Study of Distributed Wireless Access Point Controller

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***Abstract*— In these days, as proliferating the use of mobile devices like tablet PC and smartphone, wireless AP should be distributed arrangement and cover a wide area by radio signal. There is the necessity of wireless AP controller because administrators of a wireless network can manage remotely and efficiently many APs on distributed area. The most of wireless AP has to use only one controller, so it may cause failure of the whole system in case of having some problem on controller managing APs. Therefore, in this paper, we propose distributed wireless AP controller using replicated key-value store called etcd. The distributed controllers connected by etcd protect the data about the managed AP, even if some controller fails. And each controller manages nearly located AP by using the way of the draft like what is uses in sports. This way using draft can reduce time to communicate between controller and APs and increase an efficiency of managing mechanism. We expect that this proposed method enhances reliability and provides high availability of wireless network managed by the controller.**

Keywords—wireless network; distributed; WiFi orchestration; availability;

I. INTRODUCTION

Recently, the amount of worldwide wireless network demand has grown rapidly. Since the grown of mobile devices, such as a smartphone, tablet PC and laptop. To deal well with the demand of wireless network, a lot of the access point(AP)s are widely installed. However, there is not the way to control to the APs.

Someone try to control by the only one controller. However, the only one controller is unstable. When the controller is down, APs can't find the controller and have control. It occurs that the network manager should repair each APs to be re-connected to the controller. Moreover, it's too inconvenience to use since has to use with a specific application and vendor.

In this paper, we propose a scheme that the union of distributed AP controller for controlling wireless access points. It can provide a high availability service to ensure stability. Furthermore, it offers the better wireless access point control service than ordinary.

II. RELATIVE RESEARCH

A. Wireless AP controller.

There are a lot of projects about wireless AP controller. One of the projects is the Odin projects. [1] It is designed for programmatic orchestration of WiFi Networks. Because the Odin agent is implemented in the Click Modular Router [2], it is difficult to use and to develop. In addition, the Odin controller is less stable because it only works on a single machine.

B. etcd.

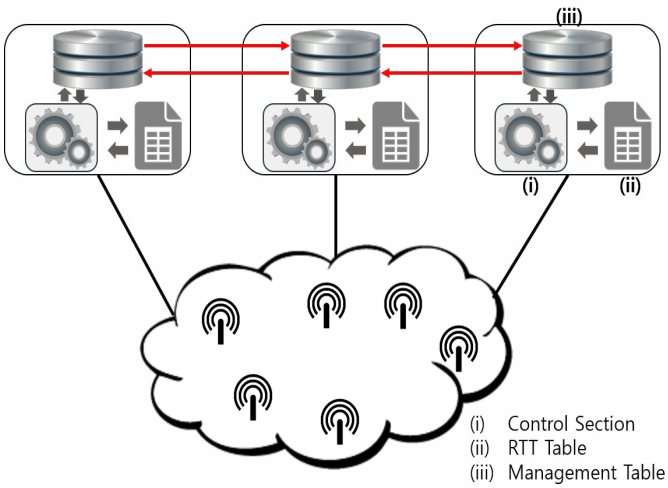
etcd [3] is written in Go programming language developed by Google and uses the Raft consensus algorithm [4] to manage a highly available replicated log. etcd is a distributed key-value storage that supports a reliable way to save data across a cluster of instances and provides a tolerance of machine failure. It stores data in directories similar to a file system.

III. PROPOSED SCHEME

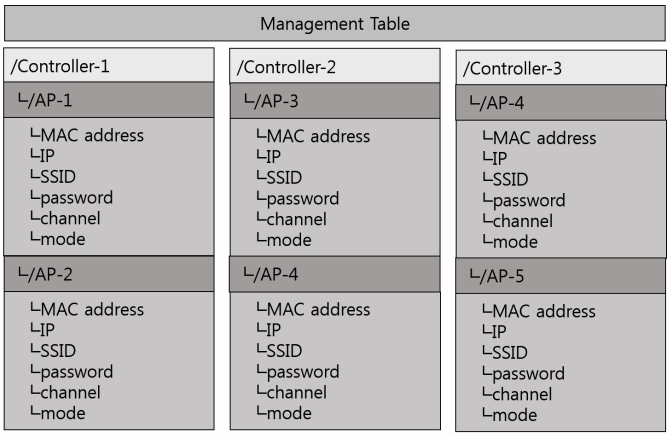
When the wireless AP are up, they request the initial session to all controllers. After replying requests, each controller measures the roundtrip between the AP and controller. One of the controllers requests to other controllers the draft. Using the roundtrip time, the controller selects the fastest AP in a rotation. And then each wireless AP has only one primary controller while other controllers become backups. If AP lost the main controller, one of the other controllers selects it. It can provide high availability for a stable management and more efficient management without physically direct repairing.

APs and controllers should use AP agent that runs on the device that installed hostapd [5] and dhcpd without a complicated program. If the command comes in from controller, AP agent process it and re-send to the controller. For example, if AP agent receives the command to change the WiFi SSID, AP agent re-write the hostapd config file with new SSID, and then AP agent restart hostapd. After all, AP agent sends the new information to the main controller.

The agent sends the heartbeat packets to the main controller to check the controller's life and AP's life. In



(a) Architecture of Distributed Wireless AP Controller



(b) The structure of the management table

Fig. 1. The architecture of this proposal

addition, AP agent sends the simple heartbeat that includes basic information such as physical address and IP to the backups for the re-draft.

The controller connects AP agent by their IP. If someone put the commands, the controller sends it to the AP agent. Table 1 shows commands.

Each controller is connected by etcd. They have the management table. The management table shows the AP's the main controller and detail information. Controllers update the table by the heartbeat packets from ap agents. If there aren't the updates to AP owner during a particular time, the table resets the AP's owner. One of controller checks that the AP doesn't have an owner and then requests re-draft to other controllers. By the re-draft, the AP has the new owner.

A. Initailizing Phase .

The blue square in Fig 2. shows this phase. First, when the AP on, it requests the initial session to known-controllers. The controller that received the requests return to AP ack with other controllers' information. If the ack that was sent by known-controller has the other controller's information, the AP requests again the initial session to the other controllers that learned some new controller by known-controllers. By this process, all of the controllers has the same AP list of each roundtrip table(RTT) and the management table of etcd has them

B. Draft Phase .

The red square in Fig 2. shows this phase. After the initializing phase, one of the controller requests drafting to the others. When it requests drafting, it sends with AP list of the roundtrip table that it has. If the other controller that received draft request has the same AP list of the roundtrip table, it responses to request.

When all responses arrive, start the draft. Each controller measures the roundtrip time of each AP by ping command. After measuring randomly determines the order of the controllers. And then, the controllers alternately select the AP with the fastest order at the table they have and write with his ownership of the selected AP the management table in etcd. If a controller wants to select AP has ownership of another controller, then to select next quick ap. After the controller of the last order selects the AP, starts its reverse selection. This process until all of the registered AP etcd to take ownership. The controller with the ownership of the AP is the main controller, and other is the backup controllers.

C. Control phase.

It manages the AP on the controller with ownership. The AP periodically sends to main controller heartbeat with AP's MAC address, IP, SSID, password, channel, etc during sends other controllers the simple heartbeat packet with physical address and IP. The main controller that has ownership of AP write the AP's detail information using the heartbeat packets and ownership to the management table.

If the backup controller that doesn't have ownership commands, process commands via the main controller. Because of this phase, we can use the controllers like the one controller although we use several controllers.

TABLE 1. Commands to control APs

Command	Description
help	Show help
show	Show ap's list
<IP> start	Start ap
<IP> stop	Stop ap
<IP> reboot	Reboot ap
<IP> ssid <value>	Change ssid
<IP> mode <value>	Change wifi mode
<IP> channel <value>	Change wifi channel

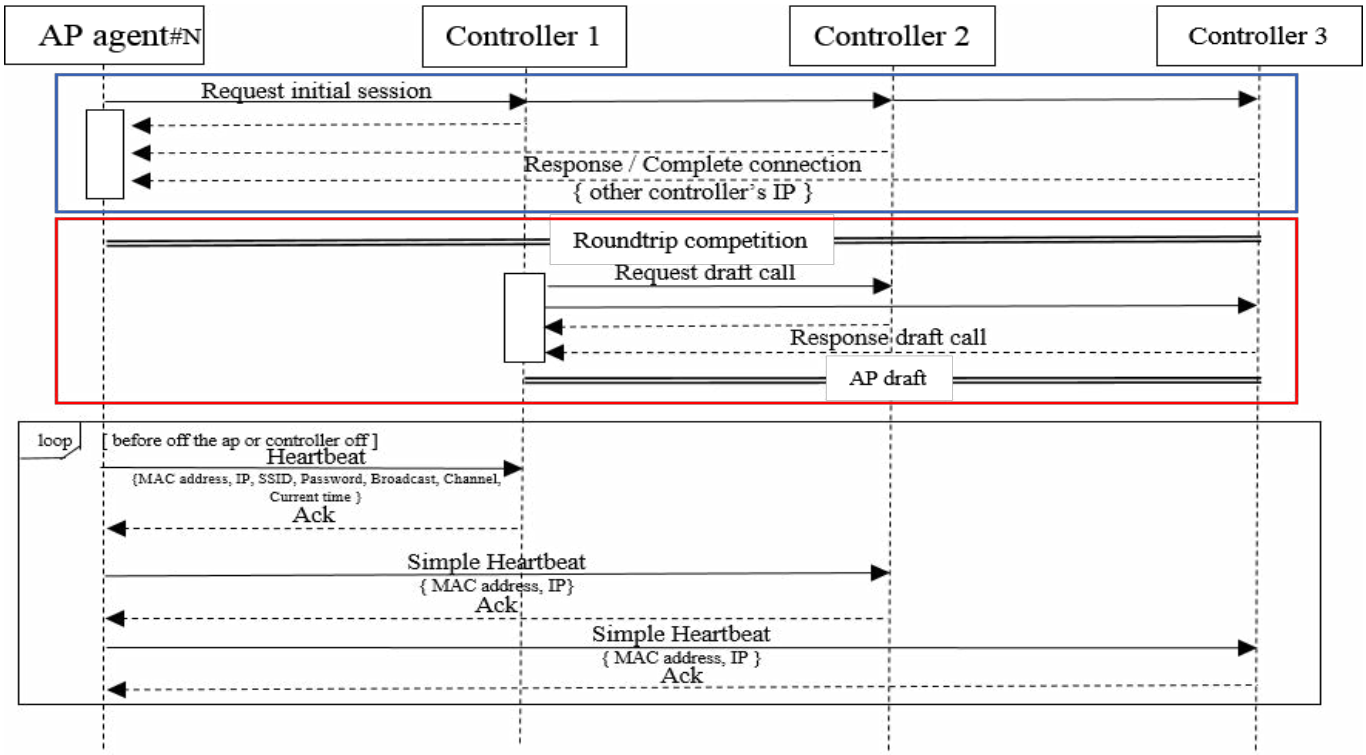


Fig. 2. The sequence diagram of whole processing.

D. Re-draft Phase .

We have 2 cases of re-draft. one is that when the one of controller is down and the other case is that when the new controller is spawn.

If the main controller is down, APs that managed become that don't have the main controller that claim ownership of it. If there is not claiming ownership of the AP over a period, remove the ownership from the management table in etcd. After removing, start again the draft phase for the AP that hasn't the ownership.

If the new controller is generated, it indicates to the existing controller and the APs. And then the new controller measures the roundtrip time of all of the APs. Then they do draft again. This occur that increases the efficiency of the administration.

IV. Conclusion and Future Work

Using the proposed scheme in this paper, it is possible to control wireless AP stably and efficiently. The distributed controlling system is obviously more reliable than a single controller. In addition, it can easily apply to the common equipment without complicated programs and expensive server. And it can reduce managing expense and time from the viewpoint of the administrator.

In future work, we will apply SDN(Software-Defined Networking) technologies to control traffic in order to manage and balance backhaul network affiliating wireless network.

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