The Security connection of DDoS through Software Defined Networking for Virtual Routing Packets

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ABSTRACT

The focus on Software-Defined Networking (SDN) has been increased in the field of research in the recent year. In terms of simplicity, elasticity and programmability have brings promising changes by replacing the traditional networking. The attention have to be increased in the parameters of the security in the initial stages of the designing process. In this research paper we have to consider the security parameters of the Software Defined Networking (SDN) [1].The characteristics have to be discussed in this SDN parameters, in this parameters we have to be analyses the features, counterparts and the threats in the Software Defined Networking which have to targets the data users for which the network architecture have to be allocated flexibly and elasticity through users. The network of SDN [2] have to targets on control and application layers of the controller, which required more elasticity and the flexibility to the resources for the virtualization of the function in the network resources. But these closed network equipment are traditional network architectures such as routers switches and gateways. So have to focus on the security measures.

Keyword : - *Software Defined Networking, SDN, Security, Security countermeasures*

1. Introduction

For the early stages of the clouds, the services provided by the networking such as bandwidth ,quality, safety or reliability that satisfy to the different users have to required architecture elasticity and the flexibility for the virtualization for resources allocations. On the other hand traditional networking have a closed equipment networking such as routers and gateway, they have some demerits such as

- Tightly coupled software and hardware forwarding devices
- Integration of the networking protocols have too complicated for the devices to perform.
- The functionality of the devices are proprietary manufactured i.e. the changes or updating are difficult for the devices.

With the increase in the functionality such as optimization and the customization of network resources effectively as per the user's satisfactions. The Software Defined Networking (SDN) is the revolutionary changes to the network research for the network functionality virtualizations. The goal of controlling the network traffic independently as per the software programming work without the existing topology of network have to be guided by the packet forwarding through the complex control network nodes. Software Defined Networking have merit over traditional network flow:

- Forwarding devices and the control equipment have to be separately upgraded independently so that the implement and the development have to be build new innovation in the network applications;
- Network management model have to be operated by Software Defined Networks which perform them effectively and conveniently;
- The global views of the centralized network logic have to provide enough information to optimize the network performance and utilizations.

Therefore the network utilization of cloud environment have to be multitenant to overcome the traditional networks behavior. The acceptance of the SDN have to provide the network feature into software platform and therefore the hardware requirement have to be reduced in industrial point of view. SDN have to be deployed in the micro software datacenter network [17] and google network [8]. The research related for Open flow SDN have involve designing of forwarding devices , performance routing decisions and the network optimized visualizations energy saving datacenters networks. Resistance of the deployment of the traditional networks have to be replace by the SDN security parameters. In SDN we have to increase the security parameters of the network architecture challenges and the solutions. The solution for the threats of the SDN have to proposed include controller replacement , authentications and the authorizations schemes for safety of the controller's denial of the services and the distributed denial of the services (DoS/DDoS)[4] attacks and the traffics managements and analysis , flow tables for the attacker protections and the other parameters . We have to see the aspect of the parameters of the security and the capabilities of device performances. We have to see the security of the enhancement in this paper have to include a) the merits and demerits of the SDN over the feature of the traditional networks regarding the security parameters; b) security threats of the different architectural layers of the SDN and have to point out the security counterparts of the different functions.

2. Overview of SDN architecture

Software Defined Networking have to be decoupled into two, first forwarding devices and the control devices; these have to be well integrated into the traditional equipment such as the switches and the routers. The data forwarding layers, the control layers and the application layers have the three fundamental architectural of the Software defined Networking as shown in the fig 1.

2.1 Data forwarding layer

The switches and the routers have to be connected through physically wired or wireless devices have to be consist of Software Defined Networking (SDN). Switches in the network field have to forward the network packets simply through the Flow Table in a wired or wireless media, consist of thousand rules that have to be formulate. Every rule in the flow table have three field: 1) the action 2) the counter and 3) the patterns. The pattern field have the set of the header field values of packets received, the switches have to be its search of its Flow Table. When the switches have to find such rules in this field the counter have to increase by one as per the rule and the corresponding rules have to be applied. Otherwise, the switch will have to notice the controller for request to help or simply discard these packets. It is the worth of noting that the forwarding rule of items are not generated itself by the switch node , but have to pushed down through the controller from the control layer.

2.2 Control layer

SDN have to manage the control layers and the entire network layer through these network node implementation for the functionality of the SDN controller and it is separately deployed by physical network devices with some specific software. The SDN controller have to communicates through the switch from standard south-bound API interfaces , e.g., Open Flow, and have to be global view of entire network topology at the data forwarding layer, i.e., links ,hubs and switches. Various routing protocols, such as BGP and OSPF, have to run on the SDN controller so that all the data forwarding takes place in the data layer is based on instructions placed by the controller. The Open Flow have to be designed, so replacement have to be done when the potential failure have to be taken place. Floodlight and the OpenDaylight have to be improves the scalability and the availability for the resources in the layered architectural of Software Defined Networking. The single controller have to be responsible for the potentially controlling the switches and the router in packet forwarding. In the SDN controller have to be communicate with other controller through east west bounds API.

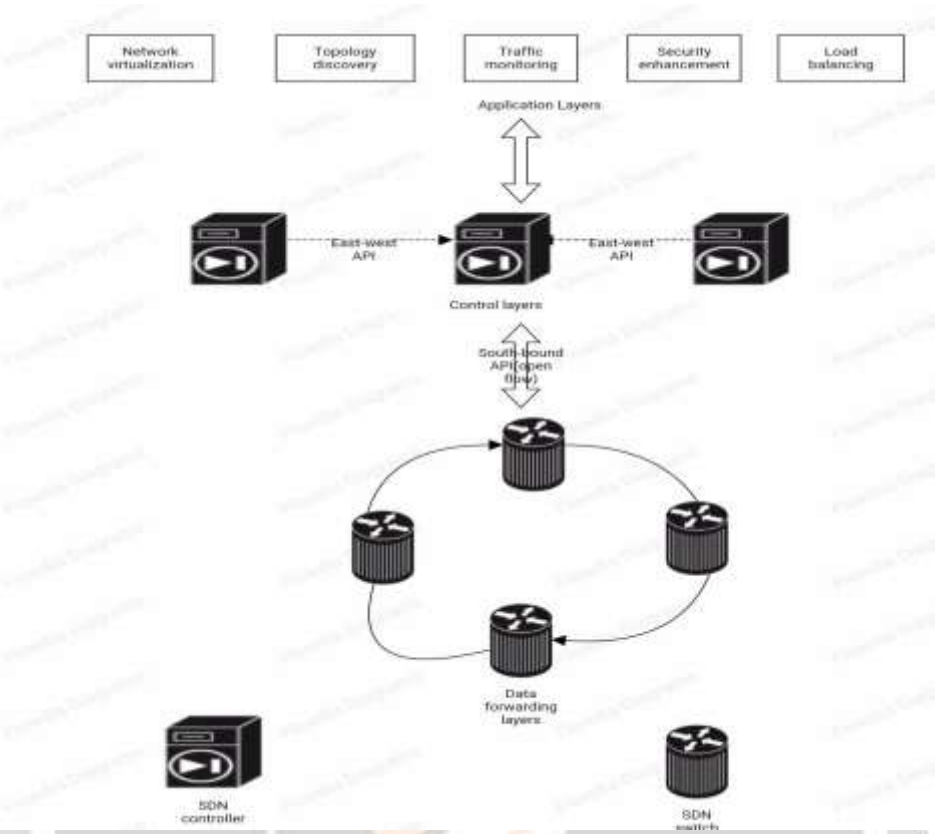

Fig -1: The architecture of SDN

2.3 Application layer

For the network operators have to utilize rapidly allocation of packets through the application layers. Network virtualization, topologies monitoring traffic discovery security and the load balancing have to be a different parts of the SDN. The communication of the application layers to the control layers is done by the north-bound API such as the REST API. Abstraction from the application layers have to be provided by control layers from different network's physical resources such as routers and switches, which means that the data paths have to be changed using software programming centrally in the SDN controller and do not configures physically to the switches one by.

3. Security analysis of SDN architecture

For the comparisons of the network layers, security threats in SDN of the traditional networks, in its design nature and the SDN security advantages of the security defects for the network packets. Therefore its advantages are includes:

- The monitoring of the random traffics: Here the traffic of the SDN controller receives, or the abnormal behavior of the traffic caused by the attackers is well monitored by the SDN controller.
- Vulnerabilities dealing through time: The programmable environment in the field of the network leads to the advantages in the functionality and the security.

After the detection of the threats, the new software analysis is to deal with vulnerability have to take place with the updating of the application software for the analysis for the integration in the manufacturer proprietary devices. In the configuration of the security SDN have to achieve the security policy for the open system interconnection (OSI) and to provide more granular security for control. The defects of the SDN have the following includes:

- Vulnerable controller: most of the network functions have the network configuration and the router flow calculations for the SDN controller. The architecture for the SDN have to provide a targeted reduction of the attacker. At the present stages of the development of the cloud computing in the large scale for the ability of the computing is to be provided. If the attacker attacks the controller of the SDN then they have to massively stop the network services and affects the controller network.
- Risks caused by open programmable interfaces: The open nature of the SDN have to give more security threats. First the information of the fully exposed of the attacker strategy for make it software vulnerabilities for the SDN controller to expose attacker. Secondly for the interaction with the malicious code e.g. virus SDN controller have to give a programmable interfaces in large number from application layers. So the SDN have to be fully evaluated and scrutinized
- More attack points: Software Defined Layers have divided into three layers such as communication between the networks, location of the various networks, and the necessary frequency needed. SDN have described in order to label as below:
- The SDN switch: Switch have to be composed of related hardware and software which have to be attacked vulnerable in the flow tables.
- The links between SDN switches: Almost SDN switches have to be encrypted for the transmitting of the data packets, which is the informational data of the user's data, security may be intercepted easily when the links are wireless.
- The SDN Controller: The controller have open in nature so it have the most attractive target, open nature for programmability and the complexity have to be functionality, the malicious nature is exploited form the controller software in the Software Defined Networking (SDN).
- Links between the controller and the switches: Controller have to insert the forwarding rules. The tampering by the attacker to the data packets have to be done through eavesdropping between the links of controller and the switches which result in the rule insertion or the malicious rule modifications. Once some malicious code have to be inserted then the data packets have to be not forwarded correctly.
- The links between the controllers: The communication have to be happening in the environment of the controller consistent in the whole network. The interception between the controllers have to be done by attacker for the compromising of the controller.
- The application software: controller in the application software have to be generally located on the controller devices. When the invocation is done by the controller in the northbound API malicious code possibly inserted which leads to conventional attack point to interception the controller.

4. Security threats to SDN and corresponding Countermeasures

In the research of SDN, manufacturing and operation in SDN have security issues. In this unit we have to detail the security and its countermeasures have to be discusses. SDN security have divided based on threats and its countermeasures which have its corresponding SDN architectural targeted design i.e. control layers, forwarding layers and the applications layers.

4.1 Threats to the data forwarding layer and countermeasures

At the bottom of the SDN layers have thousands of interconnection of the switches to each other. Switches which is giving services for the packet forwarding in network layers. The flow of the packets have to be forwarded correctly. In additional switches have to be directly network access point to the packets for the stockholders and the attackers have to be attacked to the linked ports of the switches. Therefore we have to initialize the corresponding security measures in the Software Defined Networks. Open Flow have to be specification for the SDN working principles. An OpenFlow have three function modules namely OpenFlow clients Flow Tables and Flow Buffers. The packets have placed into the switches, when it is placed to the flow buffer and search for the rules that satisfy the Flow table such as the MAC/IP address and TCP/UDP port. If the proper rules have searched then packets have to be removed from Flow buffer and pushed to outlet ports. Otherwise Packet_messages have follow the controller OpenFlow request instructions. After the calculation of routing instructions follow the new set of rules when received new messages in Flow Table. From the above process we have identify three security threats, such as man-in-middle attacks between the controller and switches, target to tamper rules, DoS attacks to Flow Table and a DoS attacks to Flow Buffer.

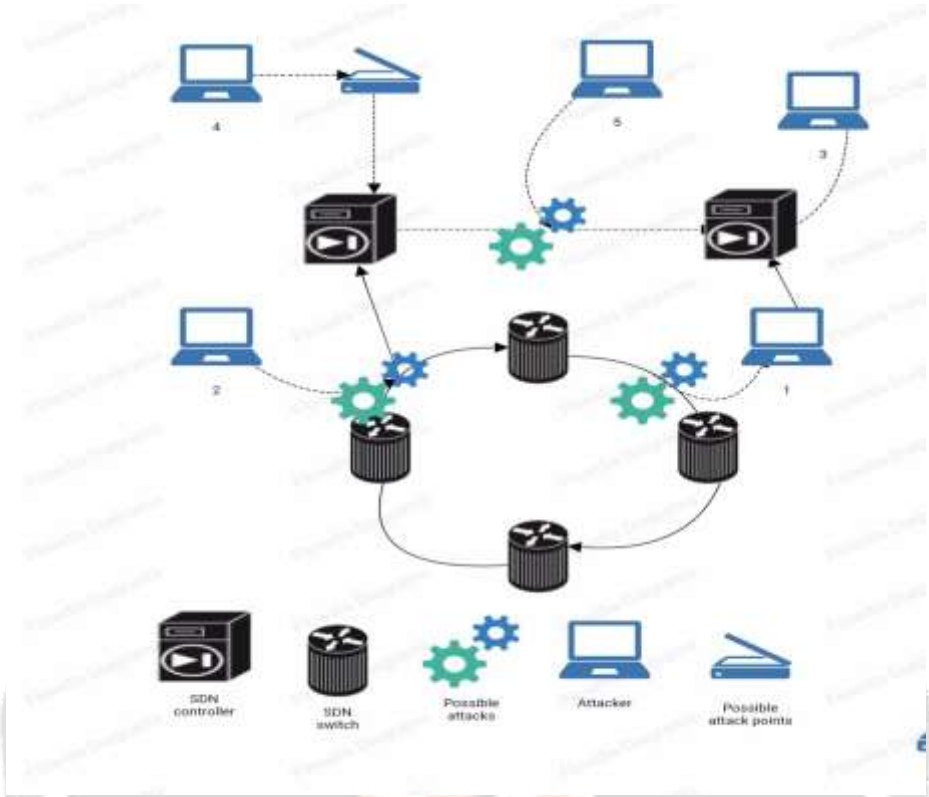

Fig -2: Possible attack points in the SDN architecture

4.1.1 Man-in-middle attack between switch and controller

4.1.1.1 Threat description

Man-in-middle-attacks have a set of instructional rules, the main principle here is that insertion of the new nodes between the source nodes and the destination nodes which will intercept the communication data and have to tamper with the detection of the communication sides. Methods include session hijacking, DNS spoofing, port mirroring, and so on. It is an ideal choice for intercept and tamper the forwarding rules issued to the gain of the network packet for forwarding devices. Black hole attacker have to implement further, controller and the switches have to be connected not physically but virtually i.e. packets have to travels through multiple switches and gateways. Therefore, every switches and the hosts of the switches have to connected directly on the communication path which susceptible to be converted to the agent nodes in a man-in-the-middle attack.

4.1.1.2 Countermeasures

For the guide of the middle-man-attacks there have much research is going to be happened in the industry. Approach to the channel between the controller and the switches have to secure in Transport Layers Security (TLS) [27].the complex configuration of the venders have to provides support to the Open Flow in switches. Therefore we have to declare the configuration of the TLS as optional. TLS can't alone provide protection means that layers of the TCP-levels have to be involved in this protections. TLS is not alone our main challenging feature which distinguished between the normal and the forged flow rules and which have caused ill effects.

Some of the present threat countermeasure Flow Checker is the validation tools for the recognitions for the errors switches and effectively to the threats. It have modelled the interconnections switches and the executions of the rapid verifications and the analysis for all the switches and their configurations are binary decisions and the model checking technology, through which the malicious detection have to be detected. Role based authentication and authorizations have security based and the enhancement of the strategy. These algorithms have to detect the collision and the various detection of the robustness and the performance of its functions causes the correction in the

malicious application attacks. Fort NOX have to be modify the digital signature or the constraint of the security. VeriFlow [27] have to act in the middle of the switches and the controller for the dynamic correction of the network and the scope of the network variable in the scope of the networks epically the forwarding rules of the network insertions. Experiments on the Mininet in the OpenFlow simulations behavior have to be conducted the result of tracking routing data, VeriFlow finishes the detections of the forwarding rules in a few hundred milliseconds in very effective manner.

The fact of the controller for the connection is important for the switches, redundant links or the mechanisms of fast recovery are the effective measure in man-in-middle attacks between the controller and the switches. OpenFlow have the connections mechanisms for preserved mechanisms for controller frequently. The master controller give response to the backup of the instruction to the switches, controller have the mechanism for the relocation i.e. when the packets do not get received to the controller for the specific duration of time period then switches have to automatically establish connections to the other controller and forget the previous controller and the networks have to continuously work with another.

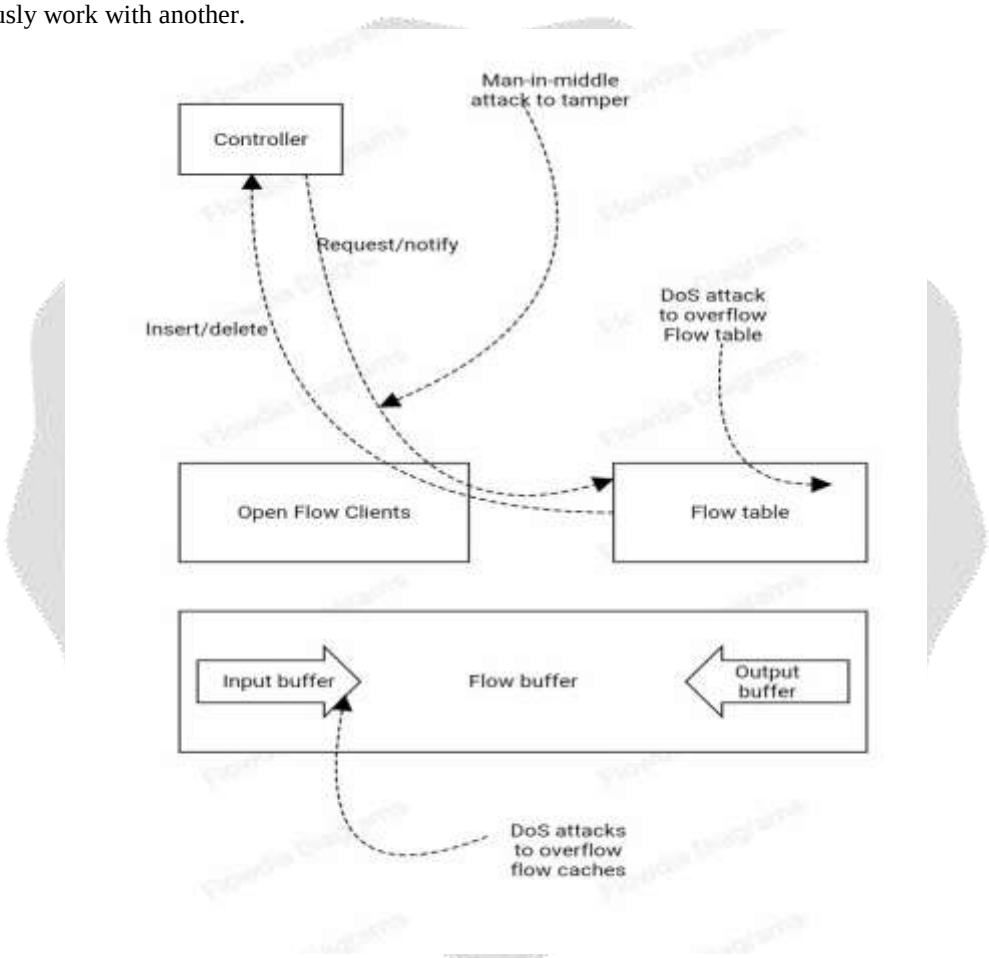

Fig -3: Working principles and security threats of Open Flow switches

4.1.2 DoS attack to saturate the flow table and flow buffer

4.1.2.1 Threat description

For the Denial of services (DOS) attacks the reactive rule for the vulnerable switches, as the packet doesn't have the destination address to the resources which can cause a new rule to the switches. An attacker have to be generate a large amount of packet to the destination address for the host form a short interval of time, thus the filling of the Flow Table with the address of the storage capacity, irregular traffic, legal traffic in the flow table have been available. Another attacks except the Flow Table is Flow Buffer, in which the packets have to be inserted in the

buffer before it got out from buffer for the search of the new result or the insertion of the new rules. Packets in the Flow Buffer have to be deleted as per the rule of First in First out (FIFO). In the Flow Table the storage have some limitation. Attacker have to flood the packets to encounter the switches normally, large packets have to buffer first before it leads to saturation of the Flow Buffer. When the storage capacity have limitation of the packages then the new packages have to be dropped for avoiding the time delays.

4.1.2.2 Countermeasures

FlowVisor [23] have countermeasure for the attackers for the network operation to differentiate header fields of the packets in the network field. FlowVisor acts as agents between the controller and the switches; they have to accept the rules from the controller and switches have to rewrite it again resulting rules only affects the network portion of the controller allowed to control that one. For example, controller have to allocate the network segments comprised of traffic to form a new web servers. The controller have to create a new rule to handle UDP traffic for the response of the DoS attacks. FlowVisor have to receive all packets, rewrite all the rule for the traffic of UDP then drop the rest of the packets without affecting rest of the networks. Virtual source Address Validation Edge (VAVE) [25] is a pre-emptive based protection OpenFlow/NOX architecture aiming to the DoS attacks caused by IP spoofing. When the new packet do not match the rule then it have to be send to the Flow Table for the validation of the address ,during this IP spoofing have to be detected, in which controller have to creates new rules and stops the old rules in the Flow Tables. However address checking in VAVE are flexible in nature compared to the related works. The method of DDoS attacks [28] which have the character of the traffic flow. Lightweight method for DDoS attacks have the characteristics for the traffic flow. This methods have well performed to analysis the attack detections. Abnormal traffic can be recognized by the detection system of the DDoS attacks. System for the integration for the dynamic access control for switch behavior, such as the rate of the request in control layers, Dynamic policies for strengthen the controller system. Security policies for the forwarding data layers have SDN based real time and packet forwarding information level.

4.2 Threats to the control layer and countermeasures

SDN have the control layers i.e. the OpenFlow controller have its security impact on the forwarding layers [29]. Whole networks have potentially very large number of switches which may be affected. Comparison of controller includes a potentially large number of switches, which may be affected. Switches haven't received the forwarding rules for the known rule from the controller for known forwarding packets. The important role for the controller have the main key to targeted role of attacks. The main threats countermeasures of control layers have to be described below.

4.2.1 DoS/DDoS attacks on the controller

4.2.1.1 Threat description

DoS/DDoS attacks have to function for the users by exhausting the computing or the memory resources. An attacker have to floods the enormous amount of flooding traffic for a short duration of time period in the SDN enabled networks. The abnormal traffic have to be mixed with the normal traffic which can't distinguished between two. In OpenFlow when the switches don't know how to handle the new packets, it will have to first store this packet in its Flow Buffer and then send the Packet_In message to the controller for request to get instructions. So the DoS attacks have to deal for a generation of the flooding of Packet_In messages in the traffic for a very short interval of time, leads to exhaustion of the resources in the normal traffic. In the same interval of time the bandwidth between the controller and the switches have to fully occupy in the time interval of attacking traffic for the performance of the whole networks.

4.2.1.2 Countermeasures

In the threats of the DoS/DDoS controller, we have to be seen the traffic flow's character in the detection of a kind of the attacks in the OpenFlow. FloodGuard [30] is a very effective and light-weight in the security frameworks independently. FloodGuard have two module of the software, first the Active Flow analyzer and second Packet Migration.

In the security for the SDN, the Active Flow analyzer have to be dynamic analysis for the real world time in the logical controller, hence we have to detect the flow caused by the DoS attacker. Processing through rotational

scheduling algorithms have to be consumed by computing of resources, the packet migrations may have responsible for it. When the DoS attacks have to be discovered then the redirection of the messages to the data forwarding layers for Packet Migration modules, Active Flow Analyzers have to be determined through various parameters or variables through the rules and then install them in the switches proactively. A DDoS is compared to DoS attacks with large principle for hijack a large number of host. Researcher have proposed the proposed DDoS Blocking Applications (DBA). This have to run intermediate between the normal traffic and abnormal traffic caused by locator/ID Separation Protocol (LISP) [30]. The position of the network node have to be notify by DBA, which is the clue to the attacker to find the changed position of the network node. The traffic of the transmission have to be exceeds then controller have to consider these packets as caused by attacker and simultaneously drop nodes directly. A Content-Oriented Networking Architecture (CONA) [31] is a proxy node between clients and the context servers and have to communicate with the controller. A Content-Oriented Networking Architecture (CONA) [31] is the communicator of the controller have to be located between the client and the content servers. In order to harm the client by CONA it have to be analyzed, intercepted and have to be filtered in order to harm DDoS attacks. Rate of request have to be exceeds for a certain point of value then DDoS have to be progressed. CONA have to send a relevantly large messages to avoid the abnormal traffic to a different directional path. The feature of the SDN have to against a protection of the DoS protection and have to develop an application for it.

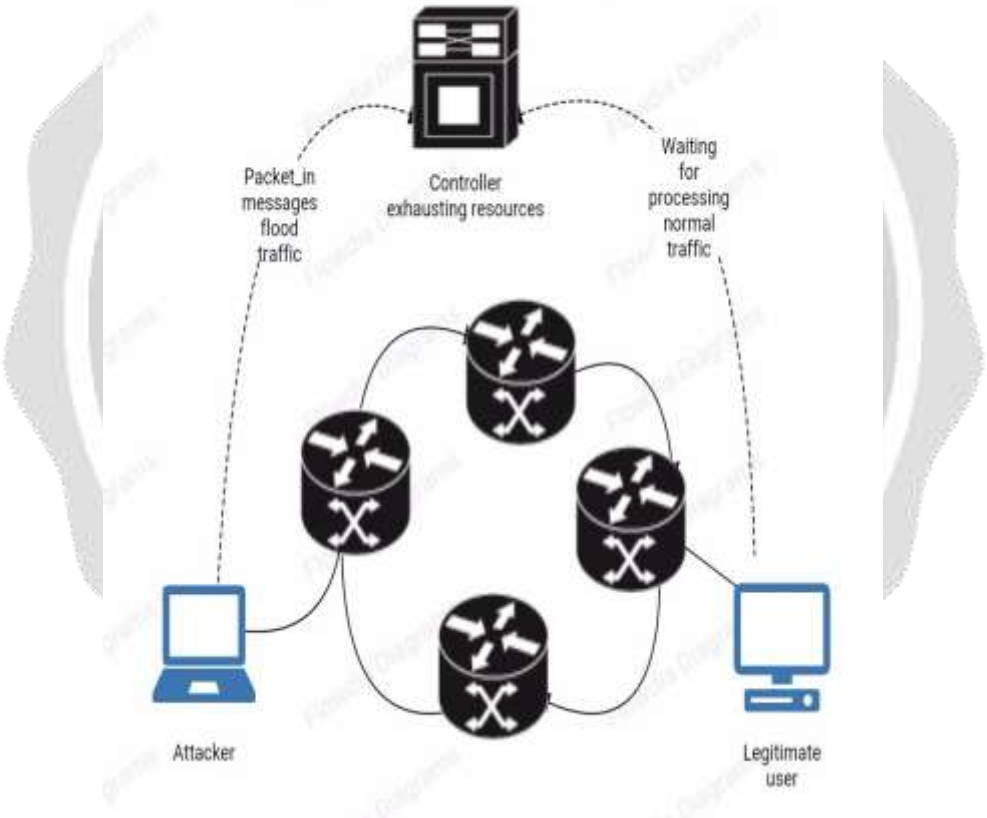

Fig - 4: DoS / DDoS attack on SDN Controller

4.2.2 Threats on distributed multi-controllers

4.2.2.1 Threat description

SDN have a demerits in the scalability and reliability for the definition of the single controller architecture. Therefore individual controller have to function as a master controller and communicate to the switches, this solution has been given in controller cluster which proposed in distributed control. Multiple physical controller have

to signally handle the entire network switches and the nodes. In this application we have to span through multiple network control domains and have to deal with security problems such as the authorization and authentication in the information transmission process. Multiple controller in the same network have cause network configuration confliction, the dynamic collaboration have to be distributed over switches [43]. Henceforth the multi-controller architecture have inconsistent in the security threat.

4.2.2.2 Countermeasures

DISCO [44] have to be distributed in the functions of the implementation based on the Floodlight [45] with a unique protocol Advanced Messaging Queuing Protocol [31]. DISCO have two modules such as inter domain control module and the intra domain control module. The monitoring process have depend on the inter-domain module and have to be travelling to the domain with flow path of calculated priorities and forwarded node packets. Therefore it can stop or redirect the traffic flow dynamically. The inter-domain control module have to manage the communication between the controllers and Trans-received the number of agents as well. Communication channel have to be provide a message transceiver module which have to exchange the entire network's information module. DICSO have to deal with distributed controller. McNettle [32] have scalable SDN controller supporting CPU which have multicore CPUs allows all kinds of the control algorithms. McNettle have deal with managing the behavior of traffic flow through the network nodes and global views of the entire network's data flow that have deal with all kind of malicious attacker nodes effectively. McNettle have the behavior as it make advanced programming language such as the monitoring stage of network nodes and see the global networks data flow that have use to detect the malicious attack data effectively. Comparatively McNettle controller performed much better then NOX. HyperFlow [48] is event driven scalable for multi-controller operation simultaneously and every controller to decide the forwarding packets individually. HyperFlow have to reduce the time for installing and generating a new rules which have to improve the performance for entire control units. Load balancing technologies [33] have to use the improvement of the security threats for the SDN controller. Somehow the safety and controllers scalability have affected by the number of controller and its logical layers [50]. The placement of the dynamic controller and its frameworks have to deploy to multiple controller. In this we have to quantify and its controller have to be adjusted dynamically for the adjustment of the parameters of the network fields. A controller have to be optimized for the least delay include the communication delay requirements between switches and controller, so effectively deal with the related attacks.

4.2.3 Threats from applications

4.2.3.1 Threat description

For the high level application in the networking field invokes with the API to the controller needs to ensure the access of the authorized applications, but have to avoid the abnormal traffic caused by malicious or incorrect applications from security threats. The controller have serious threats from the controller itself. The policies is required for different application for its function to the customize each of them. Ex load balancing applications need to have access for network packet and statistics for intrusion detection applications (IDS) which have to check the header field of packets, such security policies have to be independently required for different applications which is not yet present.

4.2.3.2 Countermeasures

When we have to deal with the security threats from higher level application, the solution related for the access of the authentication of the applications, isolation of the resources available for the auditing and tracking. The Security enhanced Floodlight controller which have to be originally for the security measures; e.g. audit of the subsystem tracks for all the security event detect events effectively. SE-Floodlight provides a north-bounds API interfaces for the functions between the functional application and the controller. SE-Floodlight haven't only contains application authorization modules to verify the integration in software modules, but have to provide functional role based authorization modules, which have to be assigned to different ranks to performs different applications. FRESCO [34] is a security framework for the development in the OpenFlow applications for the rapid design of the modular composition of the software for the implements in the security functions such as attack deflectors, IDS logic, firewalls, scan detectors and corresponding APIs to be invoked these modules. FRESCO is security based OpenFlow controller to detect the threats.

4.3 Threats to the application layer and countermeasures

The application layers have to be temper with the network configuration, and have to give network resources and so on through inserting spyware or malware programs in application layers, the interaction of the operation of the control layers and the application layers have to be influenced with reliability and the availability of the networks. OpenFlow have to be deploy some security measure for the application layers [37]. The application have to be organized for different programming layers and have to produce interoperability and security measure confection policies in the network. Some have to be summarized below.

4.3.1 Open Flow Illegal access

4.3.1.1 Threat description

For the specification of the OpenFlow, controller have to be flexible and have to be given some advantages to access of the resources and the behavior of the control networks. These application have to develop by the third party controller. Hence the lack of the security mechanisms leads to have cause some security threats. The opinion for the design have the mandatory mechanisms for the creation of the relationship in the controller and the applications running on it. There have many technique for the acceptance of the network applications.

4.3.1.2 Countermeasures

The permission system for the adaption of the OpenFlow controller and its applications running form the top of it. PermOF [38] have to set of 18 permission for enforce the API controller and have to proposed the isolation framework to maintains various priorities for application and its isolation and access control to the traffic data to achieve comprehensive resources. NICE [58] is the solution for the checking of the symbolic executions in the handling of the events which have the state space controller program written in the platform of NOX. NICE have to be used in the OpenFlow application for the correctness. Verificare [38] is a tool for the model distributions of the system verification techniques. The tool for the modelling the network correctness have its critical properties. VeriCon [38] which conform the correction of the program of the controller to the verification of the system. The deductive verification of the first order logic and the desired network wide invariants. The correction and identification of the bugs have to be developed in a large scale of the SDN applications.

4.3.2 Configuration in the conflicts and the rules in Security

4.3.2.1 Threat description

Threats have to be described to provide a wide range of the network services in the application layers the security of applications for accessing the security interfaces of the controller. The complexity of the application, conflicts have to be appear between the security rules which result in the network services and management of the complexity.

4.3.2.2 Countermeasures

Flover [39] have a checking system which involve verified flow policies for assertion sets. Flover is NOX based implementations and have to be provided for the functional behaviour of the networks security. Flover have to support the resources controller quickly. The debugging of the network configuration conflicts have composed data forwarding layers. Generally in a short time interval rather than blocking potentially disruptions of the network NetPlumber [41] is to detect the networks detection policies for the incremental changes of the networks state in real time. Header Space Analysis (HAS) [64] has the potential for the quickly validation of the incremental calculation of the dependency.

Table -1: Security threats and typical countermeasures in SDN architecture

Targeted level	Threats type	Caused by	Typical countermeasures
Data forwarding	Man-in-middle attack between	•The communication channel is not secure without TLS	•FlowChecker[4] •ForNOX

layer	switch and controller DoS attack to saturate Flow Table and Flow Buffer	support •Limited storage capacity of Flow Table and Flow Buffer •Enormous number of packets in a short time	•VeriFlow •Controller replication •FlowVisor •Virtualsource [17] Address Validation Edge (VAVE) •Resonance
Control layer	DoS/DDoS attack on the controller Threats based on distributed multi-controllers Threats from applications	•Attacking traffic can be mixed with normal traffic and is hard to distinguish •Limited computing and storage resources of the controller •Distribution of access control •Incorporation difficult for multi-tenant controllers •Inconsistent configuration of multiple controllers •Open programmatic interface •Malicious Applications	•FloodGuard [20] •DDoS Blocking Application •Content-Oriented Networking Architecture (CONA) •DISCO [34] •McNettle •HyperFlow •SE-Floodlight •FRESCO
Application layer	Illegal access Security rules and configuration conflicts	•Bypassing of the authentication mechanism •Software vulnerabilities of the controller •Variety for application software •Difference of access control and accountability for various application software	•PermOF •NICE •Verificare •VeriCon •Flover •Anteater •NetPlumber

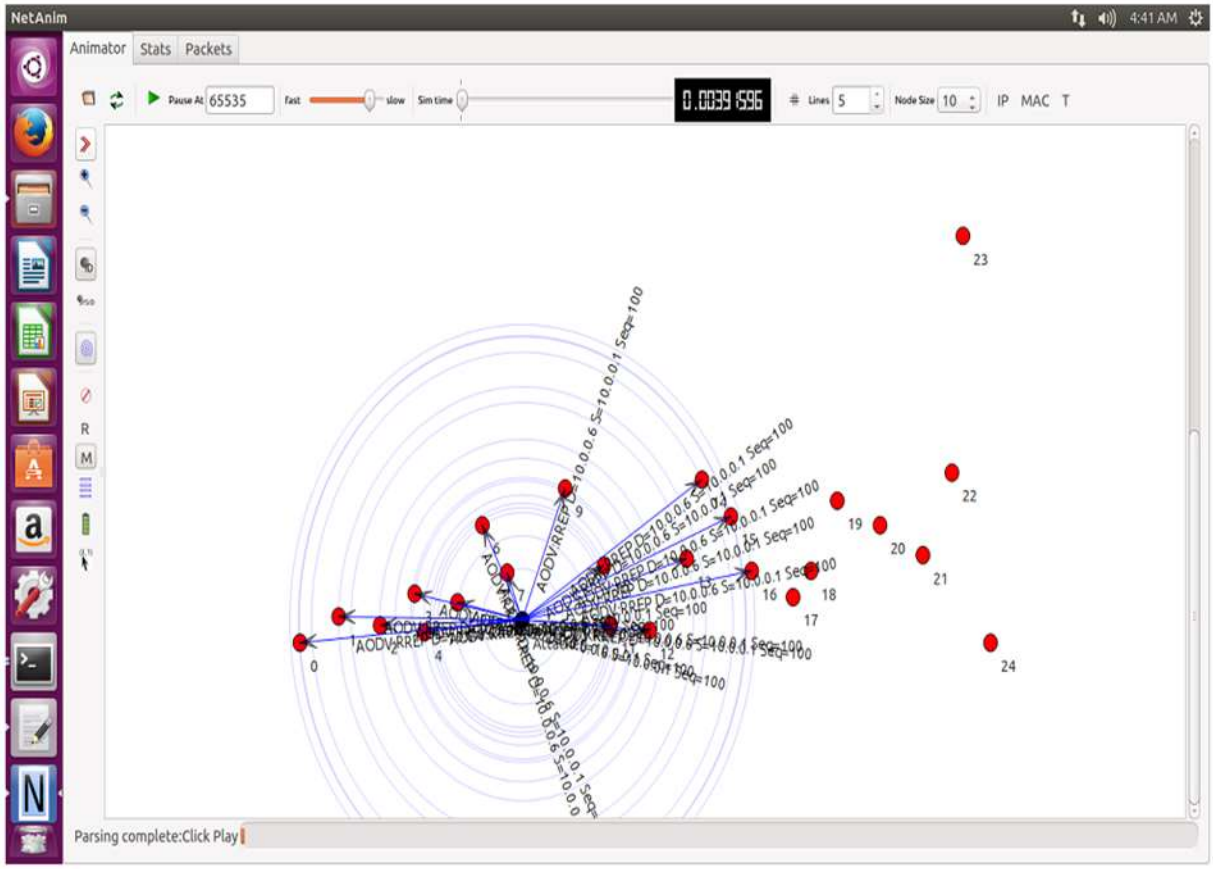

Fig - 5: Generation of attack through 25 nodes in Flood Guards countermeasure

4.4 Security issues summarization

For the summary of the security threats and its countermeasures have to be discussed in the above section.

5. CONCLUSIONS

In this we have to discuss the characteristics and its archictural behaviour of the SDN. We have to discuss the functional and the analyzed of its countermeasures for the security perspective and have to give great SDN characteristic for the uniqueness and its openness. After that the security measures and its countermeasures with three aspects such as: data forwarding layers, the control layers and the application layers. The preventive and the mitigation techniques have to be addressed for some security issues. Network Virtualization of the cloud computing have to be considered for the important application for the SDN which have to brings the security threats. Therefore the issues of the security for these application have to be increased the attention.

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