An Efficient Fuzzy-based Resource Allocation Method in NFV

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Abstract Network functions virtualization offers a new way to design, deploy and manage networking services. Besides, the network virtualization management and orchestration provides an ability to spin up network components with short time constraints. The management allows rapid onboarding and prevents system chaos. In this paper, we present a study on the management system to manage network resource for 5G. First, we use the management system to start and stop the servers based on current system load to optimize resources. Subsequently, we propose a method using several performance metrics to monitor resources. We implement the system using python, the adaptive streaming servers using Node.js. Besides, we run all of the system components in Docker to virtualize a cloud streaming system. Experiment result indicated that the system reduces resource consumption up to 10% compared to existing methods.

Keywords: *Resource management, NFV, 5G, Cloud computing, Video streaming*

1. Introduction

The network today works on heterogeneous devices, such as mobiles, computers, routers, switches. Cooperating these devices sometimes causes vulnerable functions, or system networks work inefficiently. The rise of significant competition from major Internet technology companies, such as Netflix, Microsoft, Skype, and Google has proposed a new way of managing network resources. Network function virtualization (NFV) describes how to virtualize and manage network resources, such as storage, and computing in a network.

In this paper, we exploit the MANO [1] structure to build a video streaming system. The MANO manages streaming servers. It can start/stop a server depending on the current load of the system. In this way, we can control network resource efficiently. We also propose several metrics to monitor resources. We use these parameters to find the best severing streaming server according to a client's request.

2. Related Works

A comprehensive survey [2] has been published stated about the NVF resource allocation problem. NFV promotes virtualizing network functions such as transcoders, firewalls, and load balancers, among others, which were carried out by specialized hardware devices and migrating them to software-based appliances. One of the main challenges for the deployment of NFV is the resource allocation of demanded network services in NFV-based network infrastructures.

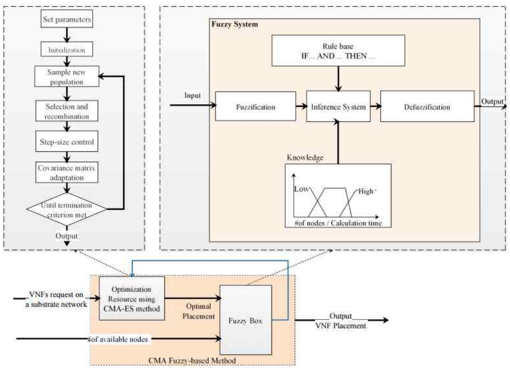

Figure 1. Fuzzy-based resource allocation method in NFV

3. Proposed Method

We model the substrate network, where VNF chains are defined and placed, as a connected directed graph, $G = (V, E)$. Some of network nodes are switch nodes, with typical routing and switching capabilities, along with (small) computational capacity that can be used for running VNFs, e.g., inside an FPGA in the switch. The remaining nodes are distributed sites with (much larger) computational capacity.

We consider each of these sites as a large computational unit, called a data center node, without looking into their internal topology. We define two types of computational capacities for the nodes: $C_d(v)$ and $c_s(v)$ ($\forall v \in V$). For today's switch nodes, C_d is zero and for current data center nodes, C_s is zero. We define both types of capacities for all nodes to keep our model open to future extensions. For example, in future, switches might be equipped with general-purpose processing capabilities, leading to $C_d > 0$ for switch nodes. The network links are directed edges in the graph, with data rate $d(v, v')$ and latency $l(v, v')$ for every edge $(v, v') \in E$. The overview of the proposed method is shown in Figure 1, where our goal is maximize remaining resource allocation (1) for substrate network under a given number of VNFs.

4. Experimental Results

We implemented the system in Ubuntu 14.04. Server applications are Node.js-based application.

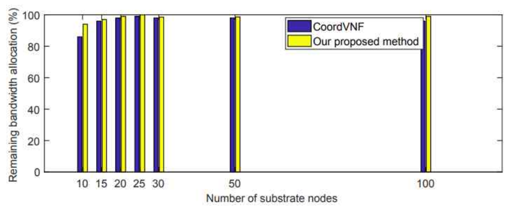

Figure 2. Remaining bandwidth allocation comparison.

We arrange three physical upload servers with mediocre performance, two physical CDN DASH servers to provide video streaming. Each server can start several Node.js applications. The main server and the client web browser running on a same physical computer but executed on Docker to ensure that it is separate virtualize machines. The client requests to upload video files to the upload servers. These files are transcoded to DASH format. This job requires extensive computation resource. Therefore, the VNFM will start new upload servers if it recognizes that current system cannot respond to client requests. The VNFM can also start new CDN DASH servers if current DASH servers overload upon current requests from clients. In this case, the new starting DASH servers synchronize DASH files to its local disk based on selected metric such as these server sync video files with the most viewed. Figure 2 shows the compared result between our proposed method and CoordVNF [3].

5. Conclusion

In this paper, we proposed a method using several performance metrics to monitor resources. We implement the system using python, the adaptive streaming servers using Node.js. Besides, we run all of the system components in Docker to virtualize a cloud streaming system. Experiment result indicated that the system reduces resource consumption up to 10% compared to existing methods. In the future research, we tend to solve resource allocation in NFV for 5G technology with multi-objective such as minimizing cost, maximizing remaining bandwidth at the time.

Acknowledgments

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