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Study on Distributed SDN Controllers and Failover Mechanisms

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ABSTRACT: The main aim of this paper is to provide detailed description on the Distributed SDN control plane in SDN and make survey on the fail over mechanisms of the Distributed SDN controller. The Software Defined Networking, is the currently emerging technology which have a centralized control plane and distributed data planes. Issue with a centralized control plane is that there can be a Single Point of Failure (SPOF). To avoid SPOF, distributed SDN controllers can be used, it can provide resiliency and scalability. The Distributed SDN control plane can be either a cluster architecture of SDN controller or a tree architecture of SDN controller. The failover mechanisms of distributed SDN control plane is a vast area, where enormous research is possible. The fail over mechanism in distributed SDN controller can be broadly classified into two: the SDN controllers with back up and SDN controllers without backup. The goal of this paper is to make survey on the distributed SDN controller architecture and the fail over mechanisms of SDN controllers in distributed environment.

KEYWORDS: Software Defined Networking, Distributed SDN controller, Failover, Controller Cluster

I. INTRODUCTION

The traditional network device, like switches, expose many limitation inorder to mitigate problems-the emerging technology is Software Defined Networks. The SDN technology could be defined as a separation of the data plane from the control logic, where data plane and control plane communicate by using protocol can openflow protocol. Openflow protocol for SDN is like operating system for a machine. The control logic would be centralized or distributed. The Software Defined Network usually have a centralized logic means it is easily programmable, but limitation is that it has a Single Point of Failure (SPOF),to mitigate this problem the distributed control logic can be implemented.Scott Shenker,one of the inventor of SDN, described SDN as a set of abstractions for the control plane in networking.The old network devices, have two planes,the control plane and the data plane,present in every device. In SDN devices, the data plane is only present in the switch and the control plane is separately placed as a centralized entity called controller. The controller and the switch will communicate by using openflow protocol. The SDN architecture is directly programmable, agile and have centralized control.

II RELATED WORK

As the network size grows up, if there is only a single controller maintained; then the load on the controller will be very high.. So to avoid the problem that may happen in single controller network, multiple controllers can be maintained with coordination among them. The multiple SDN controllers architecture can be implemented in two ways. First one is Flat hierarchy of SDN Controller: As network size multiplies, then the coordinated controllers are implemented. The benefit for this flat hierarchy is that, the topology knowledge can be shared among the member controllers.In this architecture ,the peers can exchange information among them. The peers will be placed in different domains. In flat hierarchy, controller-to-controller communication is called the east to west communication. The second architecture is Tree architecture of SDN Controller: The structure have the root controller in first level and in the next level-the leaf controllers .The hierarchical model will allow the leaf controller to share some load with the root controller. The master/root controller can have global view of the whole network. The leaf controller will be isolated from the other leaf controller. As leaf controllers, the less efficient controllers can be used.

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III. SURVEY ON DISTRIBUTED SDN CONTROLLER IMPLEMENTATION

The aim of this section is to make a survey on the papers that implemented the Distributed control.

A. CONTROLLING SDN VIA DISTRIBUTED CONTROL

The paper describes the implementation of the controller cluster and the addition of new controller without affecting the whole network operation. Advantage of a controller cluster is Scalability and reliability. The increased load on a controller can be handled by adding a new controller to the cluster this is how the scalability can be attained. The reliability can be ensured by avoiding the single point of failure (SPOF), since there is a distributed control in the controller cluster. The main goals of maintaining a controller cluster are load balancing between the controllers and the replacement of the failed controller. In this paper, the controllers in the cluster communicate by using JGroups. Then the controller elects a master controller node. The Master is periodically monitored.

B. CONTROLLER FAILOVER FOR SDN ENTERPRISE NETWORKS

The paper describes a high availability controller failover mechanism. The experiment is done with two controllers, one active controller and a standby controller. The basic modes of controller platform are initial controller mode, operational controller mode and primary controller failure mode. Initial controller mode: The controller starts, in accordance with the configuration file. Then the standby controller is started, in control plane. Operational controller mode: the standby controller will always monitor the active controller and synchronize with it. The state synchronization between controllers include the synchronization of the network view, the controller data, the controller network states and application states. Primary controller failure mode: the failure of the active controller is detected by the heartbeat messages. If the primary controller does not respond to the heartbeat message from the standby controller, then failure of primary controller is ensured. Next is the recovery stage, the standby controller will be taken as new primary controller and the controller network services, application restoration happens.

IV. FAILURE OF SDN CONTROLLER IN DISTRIBUTED ENVIRONMENT

The failover mechanisms in SDN controller mechanism consists of two functions ,that is, failure detection and failure recovery functions. The most common way for failure recovery mechanism is using a back up controller for every master controller in a domain, but the limitations of these case is that there will be a huge setup and maintenance cost. So failure recovery mechanisms can be broadly classified into : The controllers with back up and controllers without back up.The following are the different kinds of SDN controller failover mechanisms:

A.GREEDY FAILOVER ALGORITHM

Here each switch have a controller attached to it, this controller is called the master of the corresponding switches. The switch periodically sends the ECHO-REQUEST message and the controller acknowledges with the ECHO-REPLY message. If the controller fails to respond then the switch will come to know that the controller is failed. Then the switches will send LLDP-Link Layer Discovery Protocol messages to the neighbor switches, then the neighbor switches inform their master controller about the orphan switches. Then the current active controllers take up the orphan switches in their neighbor. There is no backup controller functioning in this scenario, thus we obtain a simplified network.

B. PREPARTITIONING ALGORITHM

The failure detection method is same as that of the greedy failover mechanism, but in failure detection technique: Each controller informs the other controller which all switches to be taken over,once the controller fails. Prepartitioning algorithm also do not have the concept of the back up controller.

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C.FAST CONTROLLER FAILOVER FOR MULTI-DOMAIN

In this mechanism, the whole network is divided into different domains, where each domain has a Master controller and a back up controller. In this there can be 3 cases: if a master in a domain fails then hot standby in that domain takes up the switches. if master and hotstandby of a single domain ,and the master of other domain fails,then hotstandby of this domain takes up switches. if master and hotstandby of a single domain ,and the master of other domain fails, and two hotstandby controllers are available,then the cost factor is considered,the switches are taken up by the hotstandby controller which have currently less switches.

V.CONCLUSION

The detailed study on the distributed SDN controller and the Failover mechanisms of the distributed SDN controller is done. The main aim of distributed SDN controller is that the single point of failure can be eliminated and the hectic load on the network can be reduced.

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