Impact of Software Defined Networking for Wireless Sensor Networks

Nidhi Dandotiya [1*], Abhinandan Singh Dandotiya [2], Dr. Shashikant Gupta [3]
[1] Department of Computer Science Application, ITM University, Gwalior, India
[2] Department of Computer Application, Aditya College, Gwalior, India
[3] Department of Computer Science Application, ITM University, Gwalior, India

Abstract

The main feature of Software Defined Networking (SDN) is the basic principle of decoupling a device's control plane from its data plane. This simplifies network management and gives network administrators a remarkable control over the network elements. As the control plane for each device within the network is now implemented on a separate controller, this reliefs individual devices from the overhead caused by complex routing. Specifically, this feature has been shown to be extremely beneficial in the case of resource-constrained Wireless Sensor Networks (WSNs). While keeping the control logic away from the low-powered nodes, the WSNs can resolve their major issues of resource under utilization and counter-productivity. This paper highlights the concept of Software-Defined Wireless Sensor Networks SD-WSN and the base station architecture for WSN based on SDN with a review of benefits of this technology. the importance of adopting the SDN in the WSNs as a relatively new networking paradigm. This is introduced through a comprehensive survey on relevant networking paradigms and protocols supported by a critical evaluation of the advantages and disadvantages of these mechanisms.

Key words - *SDWSN, SD frame work , Data Center, cloud services.*

I. INTRODUCTION

Wireless Sensor Network is the collection of sensing nodes that are sensing an event from physical object or process. These sensing nodes having limited battery power with processor and memory. In wireless communication take place in various form, the classical approach is direct transmission, nodes are directly communicated to Base Station. In this way in there is no right power for a given time amount balancing, a net-work point which is far away from base station will come to death first [1]. An improvement of the Direct Transmission is multi hop communication in which data is transmitted through multiple path i.e relay races. Multipath can have better energy performance as compared to Direct Transmission [2]. Both of the technique will not properly monitor the lifetime of system. To overcome deficiency a new technique proposed called clustering. In this technique sensor area is divide into sub area these area called cluster. All nodes in a given cluster directly communicate to Base Station [3]. Cluster head aggregate the data and send to the base station. Using clustering network is easy to maintain, scalable and most energy efficient technique. LEACH, CBR, EDG are popular technique for clustering. One of the main WSN performance limits is reliability, which is hard to accomplish due to not having enough workers, money, time, etc.) and communication abilities of sensor nodes. In today's WSNs, sensor nodes usually forward data to the closest neighbor. This involves that the largest amount of traffic is routed over nodes ne ar the gateway. Since electrical storage devices of these nodes quickly drain, the risk of network collapse increases. Different distributed routing sets of computer instructions have been proposed in literature to address this problem [4]. However, most of the solutions are too complex and much-improved in a way that practical implementation is not sustainable. In general, many built-in problems of WSNs are deeply rooted in the network architecture, because each node is used as self-ruling system prepared with all abilities to do things from physical up to application layer. So, besides traffic forwarding, the nodes perform many control tasks, including routing. Abilities to do things put into use on the nodes are changed to fit new conditions to the needs of sensing application. This cau ses an inconvenient situation bad effect on network use, because many networks are often sent out and used in the same or overlapping areas for the purpose of different applications, while the same goals could be reached with one programmable network [5].

Having in mind the problems said above, in this paper we think about in application of software Defined Networking (SDN) idea in putting into use of WSN infrastructure. SDN is compared to other things new model of network architecture, at first proposed for wired networks that disconnect the control logic from the traffic forwarding hardware. SDN network intelligence is controlled by one central place at programmable controller, which has worldwide view of the network and ability to change to fit new conditions the network behavior in real time via automated programs [6]. In this paper, we presented possible benefits of the SDN-based solutions for WSN architecture that could be put into use on open-source hardware flat supporting surfaces [7]. In particular, we have focused on energy efficiency issue, and demonstrated potential of SDN

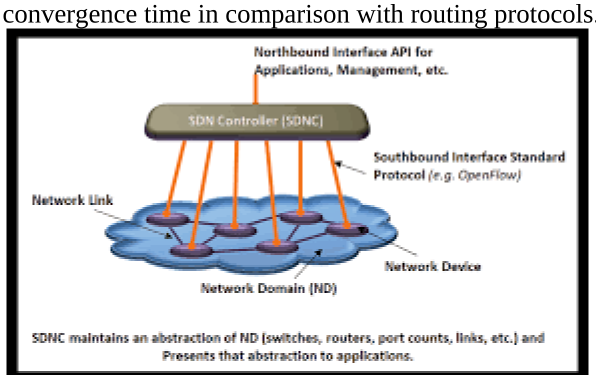
II. RELATED WORKS

An idea for managing WSN with SDN is proposed by Luo [3], with the concept of Software-Defined Wireless Sensor Networks SD-WSN. This study is based on the idea that each sensor node supports Open Flow, and sensors should be able to recognize the flow table's entries. This architecture proposes a separation between data and control plane. The Sensor Open flow (SOF) is a communication protocol between the control plane and data plane. The data plane contains sensor flow packet forwarding, and the control plane is a controller for performing routing and QoS network control. Zeng [4] has studied the Evolution of Software -Defined Sensor Networks, integrating sensors nodes into cloud computing using a SaaS. This model is named Sensing-as-a-service and combines the sensing data with existing cloud services such as mash up services. The controller is a sensor controller with SDN functionalities and it is provided with a local database to store sensed data. In this work the authors assume that every sensor node is able to deliver packets to a sensor control server. gante [5] presented base station architecture for WSN based on SDN with a review of benefits of this technology. The authors mentioned the use of an SDN controller as a base station in WSNs, but did not present any detail about communication between sensor nodes. The controller can determine the best routing, forwarding decisions and inserting these decisions into sensor nodes flow tables. In others words, the sensor nodes do not make routing decisions, they only forward and drop packets according to the rules set by the controller (base station). Contanzo [6] analyze the opportunities and challenges of SDN in IEEE 802.15.4 networks, implementing a scenario called SDWN. The controller is executed into sink nodes, and in order to communicate, each node must learn a path (as convenient as possible) to reach the controller. The controller periodically generates a beacon packet to send it to the nodes. Also, the nodes store the list of nodes from which they received a beacon packet. All discovered neighbors will be linked frequently to the sink node using a packet called a report packet. Flauzac [7] proposed a clustered WSN Architecture based on SDN. Every node in WSN may be one of the three states: simple node, gateway node and cluster-head node, and the cluster-head is called SDN cluster-head (SDNCH). Each cluster is called a SDN domain. In each SDN domain, the SDNCH is the controller, in charge of managing the operation of the sensor nodes. The collected information about the environment is processed on the domain by nodes and will be routed to the SDNCH, and the gateway is engaged in aggregating and transmitting the data from entire sensor node domains to the other domains.

Many solutions have been proposed by different authors in the SDN and WSN field, but in these solutions, the cluster-head forwards or drops the data from the sensor nodes according to whether mapping the rule of the flow table, this will waste the node's energy. this paper proposed a novel WSN architecture based on SDN, firstly, the controller only generate route table among cluster-heads, when the CH receives data from sensors, it forwards directly based on its route table; secondly, application can custom the scope of data collection for different type sensors.

III. ARCHITECTURE OF SDWSN

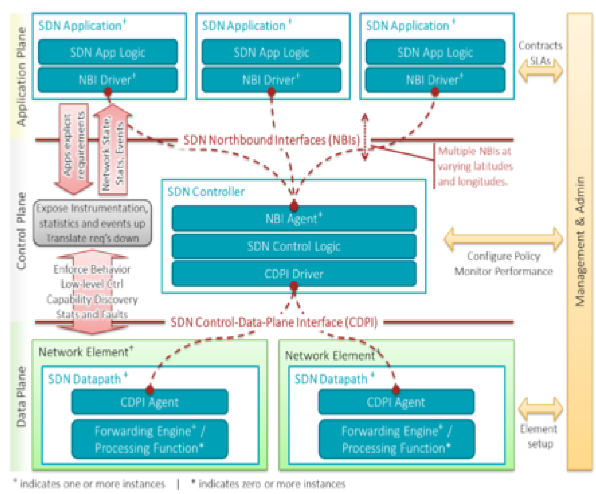
In this section, we introduce the concept of SDWSN and explain the different technologies for the realization of SDWSN. The WSN may contain hundreds or thousands of sensor nodes, and include a base station. The type of sensor nodes and their capabilities varies according to their application, such as temperature sensors, sandstorm sensors, etc. Normally, a large network cannot operate efficiently without some organized structure. For this reason, we propose to cluster the network. There exists one cluster-head (CH) in each cluster, and the other nodes are simple sensor (SN). In each cluster, the CH is in charge of managing the operation of the sensor nodes. With this clustering approach the collected information about the environment on the cluster by nodes will be sent to the CH. A software-defined sensor network relies on a logically centralized controller. From the network point-of view, the controller does not necessarily need be a standalone node. We propose that the control-logic be implemented as a part of the base station. In the software-defined sensor network framework, the sensor nodes do not have to make routing decisions. Instead, they forward packets to the next cluster-head or base station according to the route table generated by the base station. In other words, the routes which are considered the best according to application-specific criteria are calculated by the controller (in the base station). In this framework, the controller makes use of location information gathered by any localization technique when finding the best routes. In the base station architecture proposed by Gante [5], the controller needs to know the topology of the entire network SDN has a higher possible ability to develop forwarding decisions of SN based on the rules set created by the Controller, permitting a better cooperation among CH and SNs [3, 5, 6, 8]. More than that, SDN controllers [5], can reduce the energy use by different sensor nodes, making the best routing decision for the nodes. With the network management controlled by the SDN, the routing decisions and policies have low convergence time in comparison with routing protocols.



To deploy this architecture, CH has to manage the group-related network. Software-defined networking (SDN) is a architecture that aims to make networks athletic and flexible. The goal of SDN is to improve network control by enabling projects and service providers to respond quickly to changing business needed things.

IV. CHALLENGES WITHIN THE DATA CENTER

Businesses are more and more under pressure to respond to the ever-increasing demand from end-users and workers, who demand more from computer systems, networks, and mobile devices than ever before. As a result, service providers and projects are constantly exploring ways to keep up with fast changing and getting better technology popular things, business and end-user needed things, and to provide new and interesting applications and services with faster time to market. "Business Flexible athletic ability" is the is the watch word in this new world where providers are expected to put into operation and roll out services quickly. Software Defined Networking provides a new way of thinking that tries to respond to the new needed things of business flexible athletic ability and improved user experience. Many cloud -computing environments operate in an application-centric world, where virtualized computer programs are hosted within a public or private cloud. As a result, users can access their computer programs from anywhere, on any device, at any time. Users have access to more computer programs than ever before (on smart phones, tablets, etc.), and the user-experience of many of these computer programs has a dependency on the quality of the network. The Open Network Foundation (ONF) defines Software-Defined Networking as follows: "The physical separation of the network control plane from the forwarding plane, and where a control plane controls several devices." Within an SDN infrastructure, computer programs can request and get services from the hidden (under) network infrastructure. This ability leads to the development of more acting to prevent problems before they happen and energetic/changing computer programs that improve the user experience. SDN changes the way networks are designed and deployed, where the computer programs have more control on the setup of the network infrastructure. SDN offers businesses the chance to build networks with increased application knowing about something and intelligence about Layer 4 - Layer 7 rules of conduct attributes and delivery needed things. Software-defined networking allows infrastructure become much more automated and therefore able to change and get better to the needs of the uses performing (or requesting) the automation. Basic SDN solid basic structure on which bigger things can be built with 3 planes (showing central controller).



Basic SDN framework with 3 planes (showing central controller).

V. SDN SOLUTION FOR DATA CENTER NETWORKS

As cloud computing matures, more and more enterprises are moving services to cloud-computing platforms. What will next-generation data center networks look like? SDN offers a new approach to resolving data center network issues. For example, the Open Networking Foundation (ONF) has defined the SDN Open Flow communications protocol, which separates the forwarding plane from the control plane.

To better resolve data center network issues, This technique has been actively exploring SDN technologies and engaging in joint SDN invention in new things with partners. Collaborations include Tencent SRP (Sequoia Routing Protocol) and Microsoft NVGRE. Based on the strengths and practices of SDN, technique approaches data center network issues with these design invention of new things:

A. Cloud Service-Driven Hierarchy

Different user types and services present a range of concerns and requirements centered on network services, resources, devices, and forwarding stream customization. In a cloud service-driven hierarchy, the SDN architecture is divided into the management orchestration layer, controller layer, and device layer. Every network layer is abstracted, and network capabilities at each layer (including device, resource, and service layers) are open. User-facing interfaces are simplified so that users can select APIs in different layers for different service demands. The Huawei Enterprise Software Development Kit (eSDK) contains these APIs and uses RESTful, OpenFlow, and NETCONF as key interfaces to rapidly adapt platforms to service needs. Interfaces at the resource or service layers can be used – depending on actual situations – for cloud services and platforms, enabling the rapid provision of cloud services. The use of interfaces at these layers also eliminates the need to directly invoke device interfaces, which is generally quite complicated.
This technique also proposes using agile switches by opening the forwarding plane to:

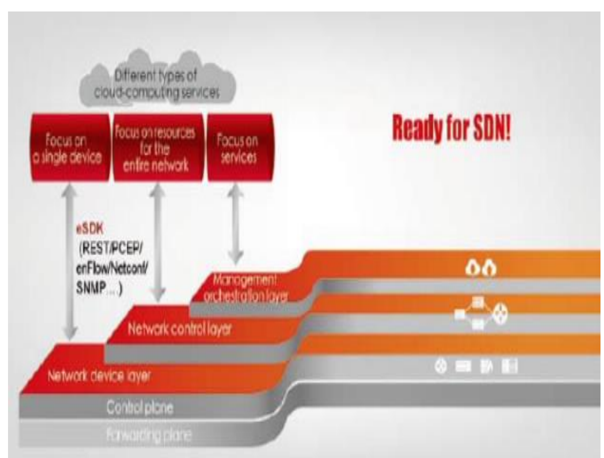
- •Provide greater network programmability;
- •Reduce the amount of time it takes to update hardware (closer to software update time) and gear networks towards the fast-changing needs of cloud computing;
- •Provide a hierarchical and adaptable SDN architecture capable of facilitating rapid service innovations for users.

B. Unified Network Virtualization

Network virtualization aims to classify, schedule, and expand network resources in a flexible structure. In SDN unified network virtualization, Layer 2/3 connections and value-added services are centrally integrated and managed by an SDN controller. At the network layer, unified overlay technologies are used to integrate intra-Data Center (intra-DC), inter-DC, and DC access and to manage physical and virtual networks from a central location. The SDN controller schedules network resources from end-to-end to facilitate fast provisioning of cloud-computing services. Unified network virtualization greatly simplifies network architectures and bearer technologies while ensuring flexible access at the edge layer and high-performance forwarding at the core layer. Moreover, unified technologies eliminate complex networking conversions and make networks simpler to manage, more efficient, and more easily scaled. With unified differentiation and orchestration under an SDN controller, device interconnectivity is further enhanced to guarantee fast connectivity and orchestration among multiple data centers.

C. Cloud Service Experience Optimization

The cloud service experience optimization function monitors and optimizes the user experience in real time. It can be deployed in conjunction with cloud services and network resources. This function provides service customization for users and enables unified management and control in real time. To meet end-to-end quality and O&M requirements for cloud services, the optimization function instantly identifies service quality issues and dynamically changes network operations through central controls. This function tools all these features immediately: identification of service quality issues, fault location, network recovery, and guaranteed service uninterrupted. Unique Packet Conservation Set of computer instructions for Internet (iPCA) presents a fresh approach to watch unusual things, etc. service quality and locating faults. When a network is being sent out and used, iPCA enables the network to monitor service quality through real-time monitoring of packet loss ratios, delays, and jitter on service paths. This function does not require manual action that helps a bad situation. It instantly reschedules network valuable supplies to make sure of a consistent end-to-end service experience energetically as needed changes to fit new conditions the network as demanded. This service-centric SDN architecture will be implemented in phases:



- • Local monitoring and local recovery;
- • Global monitoring and local recovery;
- • Global monitoring and global recovery.

SDN has resolved global monitoring issues using iPCA, which can be applied to any network or service and provides reference information and suggestions for local recovery.

D. Sustainable, Smooth Evolution

Smooth evolution focuses on making full use of existing networks. Uses a cloud controller (data center SDN controller V1.0) to provide a virtual machine moving automation solution for data centers. The cloud controller centrally manages and controls existing physical and virtual networks and connects to make part of the majority of people controllers over open APIs, putting into use automatic network policy moving will continue development of the cloud controller through cooperation with elated to a plan to reach a goal partners to provide comprehensive SDN solutions that address user demands while fully utilizing existing networks. This solution will allow users to benefit from SDN earlier than expected. This will also launch athletic switches with Rules of conduct-Unaware Forwarding (POF) to put into use high-efficiency forwarding on SDN networks. POF frees forwarding devices from the need to support special rules of conduct. By abstracting the controller and forwarding device connecting points to packet-forwarding instruction sets, forwarding devices are unaware of packet rules of conduct types. All packet-forwarding functions are controlled by the controller's software. By specifying data offsets and lengths, the controller reads or writes packet data using plain and common thing instructions. Decoupling software from hardware enables the forwarding and control planes to independently change, helping fast service use service without the need for hardware upgrades. In this way, This sustainable, smooth-architecture actively protects user investments. This Architecture provides mature SDN solutions to help users release the full possibility of existing networks and benefit from the advantages that SDN offers. This is also offers an smooth-change for the better SDN architecture that matches up customers' newly-built networks with future SDN developments through regular software upgrades.

VI. CONCLUSION

Conventional wisdom indicates SDN will first be applied to cloud data center networks to handle key issues, such as separation into different areas between the network and the cloud, immature network virtualization, poor user experience, and things that block or stop other things to network change for the better. These issues prevent networks from supporting mature cloud services. An expert once commented: "Networks always lag behind." Through joint innovation with partners, participation in standards organizations, and our own strengths in developing key technologies, This has proposed the following SDN architecture for data center networks:

- Cloud service-driven hierarchy;
- Unified network virtualization;
- Cloud service experience optimization;
- Sustainable, smooth evolution.

SDN allows data center networks to keep pace with IT development without any concern about performance or features by changing from one thing to another from closed to open networks, from hardware dependency to full programmability, from broken-up technologies to full quality promise, and from complete big change to gradual change for the better, over time. Using our in-house programmable hardware platform and data center controller, SDN architecture tools key technologies such as iPCA and POF while making combination of two things SDN available to existing networks. This makes sure of the system can complete instant supervising, local traffic optimization, and fast user service customization. This proposals include a gradual SDN evolution success plan of reaching goals that protects user investments by avoiding a complete network big change. With these new and interesting technologies, provides a stable, smooth-evaluation SDN platform to bring in users into the cloud-computing.

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