Challenges and Opportunities in the KREONET-Emulab Network Testbed

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1. Introduction

Over the last decade, network testbed has served the needs of testing new theories and technologies. Number of infrastructure made of Gigabit networks and computing nodes have been devoted to research on the future internet and virtual distributed systems. Advances in experimental infrastructure have enabled multi-national participated remote experiments. However, large-scale networking research has been severely limited by the lack of a public experimental infrastructure in realistic scenarios. It is necessary to build a new effort to represent an important step forward in helping researchers to improve discoveries and collaboration processes. The implementation of a shared testbed will promote global joint experimentation and encourage researchers to take advantage of the cutting-edge network technologies. This paper presents our experience with the KREONET-Emulab [1] testbed, and discusses the challenges and opportunities for continued development, and the federation of the testbed facility.

2. Deployment and operation of KREONET Emulab

Traditionally, the challenging experiments like a DDos test in cyber security have been hardly accepted to test on the national research networks which provide 24/7 guaranteed service. And most general purpose clusters were concentrated on computing power and I/O operations not the network itself. Network testbed supports a wide variety of experiments requested topologies without any worries to damage or crash the environments. The KREONET Emulab is a network testbed for emulated re-playable experiments and provides highly customizable network topologies for hosting diverse experiments with full administrator access to the allotted nodes for users. It is a web-accessible, time and space shared, and reconfigurable Emulab-based testbed. The Emulab Software [2] was developed by the Flux Group at the University of Utah and installed at more than two dozen sites around the world. It is widely used by not only computer Science researchers in networking and distributed systems fields but education discipline.

The KREONET Emulab consists of forty two test nodes, four control and file servers, three high performance switches and five power controllers as shown on figure 1. Java GUI is also available for the experimenters who are unfamiliar with ‘NS(network simulator)’ syntax to create network topologies graphically. As of April 2014, there are more than 80 experiments on cyber security, networking, computer educations, parallel computing, and distributed systems research using KREONET Emulab. The emulated experiments are only available on the KREONET Emulab.

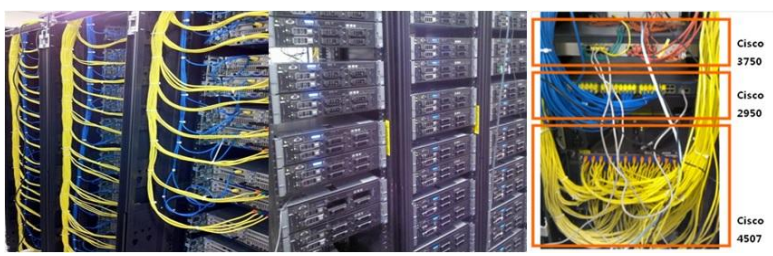

Figure 1. KREONET Emulab

3. Challenges and opportunities of testbed

Increasing number of experiments gets larger and incorporates a variety of resources and technologies. Nevertheless, the scale and scope of single testbed is limited and a federated model among testbeds has been received attention as a useful technique to serve a wide range of experimenter’s needs. A lot of promising new ideas for networking technologies like protocols and new equipments are disused due to the lack of suitable experimental facilities. Therefore the new federated facility for new ideas would accelerate the development process for the Future Internet technology. It would also enable the researchers to run larger experiments and take advantage of various resources. However, building a global federation is quite challenging, due to the issues of trust user access policy,

local regulations as well as the technical difficulties due to the heterogeneity of the resources. In addition, wireless is still active research area due to its uncertain nature and difficulties in simulation of wireless communication.

The EU-funded project, the Future Internet Research and Experimentation (FIRE) [3] and the US NSF-funded one, the Global Environment for Network Innovation (GENI) [4], both concentrate on the future internet evolution which will provide on the functionality of large-scale testbeds. There are dozens of Emulab testbeds around the world and it has been an effort on the federation of these testbeds using ProtoGENI which leads the significant architectural changes to the underlying software [5].

At the end of 2013, SMARTFIRE project to further develop Korea-EU collaboration on Future Internet research launched under the EU-FIRE program. It aims to design a shared large scale experimental testbed spanning several different sites in Europe and South Korea. KREONET Emulab joined the project as one of the five members in Korea. As figure 2 shows, KREONET Emulab is connected to the testbeds in EU and does an active role in implementing the ProtoGENI as well as mobile environment for test. The GEANT and the KREONET are interconnected via the high-speed international research network GLORIAD with 10Gbps. The WiFi enabled testbed infrastructures with wireless sensors in both Europe and Korea will be extended and federated.

Figure 2. Connecting Tesbeds between Korea and EU

We all understand that networks have become a critical role of the research process. The international collaborative experiments like LHC(Large Hadron Collider) in High energy Physic at CERN require networks beyond the commodity services and have proven them as part of the science workflow. Many other scientific areas from astronomic to climate research produce data which grow exponentially. Therefore the cloud services connecting research networks for the research community is required. There's no question about that these services will play a major role in the future. The research network and the research community can benefit from the adoption of cloud services. The new testbed including not only the wired/wireless emulation nodes but the cloud as a computing node and storage would bring a great chance to step up the current experimental environment. We see opportunities for the network testbeds to enhance the quality of cloud offering. The networking community needs to address the technology challenges to turn this vision into reality.

From the experience of operation over two years, teaching classes using KREONET Emulab has been quite beneficial for students and faculty members. It is a safe environment to use for the students and at the same time easy to develop courseware for the faculty members.

4. Conclusion

There is an increasing interest in running experiments at large scale and more nodes are needed both to enable larger experiments and to handle more users simultaneously. KREONET Emulab is facing the next phase to expand in terms of the size of the nodes, users and the quality of service. We need to work further on some practical issues related to the development of federation among the distributed testbed. It is shown that federated testbeds provide new opportunities for experimentation, but also raise the challenging issues of design a framework.

5. References

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