Information Security Literature Review

Question

**Task:** In this assessment, you are required to provide a complete report of your research project, that you chose in Assessment 3 (Research Project Abstract) by discussing the following aspects:

* Overview of the technology involved
* Relevant technologies and applications of those technologies
* Highlighting the challenges/problems in your chosen research area
	+ discussing areas/issues that you believe have been addressed in the current literature;
	+ highlighting areas/issues that have not been addressed or adequately addressed; and
	+ discussing your view(s) on the issue(s) that you see as being critical.
* Summarize the future research directions based on the identified gaps

**Answer**

**Introduction:** The recent era has seen development of many disruptive technologies and one of the most innovative of them is the internet and the factors that are associated with it Development of internet and advances in information and communication technology or ICT incorporating mobile communication, cloud computing, social networking, big data, multimedia and the increased inclination towards digital society. It has resulted in the growing complexity in their management and configuration which have also turned out to be extremely difficult and time-consuming (Masoudi&Ghaffari, 2016, pp.16). Along with these, extendibility, having access to high bandwidth as active and vigorous management are of crucial importance, particularly when it comes to the vertical integration of the network devices. Hence, a set of exceptional or inimitable predefined chains of command and operating systems or firmware has to be put to use(Masoudi&Ghaffari, 2016, pp.16). Applications that are in use in the contemporary world, such as E-Commerce, IPTV, Online Shopping, and several other, are always hungry for bandwidth. This hunger for bandwidth creates the need for further and further bandwidth as well as demands continuity in bandwidth(Shahzad, Mujtaba, & Elahi, 2015, pp.42). The SDN (software-defined networking)in the deemed scenario, appears. SDR refers to a structure that has been designed for the simplification and improvisation of network management having high flexibility through the separation of the data plane from the control plane and as a consequence, network programmability gets augmented which in turn sets in motion supplementary innovation prospects (Masoudi&Ghaffari, 2016, pp.16). The discussed report has attempted at earning an insight into the SDN. To achieve, the discussed objective the paper will review the literary work of the past and will summarize the findings accordingly to conclude the paper. The gap and scope after reviewing the literature will also be discussed before concluding.

**Literature Review**

**a. Overview of Technology:** Software Defined Networking (SDN) is a tool, which has developed as one of the promising solutions that has the potential to change the cost outline and quickness of the internet protocol (IP) networks(Braun & Menth, 2014, pp. 320). Theoretically, SDN takes apart the logic of network control from the underlying hardware that is has, and in the process allows the network administrators to exert better. Additionally, the network gains higher control over the functioning of the network and provides an integrated comprehensive view of the entire network (Jammal et al., 2014, pp.80). Software-defined networking (SDN) is a methodology for using open protocols, for example Open Flow, to put into operation universally accepted software control at the periphery of the network in order to access network switches in addition to routers that by and large would utilize closed as also proprietary firmware(Braun & Menth, 2014, pp. 320). Software Defined Networking supports organizations in their attempt at acceleration of deployment and delivery of application, thereby reducing IT costs to histrionically low levels owing to policy-enabled automation of work-flows (Cisco).The discussed system is readily associated with the protocols designed for the Open Flow. It has also been stated that the traditional network is static in nature and the networks of today’s industry need flexibility and scalability. SDN technology permits cloud architectures owing to the provision of automatic, on-demand delivery of application as also its mobility in terms of scale (Cisco). SDN comes into view as a practical or feasible alternate network architecture that permits for programming the network and introducing the possibility of creation of novel services a&applications. It also offers higher efficiencies with the power of covering the actual requirements (Caraguay et al., 2014, pp. 2014).

**b. Applications:** Usage of network in addition to their demands are rising at a very swift pace, despite the fact that the network administrators are having to face difficulties in keeping a track the access of the frequent users to the network (Jammal et al., 2014, pp.80).SDN refers to a network architecture that has the capability to eliminate the stringency and inflexibility that is present in conventional networking (Caraguay et al., 2014, pp.8). Software-defined networking pulls off management of network routing with the support of control software that is logically centralized and split up the network data plane from the control plane and this new design prototype momentously sets network innovation free (Gong et al., 2015, pp.840). The intertwining of data and the control plane is the primary reason behind the growing complexity of the design of conventional network devices especially routers and network switches. The control plane includes one or in cases more controllers that acts as the core processing unit of the plane. It even compels the network operators to keep their network controls concealed to avoid unnecessary risks (Gong et al., 2015, pp.840). Software-defined networking or SDN, as it is popularly called, has earned a huge amount of attention in contemporary years, for the reason that it is able to address the deficiency of programmability in the accessible networking architectures. At the same instance, it makes easier and speedier network innovation possible (Braun & Menth, 2014, pp. 320).Software-defined networking along with providing clear separation of the data plane from the control plane also facilitates implementations of software pertaining to the complicated networking applications (Braun & Menth, 2014, pp. 320). It creates the scope for the use of less restricted and less expensive hardware that can be regulated by the use of any software applications by means of standardized interfaces (Braun & Menth, 2014, pp. 320). In addition to this, there exists the anticipation for higher flexibility through the dynamic addition of innovative attributes to the network in the shape of networking applications. Additionally, the deemed perception is identified from operating systems of mobile phones, such as Apple’s iOS and Google’s Android, in which “apps” can animatedly be added to the system (Braun & Menth, 2014, pp. 320).

A Software Defined Networking application refers to a software program that has been designed to accomplish every task in a software-defined networking (SDN) environment. Application-Aware Networking is another approach with many prospects for providing superior quality of application to its users. Within the circumstances that are constrained by the limited network resources, such as the present-day access networks and with the use of Software Defined Networking, a specifically remarkable and interesting method for enabling management of flow-based traffic in networking systems has turn out to be available (Jarshel et al., 2014, pp.75).

Software Defined Networkinghas the potential to benefit only the data centers and cloud computing but its application can be found in case of service providers, healthcare organizations and Internet of Things (IoT) networks. It is also making the use of the technology as it remains on the track to maturity (Jacobs, 2017). SDN is significantly altering the manner in which the data center networks are taken care of and utilized. A few examples of the important applications and services that are supported and optimized by SDN include Network Intelligence and Monitoring, Security Services, Applications related to Compliance and Regulation, High-Performance Applications and Distributed Application Control and Cloud Integration (Kleyman, 2016). Software Defined Networking has the capacity to make network design significantly easier by letting the administrators aggregate the physical resources, plug them towards a conceptualized management layer (SDN). It also gives shape to rational and clever, programmatically constituted controls in the vicinity of the entire network which means that a person is able to hand out network resources to various applications and other resources(Kleyman, 2016).

**c. Challenges:** The significance of every technology is the benefits offered by it, however it does not deny the fact that there are challenges also offers significant challenges. Every technology has to face certain challenges especially in the developmental stage and Software Defined Networking, as a novel approach, is no exception. Despite the fact that Software Defined Networking is considered to be afresh research issue, it has received attention from a large number of researchers from not only industrial but also from academic institutes.Software-defined networking has to tackle a big challenge with regard to the contemporary knowledge that exists in present-day data centers(Horvatha, Nedbal&Steininger, 2015, pp.554).Integration of an SDN within a commercial entity requires the estimation of a ballpark figure related to the desired number of controllers through the determination of the topology along with the localization of the said controllers. Additionally, to this, a dearth of knowledge is likely to result in extreme security risk because of the fact that the controller of a software-defined network, who is centralized, may become extremely susceptible in comparison to the conventional forms of networks(Horvatha, Nedbal&Steininger, 2015, pp.555).SDN faces certain security issues such as

Unlawful access which means that a controller or an application that is compromised is able to gain admittance to the aspects pertaining to the network and maneuvers the countless activities.

Dataleakage takes place whenever the assessment of the time undertaken by the packets at the time of moving in the node of the switch may possibly result to release of information (Kreutz, et al., 2015, pp.34) and it may lead to the rise of the DoS attack.

Another challenge is the alteration of the data. This pertains to the risk of man-in-the-middle attacks which are the usual form of attack in the SDN, which is present between the controller and data plane objects. Between the controller and data plane, the network virtualization layers are present, which are susceptible as well.

Applications that are conceded or malicious also present great challenge. It is conceivable for every illegal or conceded application to undertake possession of the system.The reason behind the above-sated statement is that any third-party application is likely to be assimilated with the controller which comprises of northbound APIs(Scott-Hayward, O'Callaghan, & Sezer, 2013, pp.6).

Denial of service is the kind of attack, which has been identified as one of the most prominent and informal forms of attack over the SDN controllers as there occurs a large number of phony packets that are directed to the switch from the in-charge for attacking to cause a deluge of the packets with messages(Yan & Yu, 2015, pp.55).

Further than simple understanding of the basic point of SDN, users are required to define the issues that they intend to solve prior to making ant investment in the technology. IT organizations do not really desire for Software Defined Networks but they look for innovative ways that can provide them some value addition. The factors that act as inhibitors to SDN comprise of its dearth of forceful use or business cases, and undeveloped strategies related to vendors and the gross immaturity of the contemporary products only broadens the problem (McNickle, 2013). With SDN, new-age computing, network along with storage devices and features are available for use without any significant loss of time. At the time of carrying out only daily checks on whatever is novel to the existing organizational or business environment, these active, instantaneous modifications indicate crucial breaches invisibility (Bakalov, 2015). software-defined Networking plays a significant part in paving the way for effectually virtualizing and supervising the network resources as and when there is a demand (Govindarajan, Meng, & Ong, 2013). SDN is still in an immature and developmental stage, and all along the way to its evolution, it is highly essential to take a look at the ways in which vigorous real-time change, swift on-demand growth.Incorporation of context of service is also likely to play a crucial part in empowering not only a successful deployment but also in avoiding the gaps in the visibility of implementation in your infrastructure (McNickle, 2013).

It has to be kept in mind that SDN is a very new approach in networking, which is why a large number of solutions to problems that existed in classical form of networking have been reexamined though the use of the SDN architecture. Additionally,several of the problems that already existed in classical networking continue to remain quite challenging for SDN(Benzekki, Fergougui, & Elalao, 2016, pp. 5816).

**d. Gaps in Literature:** Software-defined networking presents boundless opportunities that can be exploited for increasing the efficiency and at the same time chopping of the costs and bringing down the complexity(Horvatha, Nedbal, & Stieninger, 2015, pp.560).

There exists a significant shortage of knowledge, and this in combination with the high level of intricacies, when it comes to amalgamation with the traditional networks, are the key causes behind the delayed dissemination of the technology (Horvatha, Nedbal&Steininger, 2015, pp.555). In addition to this, the research papers more often than not give a very detailed description of software-defined networking on the basis of mathematics and technology. It makes it very hard for business entities and other organizations to undertake evaluation of whether the technology has the capacity to produce any precise business influence for instance on raising efficiency or in bringing down costs (Horvatha, Nedbal, &Stieninger, 2015, pp. 560).In spite of all this there has been a steady increase in the number of users as also an expansion in the level of requirements.This has left the providers face-to-face with the necessity to have second thoughts about the utilization of contemporary network tools to remain competitive and productive. The literature review undertaken by researchers has exposed that the parting of the control and data plane provides significant advantages. The advantages include greater ease of management, new or improved features, such as active positioning of virtual networks as well as economic elements(Horvatha, Nedbal&Steininger, 2015, pp.554).

Only limited number of research works can be obtained from the huge pool of the literature available to addresses the reliability evaluation of Software Defined Network architecture with special focus on the control plane under various operating conditions (Benzekki, Fergougui, &Elalao, 2016, pp.5816).

**Future Research Direction**
A plethora or research is carried out in every discipline and SDN, as a new-fangled approach to solving challenges faced by traditional networking system is budding as a topic for scientific and academic researches.As is evident from the foregoing discussion, SoftwareDefined Networking or SDN is topic of research that keeps on getting larger in volume.However, there exists significant inadequacy of research material on certain aspects of the topic where there still lies scope for expending the research work.Above and beyond simply drawing an outline of the technical aspects the benefits of separation of the control and data plane in the form of comfortable management, improved and augmented features such as dynamic virtual network deployment. The economic factors are expected to play a significant part in widening the scope for further research, particularly in the IS domain (Horvatha, Nedbal&Steininger, 2015, pp.554).The plethora of challenges existing in Software Defined Networking still require significant additional research consideration. This considerations includes the regularization of components pertaining to SDN and the adoption of original identifiable protocols intended for software Defined Networking in order to circumvent the problems that have been inherited from the legacy networks(Benzekki, Fergougui, &Elalao, 2016, pp.5816).

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