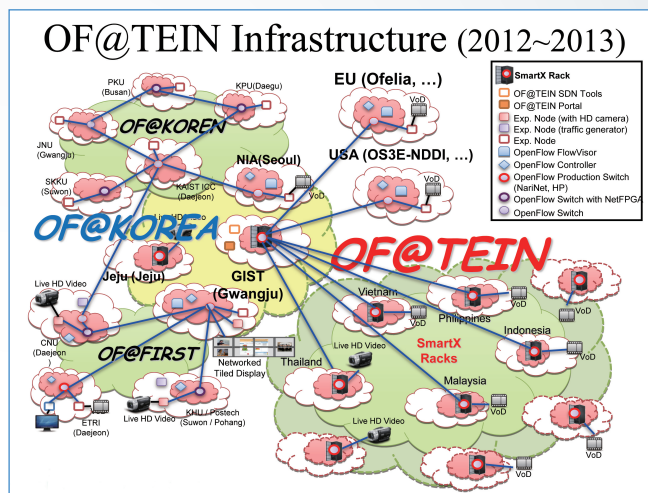# OpenFlow-
enabled SDN testbed over TEIN

The internet that we all know (an integral part of our life) has been around for nearly half a century. There have been many initiatives to explore the next generation of networks (also known as Future Internet) to meet the ever growing and diverse needs of users. Thus, over the last few years, there were a number of initiatives around the world on Future Internet testbed, such as US Global Environment for Network Innovations (GENI), EU Future Internet Research & Experimentation (FIRE), and Japan New-Generation Network (NWGN).

One of the promising technologies along with Future Internet testbeds is the OpenFlow implementation of Software Defined Network (SDN) which separates the control from the data plane. In the region, we have the OF@TEIN (OpenFlow at TEIN) which is a regional OpenFlow testbed across international boundaries.

Regional OpenFlow-enabled SDN testbed

In order to build a virtualized OpenFlow-enabled SDN testbed over international sites, the project focuses on the following goals:

- design and verification of SmartX Rack,
- site installation and verification of OF@TEIN network,
- design and development of OF@TEIN SDN tools.

OF@TEIN – A New Initiative

This new initiative, OF@TEIN, brings researchers to a new frontier where researchers have an International SDN testbed, consisting of multiple international sites, to test their applications and/or innovations at a scale never possible previously and more representative of the Internet. This would also heighten the need for global collaboration.

OF@TEIN is a collaboration project initiated by Korea. It targets to promote an OpenFlow-enabled SDN infrastructure over international sites via the TEIN network. This project is one of the e-TEIN projects funded by the National Information Agency (NIA) in Korea. It is carried out by a consortium of Korean universities and international sites, led by Gwangju Institute of Science and Technology (GIST) of Korea.

OF@TEIN – An International Collaboration Project

The OF@TEIN collaboration project started off in Year 2012 through collaborating with the TEIN NRENs in the South-East Asia (SEA) region. Besides Korea, the collaborators from SEA are: Vietnam – Hanoi University of Science and Technology (HUST), Philippines – Advanced Science and Technology Institute (ASTI), Thailand – Chulalongkorn University, Indonesia – Institut Teknologi Bandung (ITB) and Malaysia – University of Malaya.

Deployment of OF@TEIN

A unique SmartX Rack with OpenFlow switching and remote management functions was first designed by GIST. The design was then verified with verification procedure. As part of OF@TEIN network installation,

the SmartX Racks were installed at seven OF@TEIN sites (Vietnam, Philippines, Thailand, Indonesia, Malaysia and two sites in Korea) and connected to enable OpenFlow-enabled SDN experiments. Lastly, to better utilize OF@TEIN infrastructure, several SDN tools were designed and developed to support the experiments and management of OF@TEIN testbed.

Expanding OpenFlow-enabled SDN testbed

With the successful launch of OF@TEIN SDN testbed in Year 2012 that spanned over Korea and five South-East Asia sites, the international collaborators of this project are looking forward to extend the OF@TEIN infrastructure by leveraging it with the coordinated development for video-based medical collaboration and global Internet Protocol Television (IPTV) service. For the coming years, the

"This is the first-of-its-kind project involving 5 South East Asia countries and South Korea that I am participating in. This project has provided a platform for closer collaboration among us and transfer of technology from South Korea to the developing countries. The equipment provided has demonstrated the advance network connectivity through SDN with OpenFlow using TEIN4 as the underlying networking. I would like to also thank TEIN*CC for sponsoring a training workshop in Malaysia and forward for more collaborative work on this OF@TEIN project."

Prof. Teck Chaw Ling
University of Malaya

Prof. JongWon Kim
Leader of OF@TEIN project
GIST, Korea

"Continuing the initial deployment of OF@TEIN in year 2012, we will work on expanding this SDN-enabled international testbed with the close collaboration with OF@TEIN partners. Also, starting from late 2013, we are planning an exciting federation with EU FIRE testbed under the Smart FIRE project by linking Northeast Asia to Europe via Southeast Asia, which means more idealistic collaboration enabled by TEIN4 project."

team will continue to extend and upgrade the OF@TEIN infrastructure over the TEIN network; so as to promote the Future Internet research collaboration with the TEIN community. It is also working on stimulating active testbed-based researches, associated with OpenFlow-based SDN by growing cooperative research collaboration with advanced Future Internet efforts of the US and EU.

TEIN Network – a powerful tool for promoting international collaboration

The TEIN network has enabled researchers of five South-East Asia countries and Korea to collaborate and perform the OpenFlow-based SDN project. It will continue to contribute to the expanding of OpenFlow-enabled SDN testbed internationally.

TEIN4 – the research and education network for Asia-Pacific

- the fourth generation of the Trans-Eurasia Information Network
- dedicated high-capacity IP network for the research and education communities across Asia-pacific
- provides direct connectivity to GEANT and a gateway for global collaboration for over 50 million users in Asia-pacific
- supported by €16m co-funding (EC and beneficiary countries) until 2016

For more information:

TEIN4: www.tein.asia (www.tein4.net)
NIA : www.nia.or.kr
Chulalongkorn University : www.chula.ac.th/cuen
HUST : en.hust.edu.vn

EC : http://ec.europa.eu/europeaid/index_en.htm
GIST : www.gist.ac.kr
ITB : www.itb.ac.id

Prof. JongWon Kim: jongwon@gist.ac.kr
ASTI : www.asti.dost.gov.ph
University of Malaya : www.um.edu.my