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A Study of Function-Oriented Network Design

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This paper suggests a method of function-oriented network design and construction and evaluated it.

The function-oriented network is the network system that based on the functions. Today, there are many various demands in the network. These demands are the matters of management, security. In order to answer these demands, many protocols and mechanism are suggested and implemented. As means to realize these protocols and mechanism, there are many functions. It is desirable that network administrators choose a function freely and if necessary can introduce it into the network. However, by the present, network administrators carry out function addition by replacement in many cases. In this paper, I introduce “IEEE802.1X” as an example of this case.

Replacement forces network system to pay a lot of cost at every cases of functions addition. Naturally network administrators avoid an increase in cost. And It becomes the cause that these costs obstructs spread of new protocols and mechanism.

As the reason why functions addition is carried out by replacement, there are not good method for function addition. In this paper, through the searching for method of function addition without replacement, I suggests a method of function-oriented networking design. The objective one of this paper is to balance reduction in cost with technical development.

In the first part of this paper, review the today’ network environment and background of high function network, and illustrating some functions

to manage network , protect security,improve performance. In the second part, I touch the problems between functions additon and replacement costs. In the next part, I introduce other studies and approachs about this problems. I pick up some typical studies and approaches, “using high-end-switch”, “the adoption of single function appliance”, and “the method of Layer-2.5(controlling network devices)”. And I analysis these studies and point out inadequate some respects.

The First, an approches that “using high-end-switch” is provide functions by high-end-switches like a Cisco 6500. High-end-swithes have a lot of functions and high performance. Moreover high-end-switch can not adapt new protocol and mechanism which development int the future. Secondly, The approach is “the adoption of single function appliance”. This approach is unique and interesting. In this paper, I introduce “Illegal connection PC exclusion appliance” as an example of this approach. The thirdly, the study that “the method of Layer-2.5(controlling network devices)”. This study is a general-purpose network architecture that provides in direction support at layer “2.5”. In this paper, I introduce “Pswitch&Player” as an example of this approach.

In this paper, I devise a new function addition method. The fundamental ideas are “Diviing a physical Layer 2 switch between logical networks by Virtual Local Area Network(VLAN) and connecting logical networks by bypass circuit”, “Placement machines named FunctionBox realizing a function on the bypass circuit”, “Using FunctionBoxes with whole of the network by Tag-based VLAN”.

By using these ideas, I suggest a function addition program that named Network Circuit Compiler(NCC). NCC is a program that building logical network for functions addition. First of all, network administrator writing configuration file that writing network environment and FunctionBoxes. And network administrator indicate functions that he or she wanted by “formula”. NCC reads configulation file that writing network environment and FunctionBoxes, and operate network switches to building logical network for function additon which administrators wanted. In this trial, NCC is able to control Layer 2 switches by NETCONF API(Alaxala networks, AX-ON-API) and CLI(Cisco, IOS) over Telnet. This logical network is a network that supplies functions for network as administrators

wanted turn. I explain about NCC's plan and implementation.

In evaluation part, I test NCC whether NCC is able to build logical network as administrator wanted. I try to add functions, "filtering" and "logging" to network by NCC. This test methods are checking the built logical topology and network trace. This paper's initial implementation focused on feasibility and functionality, rather than optimized performance. I provide throughput and latency just to make sure. I used SmartBits for measuring throughput and latency. I measured throughput of "Layer 2 switch only", "bypass circuit by patch cable", "bypass circuit by bridge FunctionBox", and "Adding filter by FunctionBox". And I compared throughput and latency at these cases. The result are shown by some graphs.

By the conventional methods of functional addition, functions are realized by the network devices that a function was putting on or a large variety of MiddleBoxes, including firewalls, loadbalancers, SSL offloaders, web caches, and so on. Therefore functions are limited by these devices (like network devices and MiddleBoxes) location. But this function-oriented networking releases functions from boxes and location. In discussion part, I state utility and visions of function-oriented networking.