mohan, Teng Joon Lim, Mohan Gurusamy," Fragmentation-based Multipath Routing for Attack Resilience in Software Defined Networks", RESEARCH GATE, Nov 2016, pp 1-5.

[9] Joaquin Aparicio, Juan Jose Echevarria and Jon Legarda, "A Software Defined Networking Approach to Improve the Energy Efficiency of Mobile Wireless Sensor Networks",KSII Transactions On Internet And Information Systems, June 2017, pp 2848-2869.

[10] Nam-Tuan Le and Yeong Min Jang, "Energy-Efficient Coverage Guarantees Scheduling and Routing Strategy for Wireless Sensor Networks", International Journal of Distributed Sensor Networks, May 2015, pp 1-12.

[11] Wenfeng Xia, Yonggang Wen, Chuan Heng Foh, Dusit Niyato, Haiyong Xie," A Survey on Software-Defined Networking ",IEEE Communication Surveys & Tutorials, First Quarter 2015, pp 27-51.

[12] Indrajit S Acharyya," Towards Wireless Sensor Network Softwarization", IEEE Conference on Network Softwarization ,June 2016, pp 1-18.

[13] Jesús Antonio Puente Fernández, Luis Javier García Villalba and Tai-Hoon Kim," Software Defined Networks in Wireless Sensor Architectures", MDPI,March 2018, pp 1-23.

[14] Martin Jacobsson and Charalampos Orfanidis,"Using Software-defined Networking Principles for Wireless Sensor Networks", SNCNW, May 2015, pp 1-5.

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