A Virtualization and Management Architecture of Micro-Datacenter

Byungyeon Park[1], Wonhyuk Lee[1], TaeYeon Kim[2], HyunCheol Kim[3,*]

[1] Korea Institute of Science & Technology Information
Daejon, Korea, 305-806
{bypark,livezone}@kisti.re.kr

[2] Electronics and Telecommunications Research Institute
Daejon, Korea, 305-700
tykim@etri.re.kr

[3] Dept. of Computer Science, Namseoul University
Cheonan, Korea, 331-707
hckim@nsu.ac.kr

Abstract. With the cloud computing, storage and computing resources are moving to remote resources such as virtual servers and storage systems in large DCs(Data Centers), which raise many performance and management challenges. We consider distributed cloud systems, which deploy micro DC that are geographically distributed over a large number of locations in a wide-area network. In this article, we also argue for a micro DC-based network model that provides higher-level connectivity and logical network abstraction that are integral parts of wellness applications. We revisit our previously proposed logical network models that are used to configure the logical wellness network.

1 Introduction

Cloud computing is becoming a promising platform and have developed rapidly recently. In contrast to traditional enterprise IT solution, it enables enterprises to procure computing resources on demand basis and delegate management of all the resources to the cloud service provider. With emerging software defined networking (SDN) paradigm, it provides a new chance to fast service provisioning in the cloud with the network through standard programmable interfaces [1][2]. With the cloud computing, datacenters (DCs) promote on-demand provisioning of computing resources and services. Storage and computing resources (i.e., IT resources) are moving to remote resources such as virtual servers and storage systems in large datacenters, which raise many performance and management challenges [3][4].

With increasing interest in the concept of wearable computing and the popularization of hand-held devices, those movable devices are becoming start point of wellness information [5]. As shown in Fig. 1 and Fig. 2 we consider distributed cloud systems, which deploy micro DC that are geographically distributed over a large number of

* Corresponding author

K.J. Kim (ed.), *Information Science and Applications*,
Lecture Notes in Electrical Engineering 339, DOI 10.1007/978-3-662-46578-3_22

locations in a wide-area network. This distribution of micro DC over many locations in the network may be done for several reasons, such as to locate resources closer to mobile devices, to reduce bandwidth costs, to increase availability, etc [6][7]. Micro DCs are interconnected via high-speed optical wavelength division multiplexing (WDM) links. In this article, we also argue for a micro DC-based network model that provides higher-level connectivity and logical network abstraction that are integral parts of wellness applications. We revisit our previously proposed logical network models that are used to configure the logical wellness network.

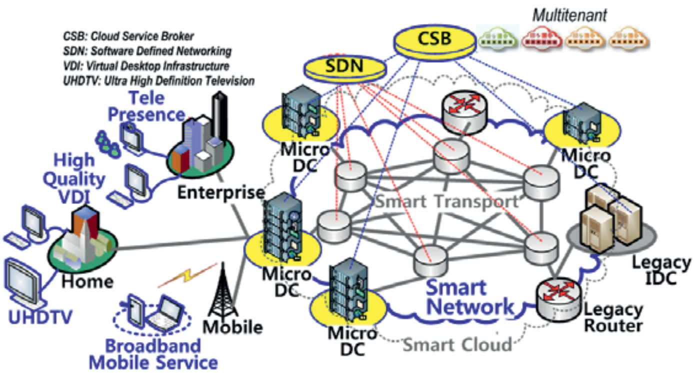

Fig. 1. Micro DC-based Smart Cloud Network Overall Architecture (Target Network)

2 Logical Network Management Schema

2.1 Topology Schema

As the topology class which expresses the configuration of logic network, it has trunk class as a subordinate class. Trunk class consists of two classes; Vlan class which contains logical information for management of Carrier Ethernet trunk and interface class which physical information. The UML diagram of topology schema, as shown in Fig. 2, it shows specific parameters which are used in the class. Each parameter has been defined using enterprise MIB information. The logic network has been configured based on the definition of PBB-TE technology.

2.2 Performance Monitoring Schema

The performance monitoring class has the following subordinate classes; Throughput, Frame Loss and Frame Delay. It consists of Frame Loss Class, Fame Loss Ratio and Fame Delay Variation. Fig. 10 shows a complete view of the performance monitoring schema. In fact, it has five classes to monitor logic network performance. Each class has been prepared based on the performance monitoring technology which is defined in ITU-T Y.1731. In terms of a UML diagram of the performance monitoring schema, specific parameters have been used. Each parameter has been defined using enterprises MIB information.

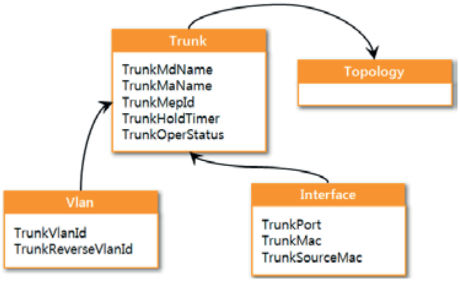

Fig. 2. Topology UML Schema

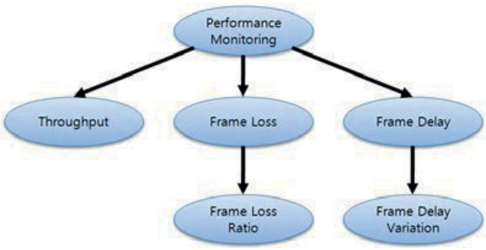

Fig. 3. Performance Monitoring Schema

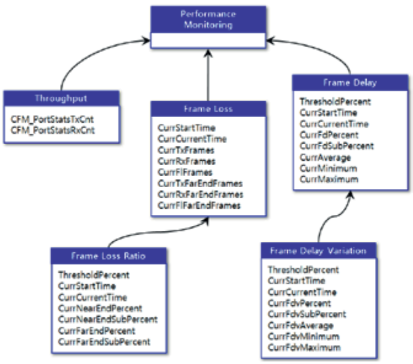

Fig. 4. Performance Monitoring UML Schema

2.3 Fault Management Schema

The fault management schema which is aimed to manage logic network faults has the following subordinate classes; Fault Verification, Power, Fault Notification, Fault Isolation and Fault Detection. Power Class includes Power Status Class which can analyze current power supply status and control the warning process and Warning Threshold Class. Fault Isolation Class has Linktrace Messages Class which can figure out network faults by analyzing LTM/LTR messages and Linktrace Relay Class. The Fig. 5 shows a complete view of the fault management schema. It consists of five super classes and four subordinate classes. As a UML diagram of the fault management schema, it shows specific parameters which are used in the class. Each parameter has been defined using enterprise MIB information.

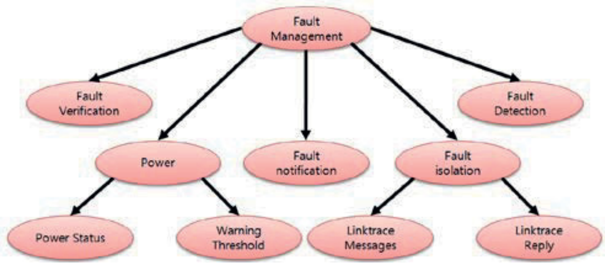

Fig. 5. Fault Management Schema

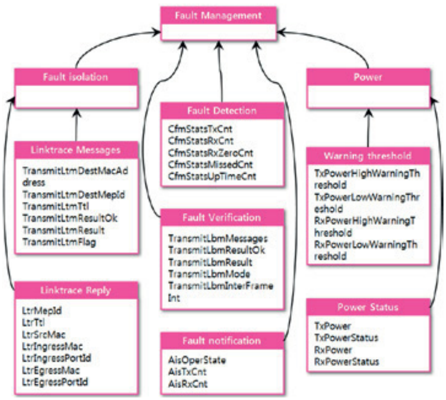

Fig. 6. Fault Management UML Schema

3 Development of Logical Network Management Framework

The logic network management framework established in this paper consists of three databases. It is comprised of DC_info, OOO_topo and OOO_inter databases. System information database table which should be created first after the establishment of framework is DC_info. It contains μ-DC configuration, performance, fault management table names as well as basic information on μ-DC equipment.

μ-DC Configuration Information Database is a database table in which logic network configuration information is stored. This table is automatically created when μ-datacenter equipment is added. It is automatically named in the form of 'OOO_topo.'

For example, Fig. 8 shows μ-DC equipment in Daejeon so that it is named 'DJN_topo.'

mysql> desc mers_info;

Field	Type	Null	Key	Default	Extra
ipAddr	varchar(15)	NO	PRI	NULL	
sysName	text	NO		NULL	
sysDescr	text	YES		NULL	
sysLocation	text	YES		NULL	
sysUpTime	varchar(20)	YES		NULL	
topoTable	varchar(10)	NO		NULL	
perfoTable	varchar(10)	NO		NULL	
faultTable	varchar(10)	NO		NULL	
interTable	varchar(10)	NO		NULL	

9 rows in set (0.00 sec)

Fig. 7. μ-DC Information Table

mysql> desc mers_info;

Field	Type	Null	Key	Default	Extra
ipAddr	varchar(15)	NO	PRI	NULL	
sysName	text	NO		NULL	
sysDescr	text	YES		NULL	
sysLocation	text	YES		NULL	
sysUpTime	varchar(20)	YES		NULL	
topoTable	varchar(10)	NO		NULL	
perfoTable	varchar(10)	NO		NULL	
faultTable	varchar(10)	NO		NULL	
interTable	varchar(10)	NO		NULL	

9 rows in set (0.00 sec)

Fig. 8. μ-DC Information Table

μ-DC Interface Information Database is a database table in which μ-DC interface information is stored. It is also automatically created when μ-DC equipment is added just like topology table. It is automatically named in the form of 'OOO_inter.' For example; Fig. 8 shows μ-DC equipment in Daejeon so that it is named 'DJN_inter.'

mysql> mysql> desc DJN_inter;

Field	Type	Null	Key	Default	Extra
ifIndex	varchar(4)	NO	PRI	NULL	
Descr	text	YES		NULL	
Mtu	int(11)	YES		NULL	
Speed	bigint(20)	YES		NULL	
PhysAddress	varchar(20)	YES		NULL	
OperStatus	varchar(10)	YES		NULL	
InOctets	bigint(20)	YES		NULL	
InUcastPkts	bigint(20)	YES		NULL	
InNUcastPkts	bigint(20)	YES		NULL	
InErrors	bigint(20)	YES		NULL	
OutOctets	bigint(20)	YES		NULL	
OutUcatPkts	bigint(20)	YES		NULL	
OutNUcastPkts	bigint(20)	YES		NULL	
OutErrors	bigint(20)	YES		NULL	

14 rows in set (0.01 sec)

Fig. 9. μ-DC Interface Table

μ-DC Configuration Information is the most important part in management framework. The logic network in which μ-DC equipment is configured across the nation can be precisely understood. Fig. 10 shows μ-DC in Seoul. It can be understood at a sight that it consists of μ-DC equipment and trunk in Daejeon and Gwangju. In addition, MAC address, Vlan ID and port number which are essential in configuring PBB-TE can be checked.

```
mysql> mysql> desc DJN_inter;
+----------------+-------------+------+-----+---------+-------+
| Field          | Type        | Null | Key | Default | Extra |
+----------------+-------------+------+-----+---------+-------+
| ifIndex        | varchar(4)  | NO   | PRI | NULL    |       |
| Descr          | text        | YES  |     | NULL    |       |
| Mtu            | int(11)     | YES  |     | NULL    |       |
| Speed          | bigint(20)  | YES  |     | NULL    |       |
| PhysAddress    | varchar(20) | YES  |     | NULL    |       |
| OperStatus     | varchar(10) | YES  |     | NULL    |       |
| InOctets       | bigint(20)  | YES  |     | NULL    |       |
| InUcastPkts    | bigint(20)  | YES  |     | NULL    |       |
| InNUcastPkts   | bigint(20)  | YES  |     | NULL    |       |
| InErrors       | bigint(20)  | YES  |     | NULL    |       |
| OutOctets      | bigint(20)  | YES  |     | NULL    |       |
| OutUcatPkts    | bigint(20)  | YES  |     | NULL    |       |
| OutNUcastPkts  | bigint(20)  | YES  |     | NULL    |       |
| OutErrors      | bigint(20)  | YES  |     | NULL    |       |
+----------------+-------------+------+-----+---------+-------+
14 rows in set (0.01 sec)
```

Fig. 10. μ-DC Topology Information

Fig. 11 reveals the interface information of μ-DC equipment. As L2 switch equipment, μ-DC equipment has several interfaces. It includes MAC address per interface, MTU size, current operating status and port number which is essential in configuring a logic network.

MERS-SEL Interface Information

ifIndex	Descr	Mtu	Speed	PhysAddress	OperStatus	InOctets	InUca
64	1000Gbic850Sx Port 1/1 Name	1950	1000000000	0:24:43:97:70:0	up	22119063	2
65	1000Gbic850Sx Port 1/2 Name	1950	1000000000	0:24:43:97:70:1	up	6424	
66	1000Gbic Port 1/3 Name	1950	1000000000	0:24:43:97:70:2	up	942171299	3815
67	1000Gbic Port 1/4 Name	1950	1000000000	0:24:43:97:70:3	up	2524115896	749
68	1000Gbic Port 1/5 Name	1950	0	0:24:43:97:70:4	down	0	
69	1000Gbic Port 1/6 Name	1950	0	0:24:43:97:70:5	down	0	
70	1000Gbic Port 1/7 Name	1950	0	0:24:43:97:70:6	down	0	
71	1000Gbic Port 1/8 Name	1950	0	0:24:43:97:70:7	down	0	
72	1000Gbic Port 1/9 Name	1950	0	0:24:43:97:70:8	down	0	
73	1000Gbic Port 1/10 Name	1950	0	0:24:43:97:70:9	down	0	

Fig. 11. μ-DC Interface Information

4 Conclusions

This paper has investigated a framework in which a logic network is described and managed by particular application based on science & technology research network resource specification. As a result, a schema through which topology, performance and fault information can be systematically managed in accordance with international standards has been completed. In addition, database has been created based on the schema which has been designed in accordance with international standards, and a network management framework through which a logic network can be managed has been built. Then, information has been brought from the current Carrier Ethernet equipment and provided to an administrator.

However, a further study needs to be conducted on the construction of a management framework which can reveal topology, performance and fault information in a more dynamic manner using the collected information. Even though the current management framework shows the configuration of a logic network in a static manner using a table, the network could be operated more effectively once a management framework just like a weather map is built.

Acknowledgement This work was supported by the ICT R&D program of MSIP/IITP, Republic of Korea. [14-000-05-001, Smart Networking Core Technology Development]

References

1. Banikazemi M.; Olshefski D., Shaikh A., Tracey, J., Guohui Wang, “Meridian: an SDN platform for cloud network services,” Communications Magazine, IEEE, Vol. 51, Issue 2, pp. 120–127, 2013.
2. Alicherry M., Lakshman T.V., “Network aware resource allocation in distributed clouds,” INFOCOM, pp. 963-971, 2012.
3. Mon-Yen Luo, Jun-Yi Chen, “Software Defined Networking across Distributed Datacenters over Cloud,” International Conference on Cloud Computing Technology and Science (CloudCom), pp. 615-622, 2013.
4. M. F. Bari, R. Boutaba, R. Esteves, L. Z. Granville, M. Podlesny, M. G. Rabbani, Z. Qi, and M. F. Zhani, “Data Center Network Virtualization: A Survey," Communications Surveys & Tutorials, IEEE, Vol. 15, pp. 909-928, 2013.
5. Sunyoung Kang, Hyuncheol Kim, Seungae Kang, “Virtual private network for wellness sports information," Multimedia Tools and Applications, Online First Article, Springer, 2014.
6. M.-Y. Luo and J.-Y. Chen, “Towards Network Virtualization Management for Federated Cloud Systems,” International Conference on Cloud Computing, IEEE, 2013.
7. Khethavath P., Thomas J., Chan-Tin E., Hong Liu, "Introducing a Distributed Cloud Architecture with Efficient Resource Discovery and Optimal Resource Allocation", IEEE, Services (SERVICES), pp. 386-392, 2013.
8. Shicong Meng, Ling Liu, Ting Wang, "State Monitoring in Cloud Datacenters", Transactions on Knowledge and Data Engineering, IEEE, Vol. 23, Issue 9, pp. 1328-1344, 2011.
9. Hassan, Mohammad Mehedi, Song, Biao, Hossain, M.Shamim, Alamri, Atif, “QoS-aware Resource Provisioning for Big Data Processing in Cloud Computing Environment,” International Conference on Computational Science and Computational Intelligence(CSCI), pp. 107–112, 2014.
10. Haiying Shen, Guoxin Liu, “An Efficient and Trustworthy Resource Sharing Platform for Collaborative Cloud Computing,” Transactions on Parallel and Distributed Systems, IEEE, Vol. 25, Issue 4, pp. 862–875, 2014.