ARC '16

مؤتمر مؤسسة قطر
السنوي للبحوث
QATAR FOUNDATION
ANNUAL RESEARCH
CONFERENCE

Towards World-class
Research and Innovation

مؤسسة قطر
Qatar Foundation
لإطلاق قدرات الإنسان
Unlocking human potential

Information Communications Technology Pillar

http://dx.doi.org/10.5339/qfarc.2016.ICTSP3072

Adaptative Network Topology for Data Centers

Zina Chkirbene[1], Sebti Foufou[2], Ridha Hamila[3]

[1]Department of Computer Science and Engineering College of Engineering, Qatar University, Qatar LE2i Lab, University of Burgundy Dijon, France, QA
[2]Department of Computer Science and Engineering, QA
[3]Department of Electrical Engineering, QA

Email: zina.chk@qu.edu.qa

Data centers have an important role in supporting cloud computing services (such as email, social networking, web search, etc.) enterprise computing needs, and infrastructure-based services. Data center networking is a research topic that aims at improving the overall performances of the data centers. It is a topic of high interest and importance for both academia and industry. Several architectures such as FatTree, FiConn, DCel, BCube, and SprintNet have been proposed. However, these topologies try to improve the scalability without any concerns about energy that data centers use and the network infrastructure cost, which are critical parameters that impact the performances of data centers.

In fact, companies suffer from the huge energy their data centers use and the network infrastructure cost witch is seen by operators as a key driver for maximizing data centers profits and according to industry estimates, the united states data center market achieved almost US\$39 billion in 2009, growing from US\$16.2 billion in 2005 Moreover, the studies show that the installed base of servers has been increasing 12 percent a year, from 14 million in 2000 to 35 million in 2008. Yet that growth is not keeping up with the demands placed on data centers for computing power and the amount of data they can handle. Almost 30 percent of respondents to a 2008 survey of data center managers said their centers will have reached their capacity limits in three years or sooner.

The infrastructure cost and power consumption are the first order design concern for data center operators. In fact, they represent an important fraction of the initial capital investment while not contributing directly to the future revenues. Thus, the design goals of data center architectures seen by operators are high scalability, low latency, low Average path length and especially low energy consumption and low infrastructure cost (the number of interface cards, switches, and links).

Cite this article as: Chkirbene Z, Foufou S, Hamila R. (2016). Adaptative Network Topology for Data Centers. Qatar Foundation Annual Research Conference Proceedings 2016: ICTSP3072 http://dx.doi.org/10.5339/qfarc.2016.ICTSP3072.

Motivated by these challenges, we propose a new data center architecture, called VacoNet that combines the advantages of previous architectures while avoiding their limitations. VacoNet is a reliable, high-performance, and scalable data center topology that is able to improve the network performances in terms average path length, network capacity and network latency. In fact, VacoNet can connect more than 12 times the number of nodes in FlatNet without increasing the APL. Also, it achieves a good network capacity even with a bottleneck effect (bigger than 0.3 even for 1000 servers). Furthermore, VacoNet reduced the infrastructure cost by about 50%, and the power consumption will be decreased with more than 50000 watt compared to all the previous architectures.

In addition, and thanks to the proposed fault tolerant algorithm, the new architecture shows a great performance even when the failure rate equals to 0.3, which means when about one third of the links failed, the connection failure rate is only 15%. By using VacoNet, operators can win till 2 million US dollars compared to Flatnet, Dcell, Bcube and Fattree.

Both theoretical analysis and simulation experiments have conducted and validated to evaluate the overall performance of the proposed architecture.