SDN: ROADBLOCKS IN THE EDUCATION SECTOR

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ABSTRACT

During the past few years the term Software defined network has been resonating frequently in the networking world. SDN, with its three layered architecture claims to simplify network management. This claim is supported by the fact that a significant amount of SDN implementation has happened in the data center sector. While the simplification of architecture is a welcome development for the network administrators, the purported benefits of SDN is yet to be seen or felt in the services sector. Whether this technology can benefit the developing and under developed countries is still questionable. Through this paper the authors try to understand if the so called benefits of SDN are valid and if it would be of any significance to service sectors like education, healthcare and small scale enterprises. Special attention has been paid to the current technology scenario in the education sector .This paper finds that setting up an SDN network is not cheaper when compared to normal network as claimed by the supporters of the new paradigm.

General Terms

SDN, programmable networks, computer networks

Keywords : Software defined network, SDN, Social impact.

I. INTRODUCTION

Over the past ten years researchers in the field of networking have been working hard towards simplifying network management – in terms of technique as well as costs. Their work has been revolving around the idea of programmable networks. This novel concept is popularly known as Software Defined Network. SDN is a networking paradigm with a three tiered architecture viz. applications, controller and physical and virtual devices [1].

In SDN the software called Controller provides an overview of the network and manages the network state. With this software as the network manager, a single network can be virtually partitioned to multiple networks and devices can be programmatically configured via APIs. With the control in the hands of a program, the network hardware can be rid of the proprietary software residing in them – thus making the network management easier and cheaper. This separation enables a large number of software-driven features in networking, allowing cheaper, but quicker deployment of a network and service infrastructure on demand [2]. It will uniquely enable network operators to move forward from the existing business of managing inflexible infrastructures towards software-enabled network features and service execution environments.

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Google, when it announced that its data centers were running on SDN, gave credence to the claims by SDN proponents [3]. But the question here is – how can SDN help our services sector which is languishing technologically? However great a technology is, it'll be considered meaningful if only it is of relevance to the society in general. There have been several instances where technologies that were claimed to be revolutionary and launched with much fanfare were rejected by the masses. Unless the general public finds it useful, any new product or architecture cannot be considered a success.

For instance, take the traditional computer network architecture - this is one technology that has been accepted and adopted and has become the core of communication. The traditional network with its numerous protocols binds the world together through the internet and allows us to communicate and share resources. Though setting up a network, and administering it, is not a simple task, we are in a stage where we cannot afford not to be connected to the internet. In some ways, it could be said that the internet controls our lives and this is the greatest proof of the success of the legacy network architecture. The proponents of SDN aim to achieve a similar level of success and with the entry of SDN in the data centre segment a beginning has been made. But, is the success in enterprise and data centre sufficient?

If software defined network has to make an impact, its proponents have to target the small scale businesses and academic institutions which are at present reeling under the pressures of network management or lack of it. Unfortunately, no such attempts have been made to popularize the paradigm among the above mentioned groups.

This paper compares SDN with traditional networks and argues that the social impact of SDN will be considerable only if there is a better awareness among the common users. In section II, we compare SDN with the traditional networks. In section III we discuss the state of technology scenario in education sector. Section IV analyses the SDN awareness level in educational institutions. In Section V, we compare the cost of setting up a simple network with that of an SDN. Finally in section VI, we conclude our paper.

II. SDN v/s Traditional Networks

The traditional network requires that the network elements be programmed individually when implementing routing protocols like OSPF or IS-IS. Moreover, a network administrator should have a complete knowledge of the physical and virtual network infrastructure as well as a lot of parameters that should be configured on different network elements to enforce a consistent network wide policy. In other words, several lines of configurations in command line syntaxes specific to each equipment manufacturer, or several mouse clicks in GUI based proprietary software – these are the only ways to configure the network. This method is error prone and could lead to improper configurations when global network policies are configured on each individual network element spanning a very large network.

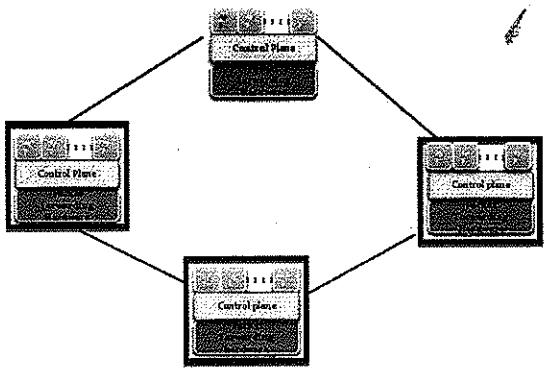

Figure 1: Classical network

The complexities discussed above are essentially because current network architecture operations are based on a distributed control plane model. Some of these operations are locked in to vendor hardware, thus limiting innovation and adoption of new network services. In other words, legacy network hardware components are islands with their own features, interfaces and policies [4].

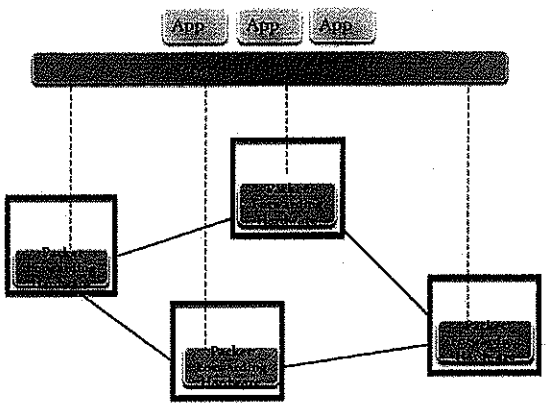

Figure 2: Software defined network

In the SDN architecture, the control plane is decoupled from the data plane and is centrally located. The OpenFlow protocol forms the communication channel between the data plane and the control plane.

The global view that the controller has of the network enables it to manage the state of the network. The northbound API in SDN allows the network specialists to control the devices. The splitting up of the control plane from the data plane makes it convenient for the SDN network to incorporate newer devices [2].

III. Technology In Education Sector

In this section we highlight some of the rampant issues faced by the education sector in India. Unless steps are taken to rectify these issues, the standard of technology education will remain below par.

Though computers have become an integral part of education right from the primary level, the education sector is plagued with technology related issues – such as lack of skilled technicians, outdated hardware and software, and in some cases, no hardware or software at all. This is especially true for schools in rural areas.

Educational institutions in the country can be grouped on the basis of their financial strength as privileged and underprivileged. Most of the privileged schools make use of high end technology in classrooms such as virtual class rooms and mobile devices. Though these devices assist in learning, their usage demands the existence of a good network. As the number of devices increases, so does the complexity of the wireless network. Better technology demands better configuration and management viz. highly skilled network administrators - unfortunately they are a species which are endangered.

The scenario is slightly different for underprivileged institutions- first and foremost; it would be a matter of

elation if a computer network exists in such schools. These, schools which are financially weak, too face a similar shortage of skilled personnel to manage their existing wired networks (if at all they have one). In most schools the teachers themselves take up the job of technical support even though they have no experience in handling network related issues, resulting in wastage of teaching hours. The situation is so bad that in many schools the network is down for days at a time.

The next section focuses on the technology issues faced by the schools in South India.

IV. Awarness Of Sdn In Education Sector In South India

It was ten years ago that Brewer et.al had stressed on the need for a cost effective network infrastructure in rural regions [5]. Some other publications also have discussed the effectiveness of shared computing model in developing nations [6]. Unfortunately since then, not much has been done to learn about the usage and awareness of networking technology in developing nations. To get some information about the same in the education sector, the authors conducted a study on the awareness of networking technology and its usage across 100 schools in South India. The education sector was chosen mainly due to the fact that information technology is a part of the curriculum from primary classes.

To get the requisite information, data was collected from among various K12 schools in Karnataka, Kerala and TamilNadu. The purpose of the study was to determine the infrastructure availability, awareness and skill level among the faculty and network administrators. A sample of 100 schools was included in the survey with equal importance being given to urban and rural schools [7]. Table 1 shows the state wise breakup of schools from where data was collected.

Table 1: State wise break up of schools

	No. of schools state wise		
Grand Total	Karnataka	Kerala	Tamil Nadu
100	61	28	11

Though most of the financially strong schools were network enabled, out of the 33% which were not connected, many of them stated financial constraints and lack of networking technology awareness to do the same. Some exceptions in this group were the high end schools which charged 0 .5 lakh per annum and owning up to 90 computers. They simply did not find the need for getting connected. When asked about the future plans, 90% of the non networked schools replied that they did not have plans to set up a network at all. Most of the schools stated either of the two reasons – 1) Financial constraints 2) They did not find the need to set up one.

Table 2: Schools with plans for a network

	Plans to set up a network	
Total	Yes	No
33	4	29

Another fact that came up was that 61% of the schools did not have a separate resource for managing the

network. The network administration was either outsourced or the responsibility of the faculty.

Except for some top level schools, most of the schools were using outdated software and devices, such as Windows 2000. Administrative staff were found to be lacking in technical knowledge. In some schools, the concept of computer network had to be explained while collecting the data.

When asked if they had heard about the technology of SDN, only 26% answered in the affirmative. All of these schools belonged to the privileged category. The others, though they were unaware of the concept of SDN were receptive to the idea of a network being managed by software.

V. Cost Ananysis Of An Sdn Network

Gigaom Research ran a survey in December 2013 amongst 600 network operators in North America [8]. Over 60% cited network management & operating expenses as major issues that need to be taken care of. The supporters of SDN claim that since the control plane is decoupled from the data plane, the implementation and management is not only flexible[9] ,but also cost effective in terms of operational expenses[10].

To understand if implementing an SDN network in the services sector would be of any financial benefit, we tried to compare the costs of setting up a traditional network and a software defined network for a school with 20 to 25 systems We took into consideration only the cost of network equipment involved and not that of the communication links or that of the computers. It was assumed that the school in question already had invested some amount for the purchase of computers. Around 20 of these would be in Lab and the rest would be in administration section.

A typical network in this case would require desktop access switch for the lab, a 5/8 port normal switch for the office and a core switch to connect to the router and server.

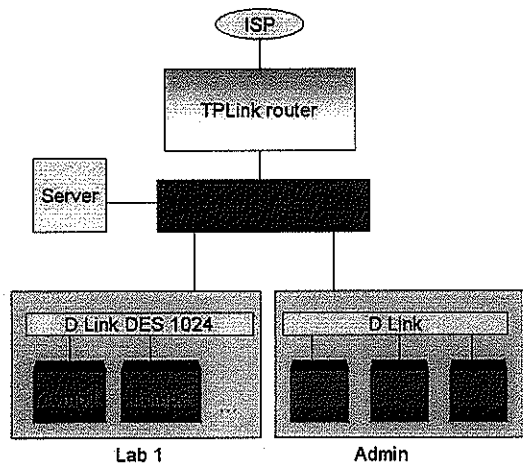

Figure 3: The classical network layout

The following table shows the devices that would be required to set up a simple network for a school owning 20 systems and their approximate cost per unit quantity. As the number of systems increases, accordingly the number of desktop switches and the distribution switches would have to be increased.

Table 3 : List of devices required for a small network

Hardware	Model/Spec	Approx. Cost
ROUTER	300MBps TPLink router (TL-WR1043ND)	Rs.4700/-
SWITCHES	Cisco 24 Ports 90 Series Unmanaged Switch (SF90-24)	Rs. 2,800
	D-Link DES-1024D 24-Port Fast Ethernet 10/100 Desktop Switch	Rs. 2,500
	5/8 Port Normal switch (DLink)	Rs.500/-
PATCH PANEL	Rack mount or Wall mount 24-Port Cat6 RJ45 Patch Panel	Rs 3500
I/O PORT	Dlink CAT 6 I/O Se t Face Plate with Gang Box	Rs 350
TOTAL		Rs.14,350/-

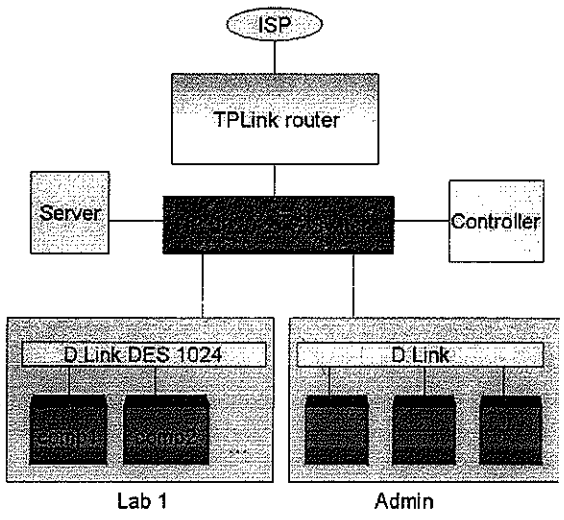

Figure 4: SDN network layout

The table (Table 4) below shows the devices and the approximate expense that would be incurred to set up an SDN network for a school with 20 systems[1]. SDN would require additional controller software which could be either commercial or open source. Networking giants such as Cisco and HP have been offering commercial controllers. Apart from these, Nicira, Brocade, Plexxi, Juniper and IBM too have their own offerings. But, since the licensing and support fee for these commercial controllers are on the high end, open source controllers such as Floodlight[11] or Ryu[12] can be used. Floodlight is a Java based controller whereas Ryu is Python based.

[1] The data listed was collected after extensive discussions with a few network administrators within India and abroad One of the major roadblocks faced during this process was that the concept of SDN was not well known among the Indian network administrators. Moreover all the earlier and current implementations focused on data centers, large enterprises and research test beds. Implementing SDN for a school or a small network had not been considered before.

Table 4: List of devices required for an SDN network

Hardware	Model/Spec	Approx. Cost
ROUTER	300MBps TPLink router (TL-WR1043ND)	Rs.4700/-
SWITCHES	HP 2920-24G Switch (J9726A)	Rs. 54000/-
	D-Link DES-1024D 24-Port Fast Ethernet 10/100 Desktop Switch	Rs. 2,500/-

	5/8 Port Normal switch (DLink)	Rs.500/-
PATCH PANEL	Rack mount or Wall mount 24-Port Cat6 RJ45 Patch Panel	Rs 3500/-
I/O PORT	Dlink CAT 6 I/O Set Face Plate with Gang Box	Rs 350/-
TOTAL		Rs.65,550/-

The cost analysis of the traditional network and the SDN network shows that, at the time of this research, the claims of SDN being cost effective when compared to the legacy architecture is not true. The reasons for this are manifold - the most important being the fact that SDN is a new paradigm and not yet standardized. SDN has been adopted and marketed only by a few hardware vendors thus making it a niche product. Moreover, the hardware devices being sold now are high end devices which makes them all the more expensive.

It would be unfair to expect the smaller businesses and schools to adopt SDN when the cost of setting it up is enormous. To gain acceptance, the costs would have to come down and visibility should increase. An invisible technology is as good as nonexistent.

VI. Conclusion

With the focus on technology education growing in the primary and secondary school sector, it becomes absolutely important that the schools are provided with updated technology at an affordable cost. But once such a technology is provided, it is also necessary to ensure that it is put to good use – and for this technically competent faculty and staff are required. While the classical network is cheaper and widely available, its potential remains untapped in the education sector due to lack of awareness and resources. On the other hand, SDN, with its global network management and network virtualization promises, remains largely unavailable, difficult to set up due to lack of skilled personnel and also hugely expensive. Unless network vendors do not manufacture cheaper, low end SDN enabled devices and promote SDN for small scale networks, this scenario is going to remain the same for some years to come.

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