

OF@TEIN+ Playground: Overview

OF@TEIN+ 1st Annual Meeting 2018

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Gwangju Institute of Science and Technology (GIST)
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Outline

- **OF@TEIN Playground: Review**

- OF@TEIN Playground: Overview
- OF@TEIN Playground: Multi-domain Infrastructure
- OF@TEIN Playground: Resources (Tower & Site Boxes)
- OF@TEIN Playground: Tower and SmartX Box
- OF@TEIN Playground: Centers (P, V, O and S)
- OF@TEIN Playground: Operations Rooms
- OF@TEIN Playground: Experiments
- OF@TEIN Community
- OF@TEIN Playground: Limitation and Improvement Requirement

- **OF@TEIN to OF@TEIN+ Preparation / Transition**

- OF@TEIN Playground Extension Trial for SDX
- OF@TEIN Playground Extension Trial for DataLake
- OF@TEIN Playground Extension Trial for Visibility
- OF@TEIN Playground Extension Trial for Accessibility

- **OF@TEIN+ Playground: Proposed Future Directions**

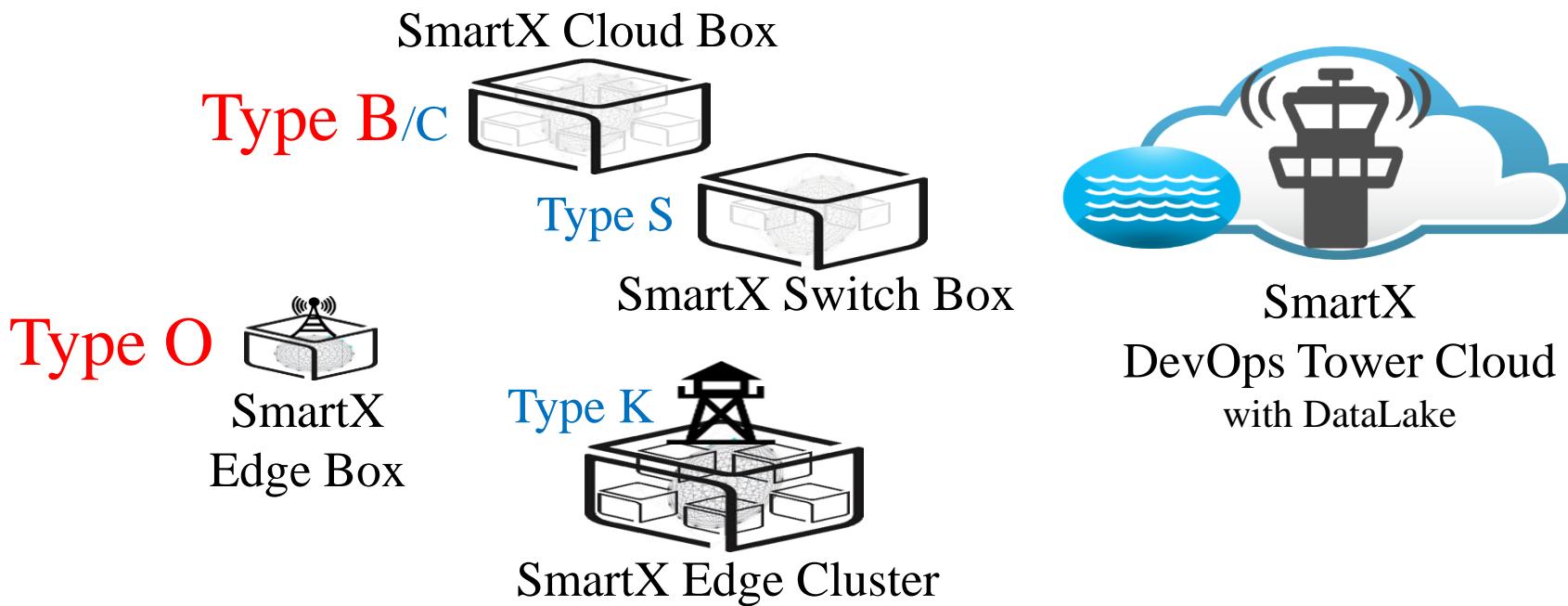
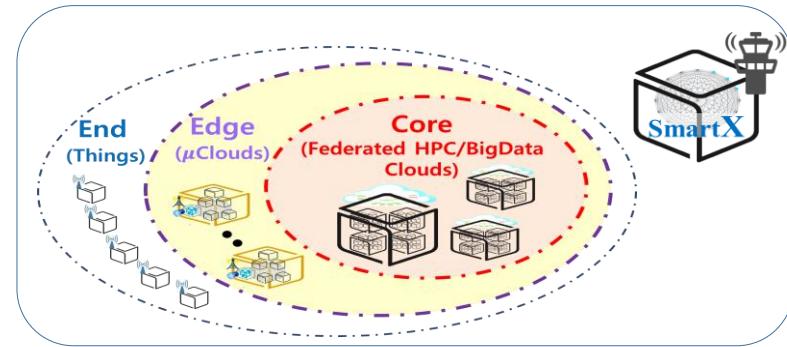
- Affordable, Federated and Visible Playground
- DevOps-automation for Playground Operation
- OF@TEIN+ Playground: Proposed Design
- OF@TEIN+ Playground: Features or Goals (5 items)
- OF@TEIN+ Playground: Software-defined Playground
- OF@TEIN+ Playground: Visible Playground with MultiView Framework
- OF@TEIN+ Playground: Collaborative Playground Towers for Multiple Differentiated Playground
- OF@TEIN+ Playground: IoT-Cloud Services Introduction
- OF@TEIN+ Playground: Secured Playground with Accessibility Support

Definition and Terminology

Playground	Miniaturized testbed which is expected to be easy to deployed and interesting to be used for experiments (i.e., plays)
Tower	Centralized location/space for managing the playground which contains multiple centers with different functionalities
Center	Software-based functionalities (i.e., provisioning, visibility, intelligence, orchestration and security) for managing and controlling the playground site resources
Sites	Distributed location spreads over geographical areas where the resources (e.g., SmartX Box) will be deployed
SmartX Box	Hyper-converged box-style resources (computing + storage + networking resources)
Developers	Person who did experiment and development to improve the playground functionality
Operators	Person who maintain the playground resources to be ready to use by the developers

SmartX Composable Playground & Boxes

(2018.01)



End

Edge

Core

Things

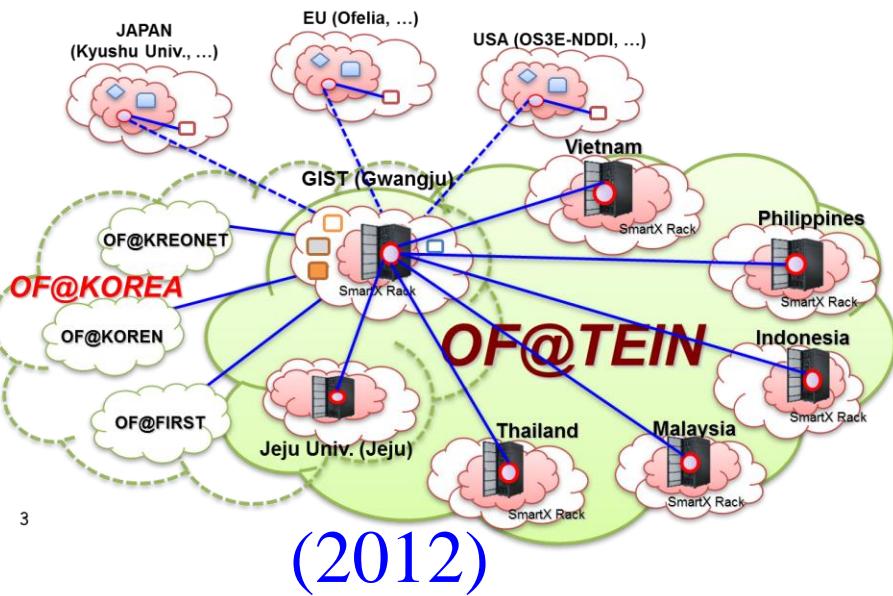
μ Clouds
(SDN/NFV)

Clouds
(HPC/BigData)

OF@TEIN Playground Review (2012 ~ 2015)

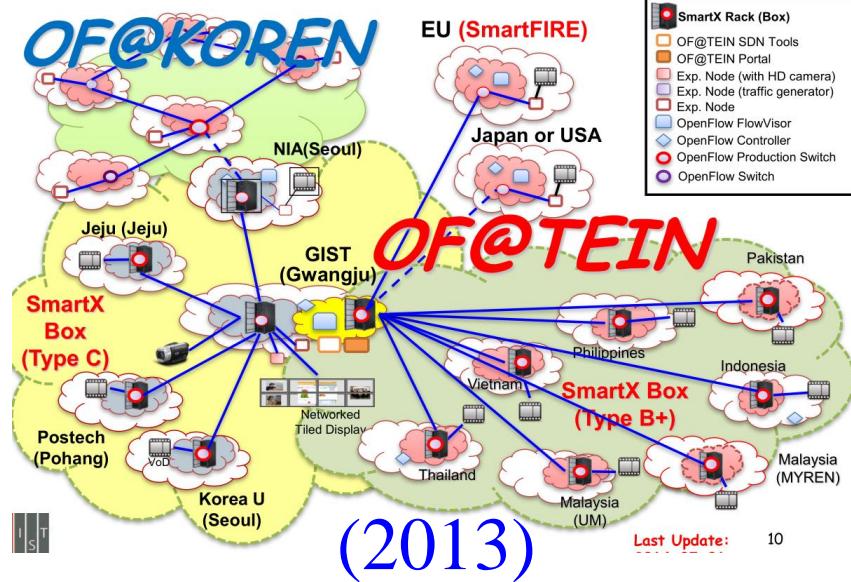


OF@TEIN Playground

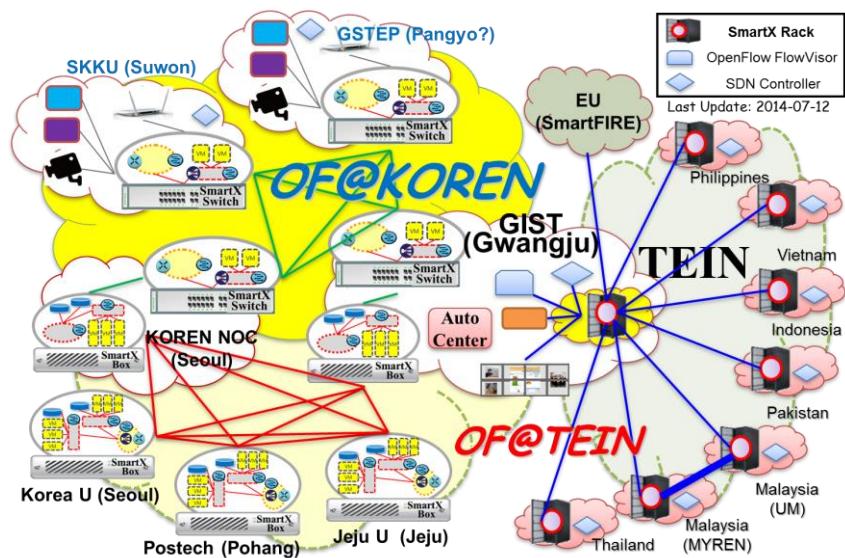


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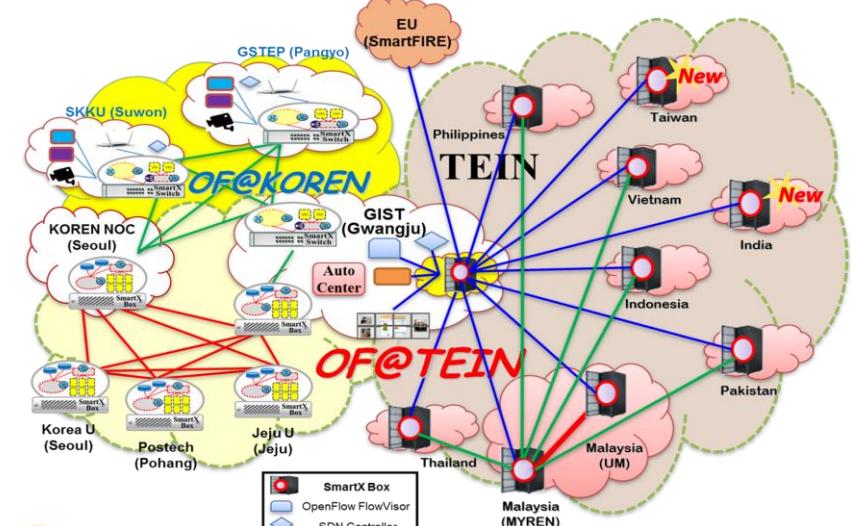
(2012)



Last Update: 10

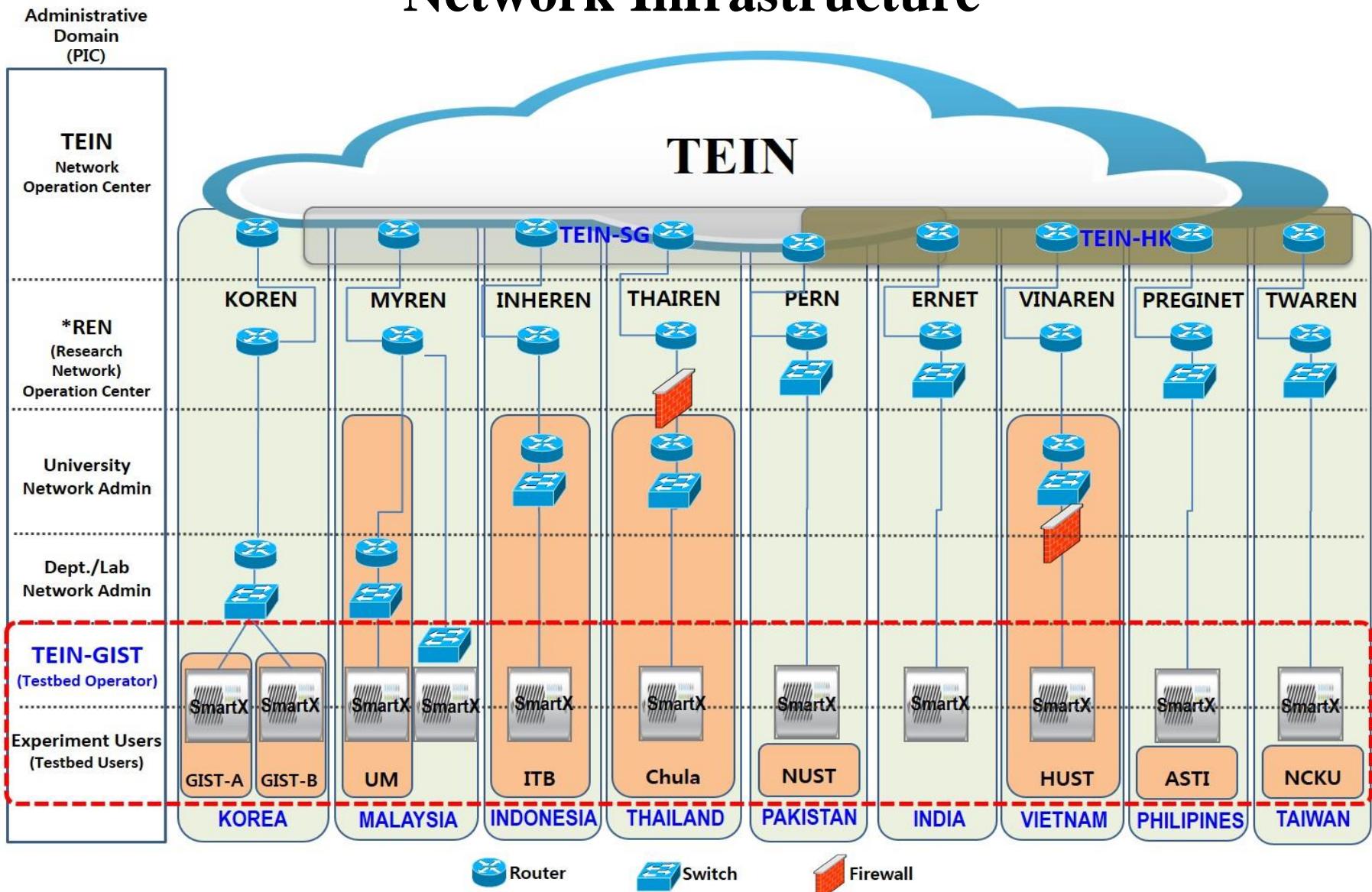


(2014)



(2015)

OF@TEIN Playground: Multi-domain Network Infrastructure



APAN



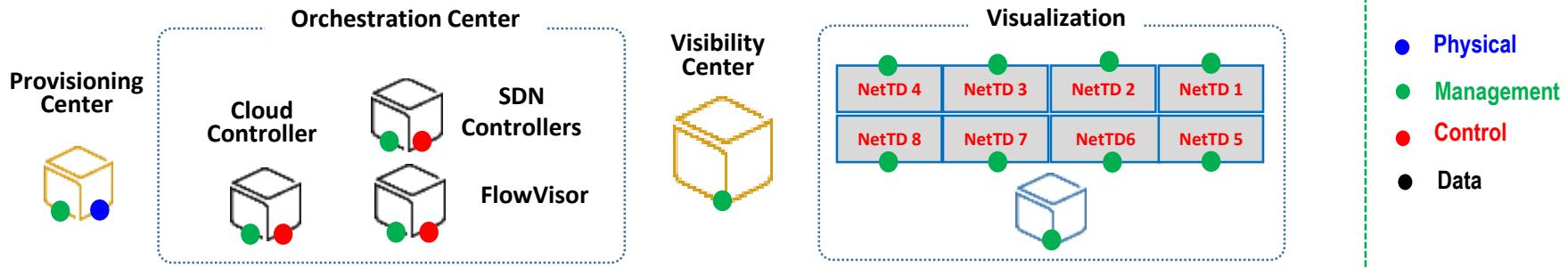
**TEIN CC
COOPERATION CENTER**



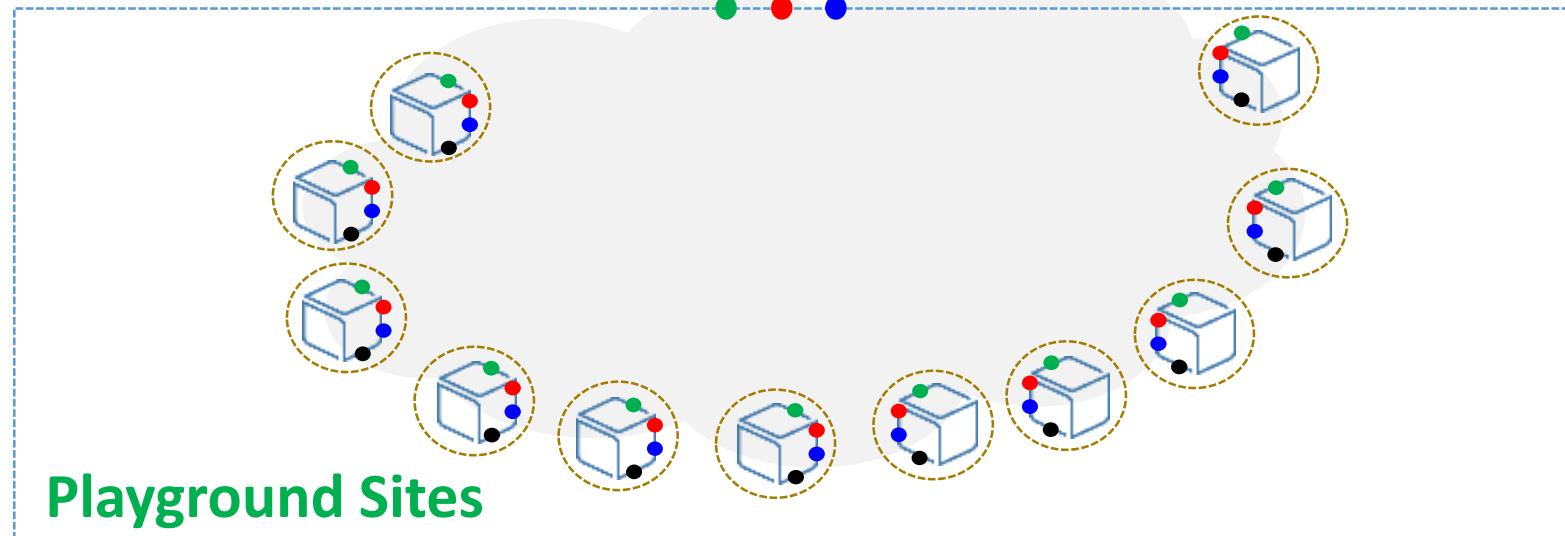
Asia@Connect

OF@TEIN Playground Tower and Site Resources

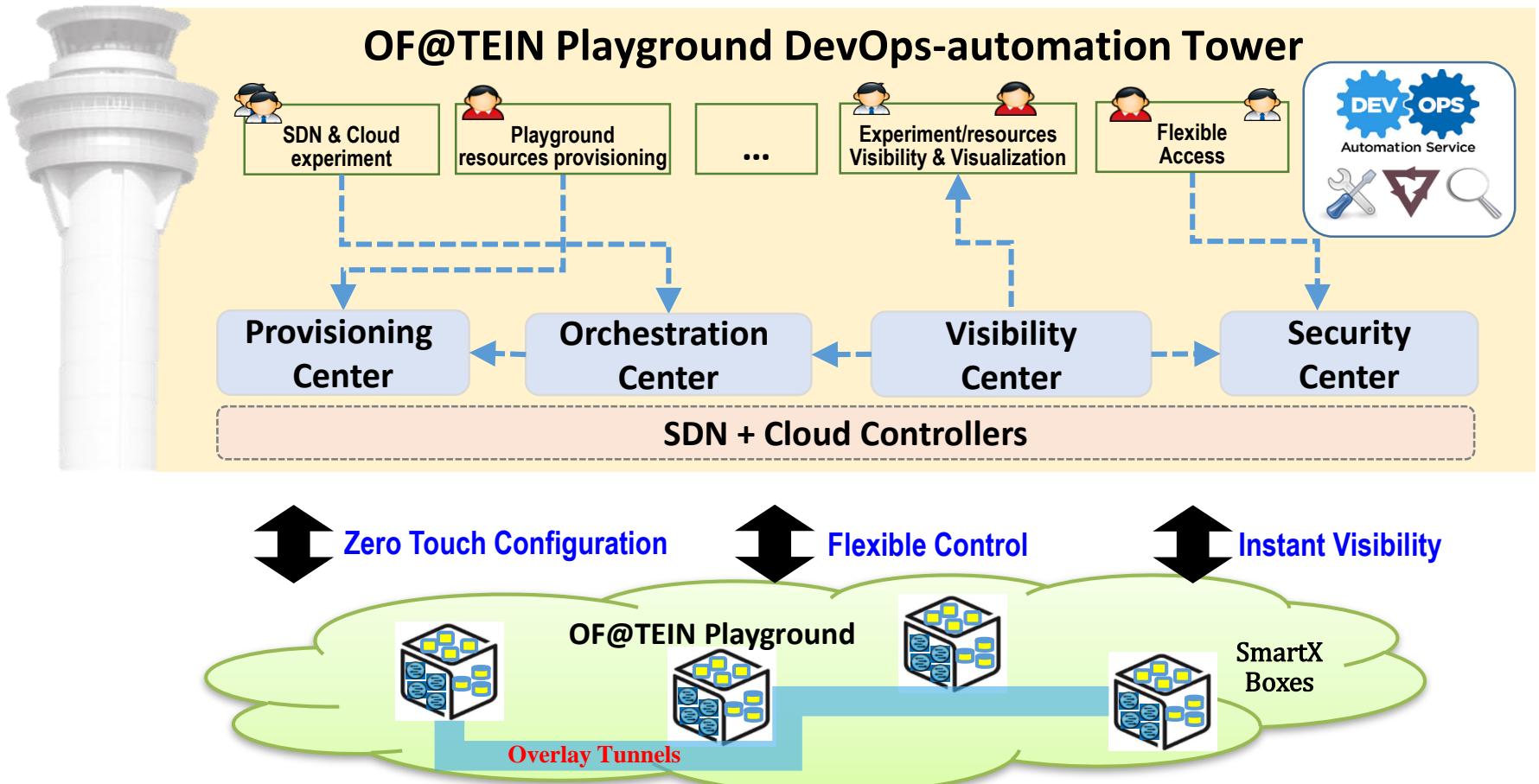
Playground Tower



Playground Sites



OF@TEIN Playground Tower

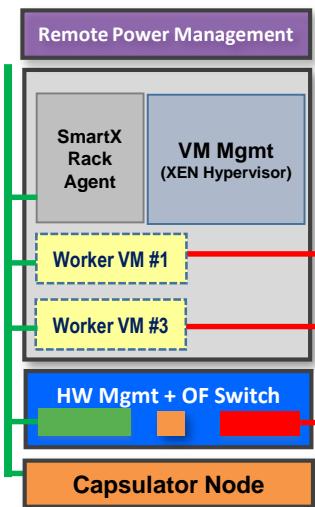


OF@TEIN Playground: SmartX Boxes

(2012)



(Type B)



(2013)



(Type B+)



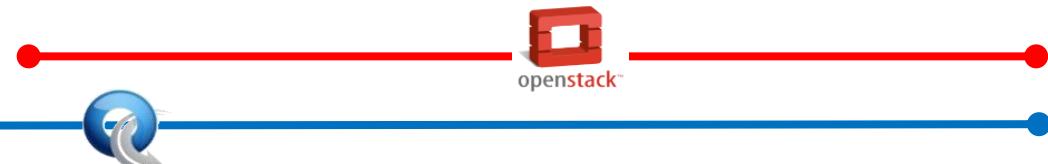
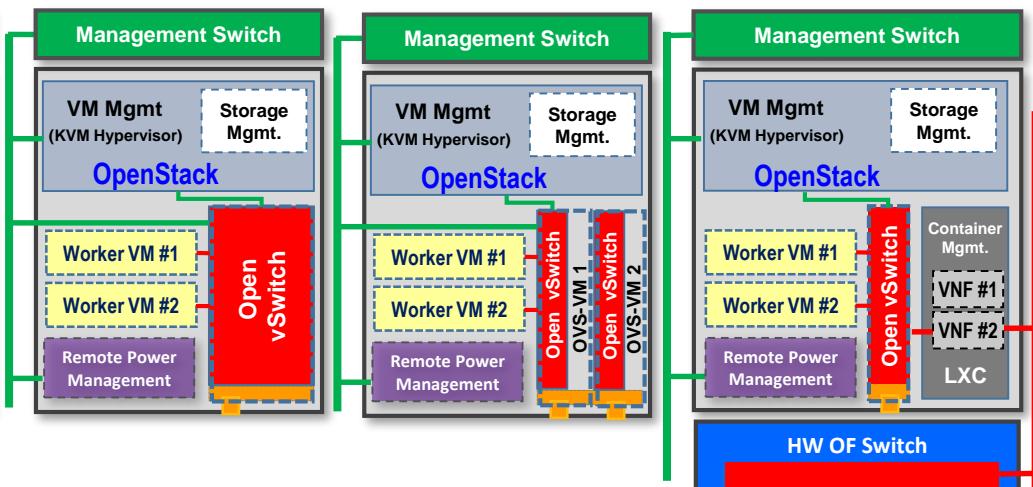
(Type B*)



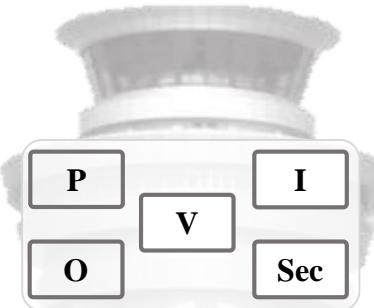
(Type B**)



(Type B#)



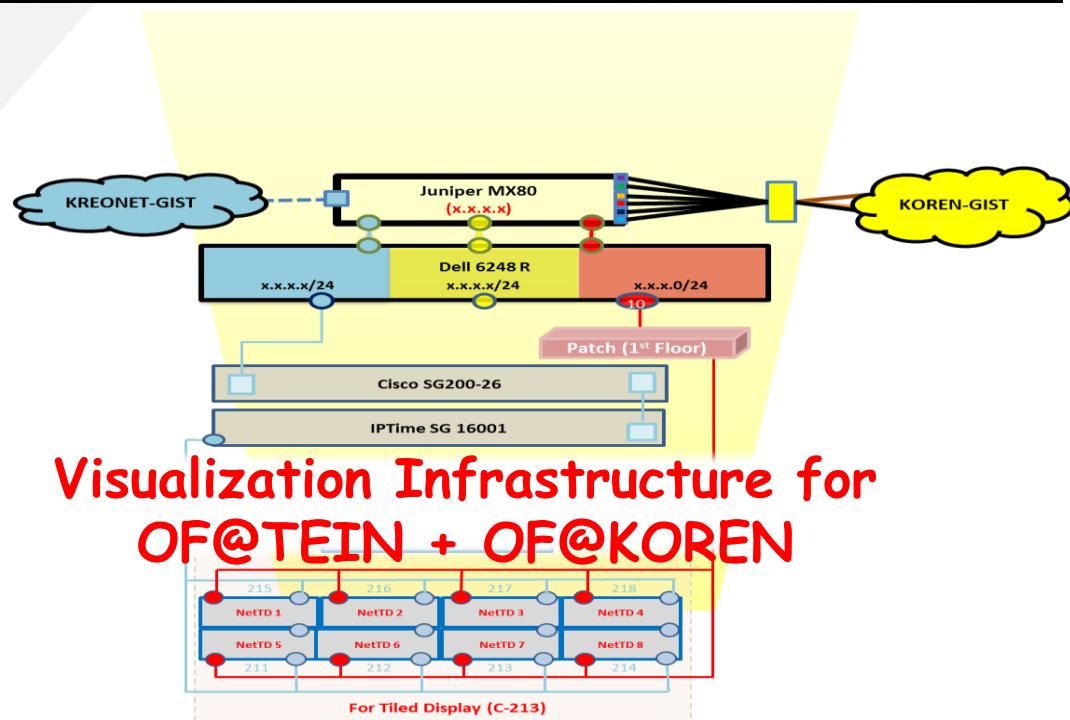
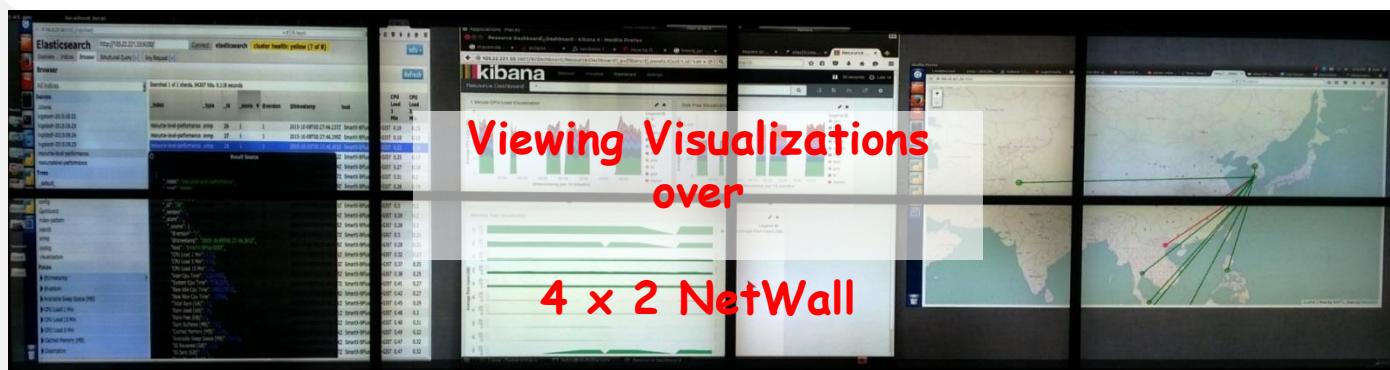
OF@TEIN Playground Operation Room



Playground
Tower

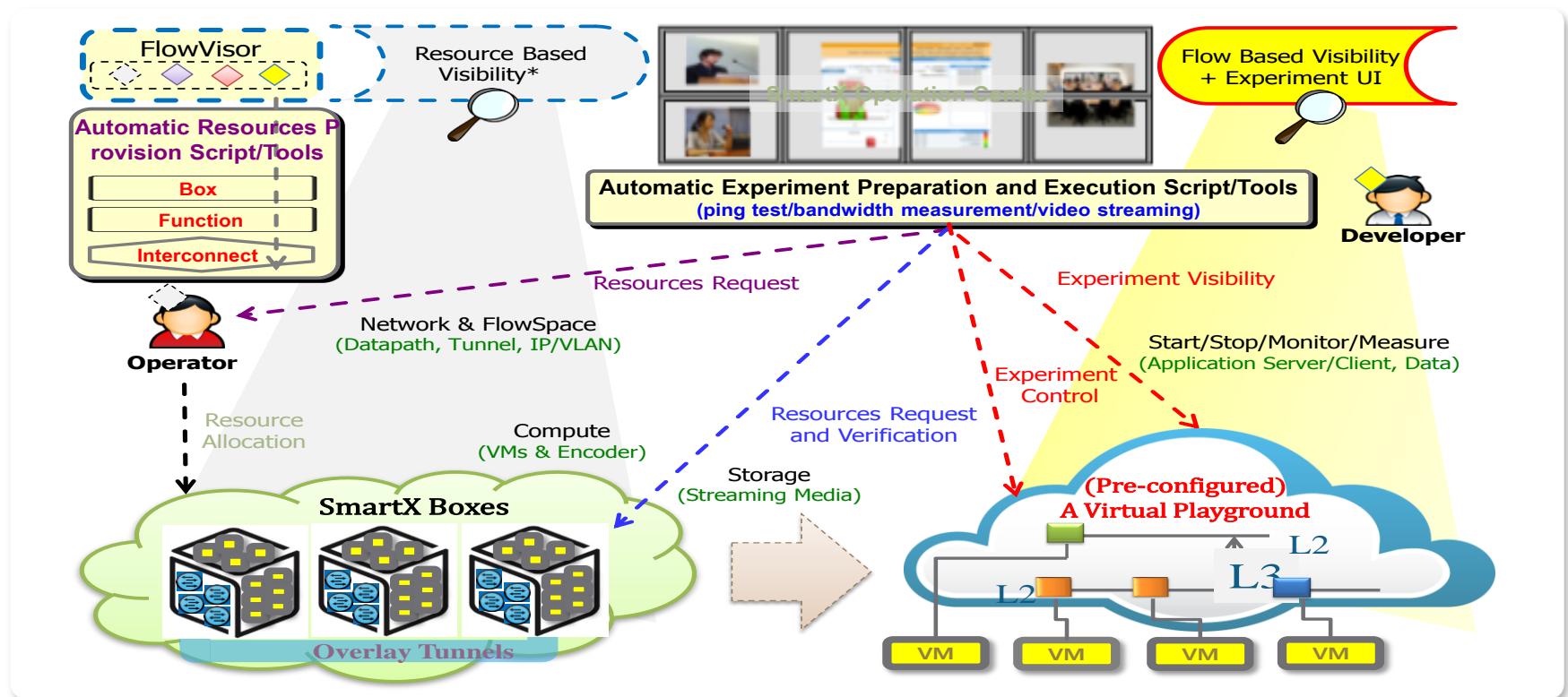


NetWall + OF@TEIN
Playground Operation



Visualization Infrastructure for
OF@TEIN + OF@KOREN

Lifecycle Experiments over OF@TEIN Playground



The realization of lifecycle experiments in order to partially automate the resource provisioning and experiment execution according to link bandwidth measurements and the automated re-installation of broken resource node(s).

Publication

Running Lifecycle Experiments over SDN-enabled OF@TEIN Testbed

Aris Cahyadi Risdianto, Taeheum Na, and JongWon Kim

School of Information and Communications

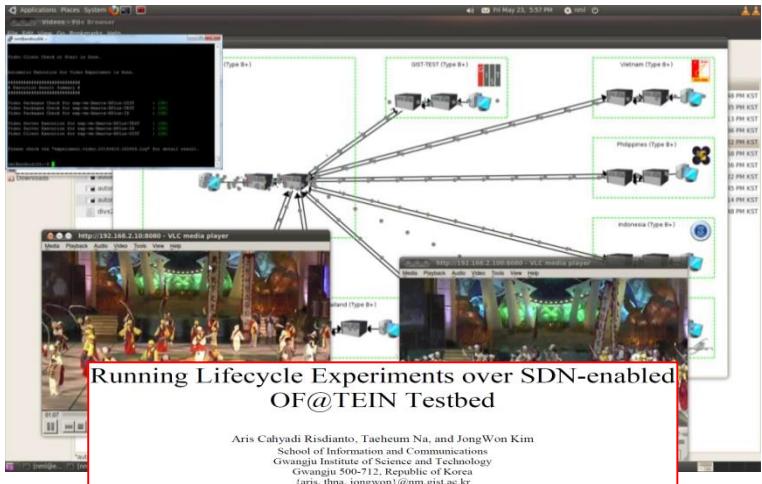
Gwangju Institute of Science and Technology

Gwangju 500-712, Republic of Korea

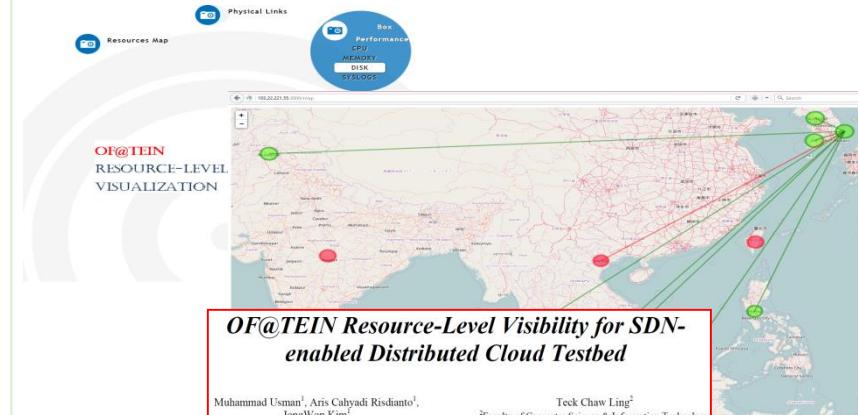
{aris, thna, jongwon}@nm.gist.ac.kr

Example Experiments over OF@TEIN Playground

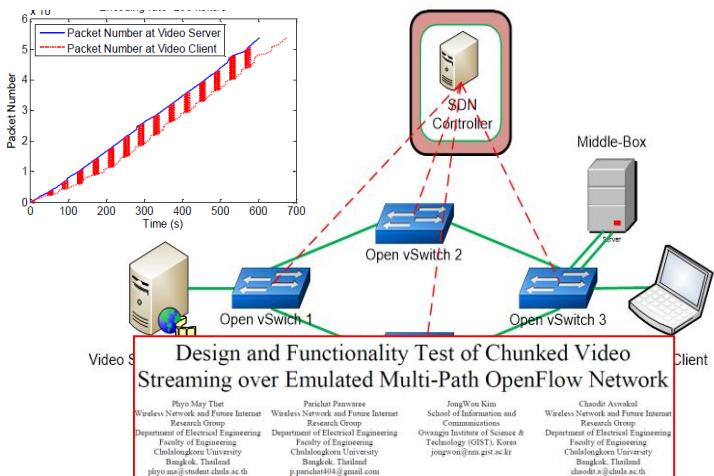
Video QoS Measurement



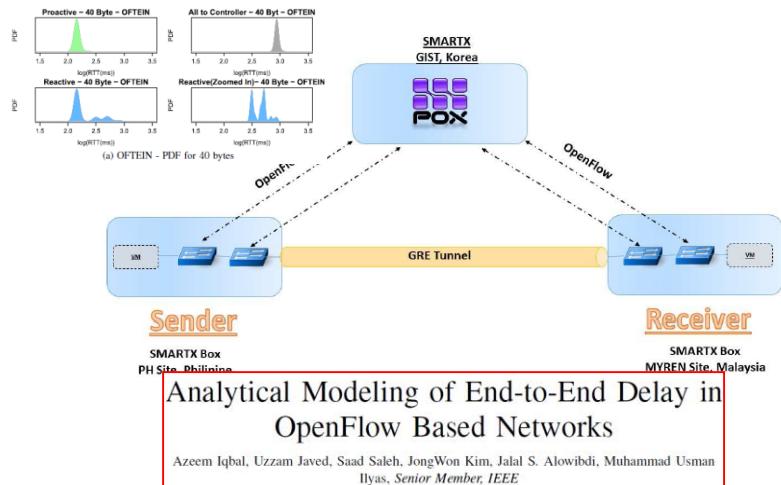
Playground Visualization



Multipath Video Testing



End-to-End Delay Measurement



OF@TEIN Community Portal

Wiki - OF@TEIN Commun...  oftein.net/projects/OF-TEIN/wiki 

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Welcome!

[OF@TEIN Project](#)
[OF@TEIN Workshop](#)
[OF@TEIN Open Boards](#)

Introduction

What is OF@TEIN?

Toward a OpenFlow2-enabled Software Defined Networking Infrastructure over TEIN project, is one of e-TEIN projects sponsored by Korean Government via NIA (National Information Agency) and was officially launched in July 2012. This OF@TEIN collaboration project is carried out by a consortium of Korean universities and institutes and international collaboration sites, led by Prof. JongWon? KIM from Networked Computing Systems Laboratory, Gwangju Institute of Science & Technology (GIST), Korea.


OF@TEIN
Community
OF@TEIN (2012~2015)



<http://oftein.net/projects/OF-TEIN/wiki>

OF@TEIN Playground: Limitation and Requirements for Improvement

- Composable playground for customized experiments by only changing the software component and configuration
- The difficulties to maintain playground site resources spreads over multi-domain network infrastructure through a single playground tower
- Monitoring support for each playground site as well as playground site resources
- Providing orchestration capability by introducing services over the playground
- Accessibility issues due to security-related policies for the playground

OF@TEIN to OF@TEIN+ Playground Preparations / Transitions (2015 ~ 2017)



OF@TEIN (2012~2015)

Open Call

Tentative OF@TEIN+ (2015~)

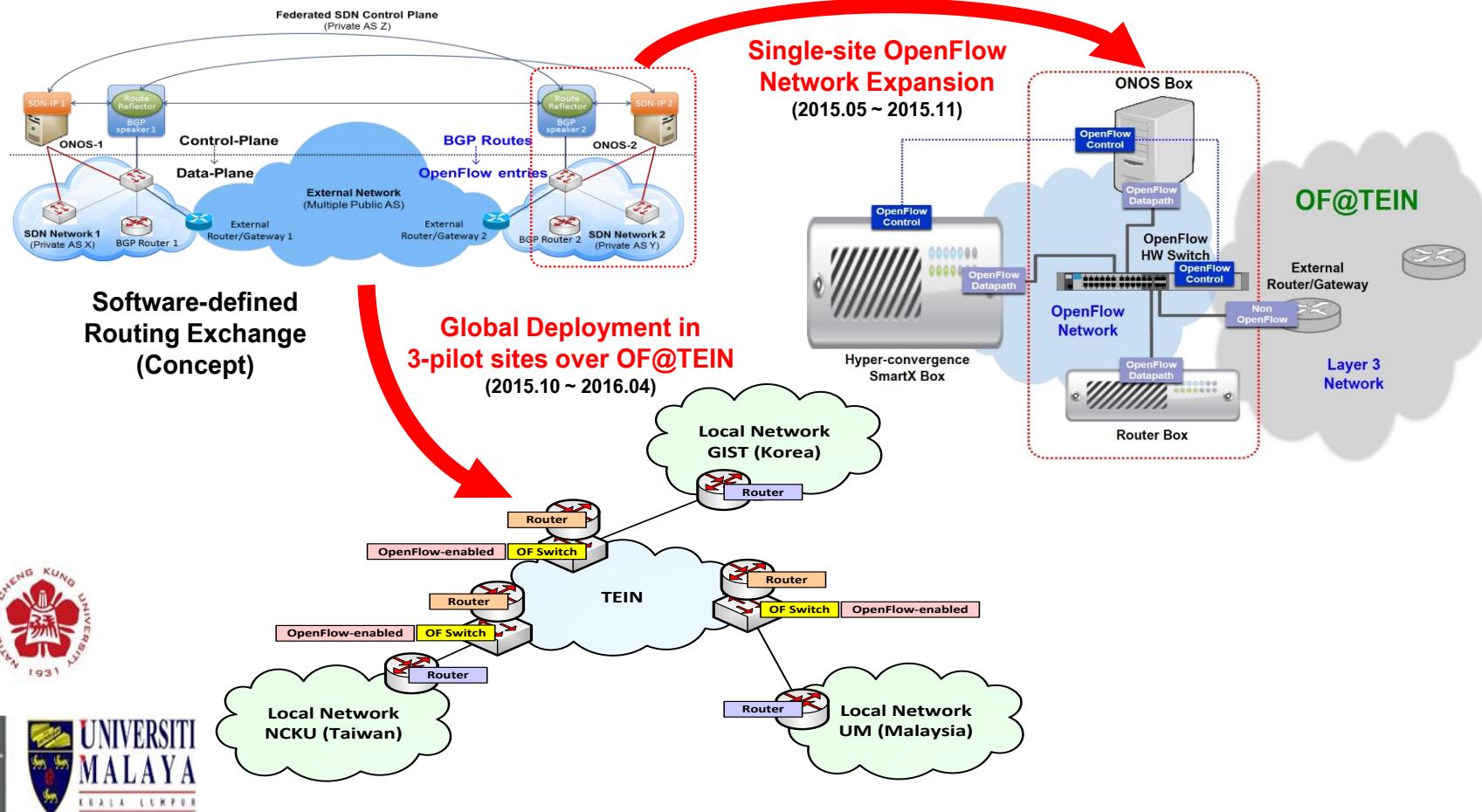
OpenFlow@TEIN

→→ 2015 →→

OpenFederation@TEIN+



SDX Collaborative Experiment for OF@TEIN Playground Inter-Connections Enhancement



Publications

Leveraging Open-Source Software for Federated Multisite SDN-Cloud Playground

Aris Cahyadi Risdianto
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Gwangju Institute of Science and Technology (GIST)
Gwangju, Korea
aris@nm.gist.ac.kr

Pang-Wei Tsai and Chu-Sing Yang
Department of Computer and Communication Engineering
Institute of Computer and Communication Engineering
National Cheng Kung University
(pcwsai, csysng)@ee.cukee.edu.tw

Teck Chaw Ling
Department of Computer System and Technology
University of Malaya
jcwteck@um.edu.my
tchaw@um.edu.my

ENHANCED ONOS SDN CONTROLLERS DEPLOYMENT
FOR FEDERATED MULTI-DOMAIN SDN-CLOUD WITH SD-ROUTING-EXCHANGE

Aris Cahyadi Risdianto¹, Pang-Wei Tsai², Teck Chaw Ling³, Chu-Sing Yang², and JongWon Kim¹

Deployment and Evaluation of Software-Defined Inter-Connections for Multi-domain Federated SDN-Cloud

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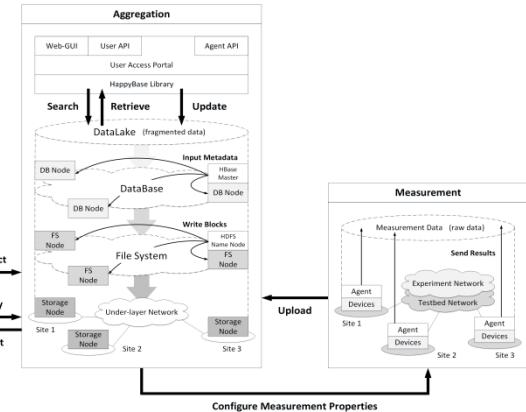
JongWon Kim
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+82-62-7152219
jongwon@nm.gist.ac.kr

DataLake Framework Design and Deployment for Multi-domain Playground Operation

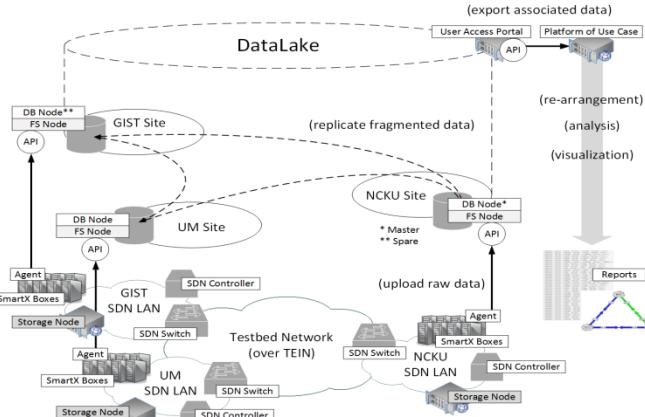
Concept

Data-Lake, a framework to perform accurate and precise aggregation of the measurement data on the OF@TEIN testbed. Facilitates operators and users to get transparent and factual information to fulfill their operational and experimental requirements.

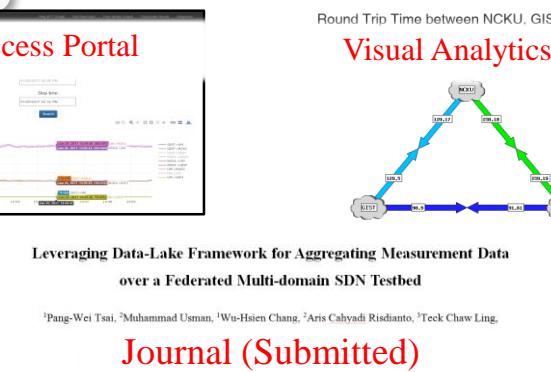
Design



Deployment



Results & Publication



¹Pang-Wei Tsai, ²Muhammad Usman, ¹Wu-Hsien Chang, ²Aris Cahyadi Risdianto, ³Teck Chaw Ling,

Journal (Submitted)

¹Networked Computing System Lab, Gwangju Institute of Science and Technology, Republic of Korea

²Faculty of Computer Science and Information Technology, University of Malaya, Malaysia

³csyang@ee.ncku.edu.tw

Initial Multi-layer Playground Visibility and Visualization

Concept

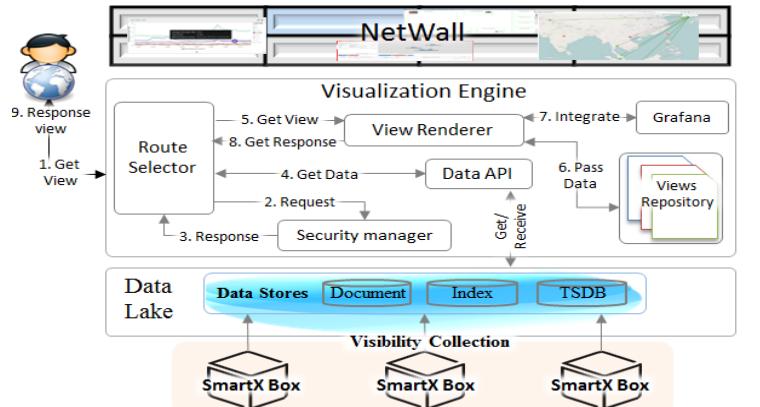
Realize visualization software to assist both developers and operators to make OF@TEIN playground visible specifically, collecting and visualizing visibility information from multiple visibility layers



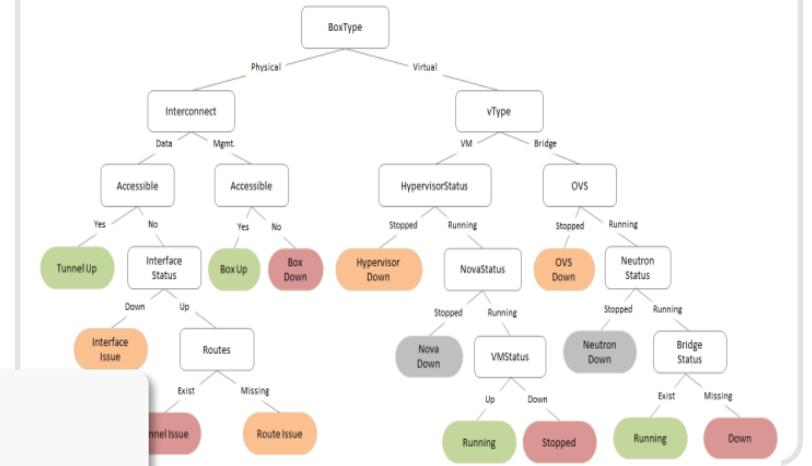
Collaborators



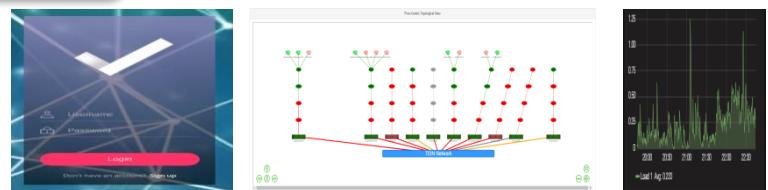
Deployment



Design



Results & Publication

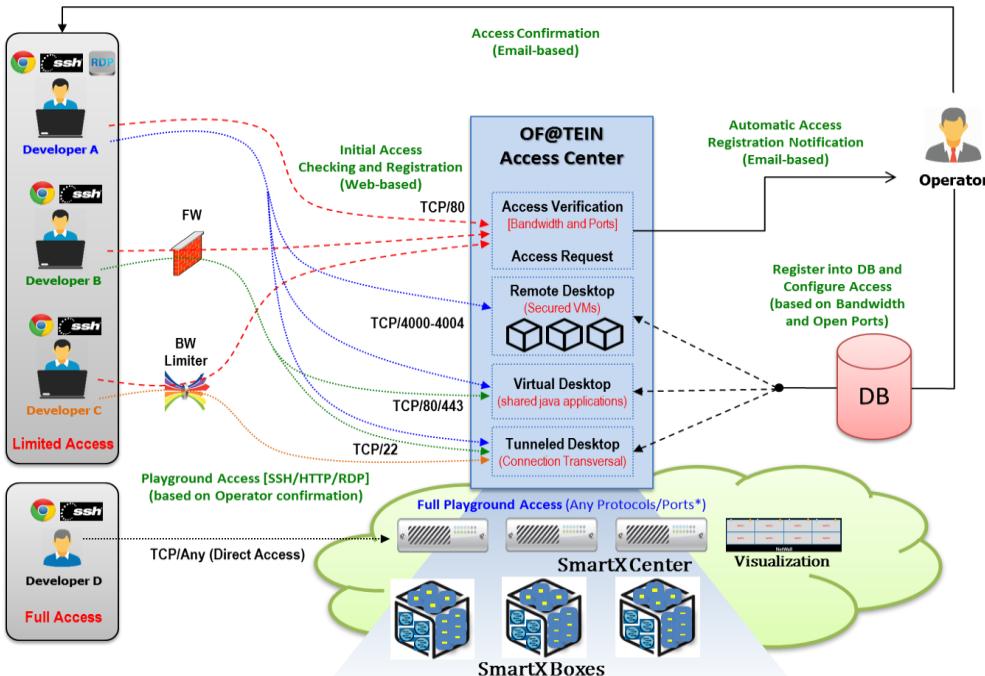


Physical-Virtual Topological Visualization of
OF@TEIN SDN-enabled Multi-site Cloud

Muhammad Usman, Aris Cahyadi Risdianto,
Jungsu Han, JongWon Kim*
School of Electrical Engineering & Computer Science
Gwangju Institute of Science & Technology
Republic of Korea
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Nguyen Van Huynh
School of Electronics & Telecommunications
Hanoi University of Science & Technology
Vietnam
nguyenvanhuyhn@hust.edu.vn

Access Center Deployment to Facilitate Flexible Playground Access



The screenshot shows the 'OF@TEIN Playground Access Gateway' interface. It includes sections for checking bandwidth and open ports, sending account request and information, and selecting the access method. The 'Access Method' section lists three options: Tunnel Mode (SSH Protocol), Open Virtual Desktop Portal (HTTP Protocol), and Virtual Machine Remote Desktop (RDP Protocol). A 'Learning this Access Gateway Implementation' section provides links to Tunnel Access, OpenVirtual Desktop, and Remote Desktop.

"Providing common/similar access to every operators and developers to OF@TEIN resources in every sites from different networks (including public internet) for experimentation and resource management."

Publication

Proceedings of the APAN – Research Workshop 2016
ISBN 978-4-9905448-6-7

Deploying and Evaluating OF@TEIN Access Center and Its Feasibility for Access Federation

Aris Cahyadi Risdianto¹, Phylo May Ther², Azeez Iqbal¹, Nurul Ainaa Binti Muhamad Shaari⁴, Hari Krishna Athuri³, Galih Nugraha Nurkhalif¹, Apichart Wantamance², Rifqy Hakim⁵, Uzzam Javed⁶, Muneeb Ahmad⁶, Chaodit Aswakul², Muhammad U. Ilyas³, Teck Chaw Ling⁴, Arumugam Paventhan⁴, Eueung Mulyana⁶, and JongWon Kim¹

OF@TEIN+ Playground: Proposed Future Directions (2017 ~)



Key Abstractions for SmartX Playground

- SmartX **Playground** = Miniaturized, Composable, Hyper-converged, SDI-ready Testbed under 'Smart + X' concepts
- DevOps-Automated Playground **Tower(s)** with Provisioning/Visibility/Orchestration/Intelligence/Security **Centers** with large-scale Visualization
- Overlay-interconnected, IoT-SDN/NFV-Cloud-enabled Playground **Site(s)** with Hyper-converged SmartX **Boxes**

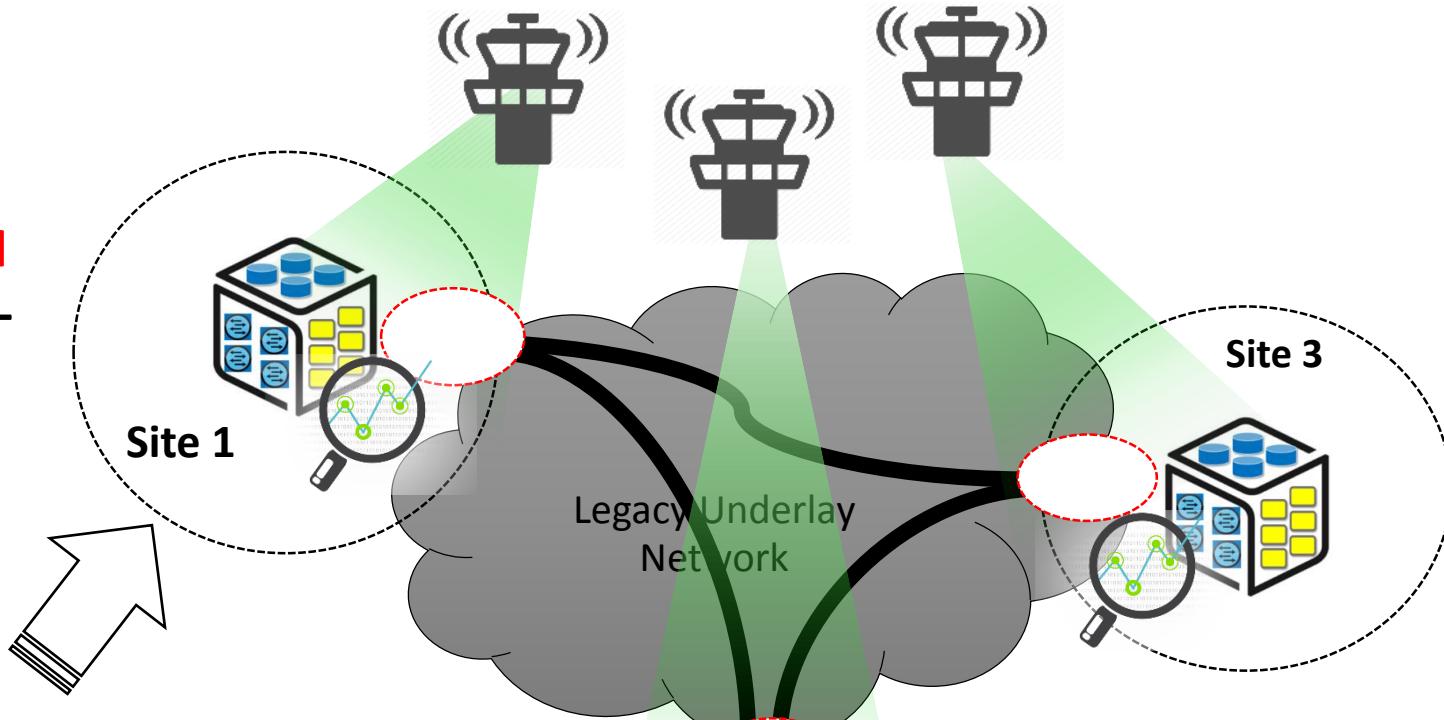
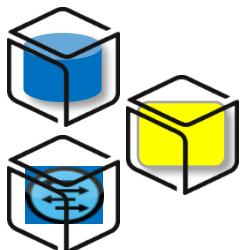
Playground Overall Concept

- **(Affordable + Visible + Federated) Playground**
 1. Affordable : cheap and easy to be deployed and operated
 2. Visible: easy and instantly to be monitored
 3. Federated: easy and flexible to be integrated/integrated/inter-operated
- **DevOps-automated Playground Operation**

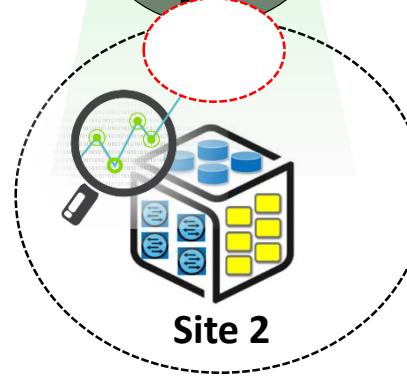
Affordable + Federated + Visible Playground

Federated Playground with
Collaborative Multiple Towers

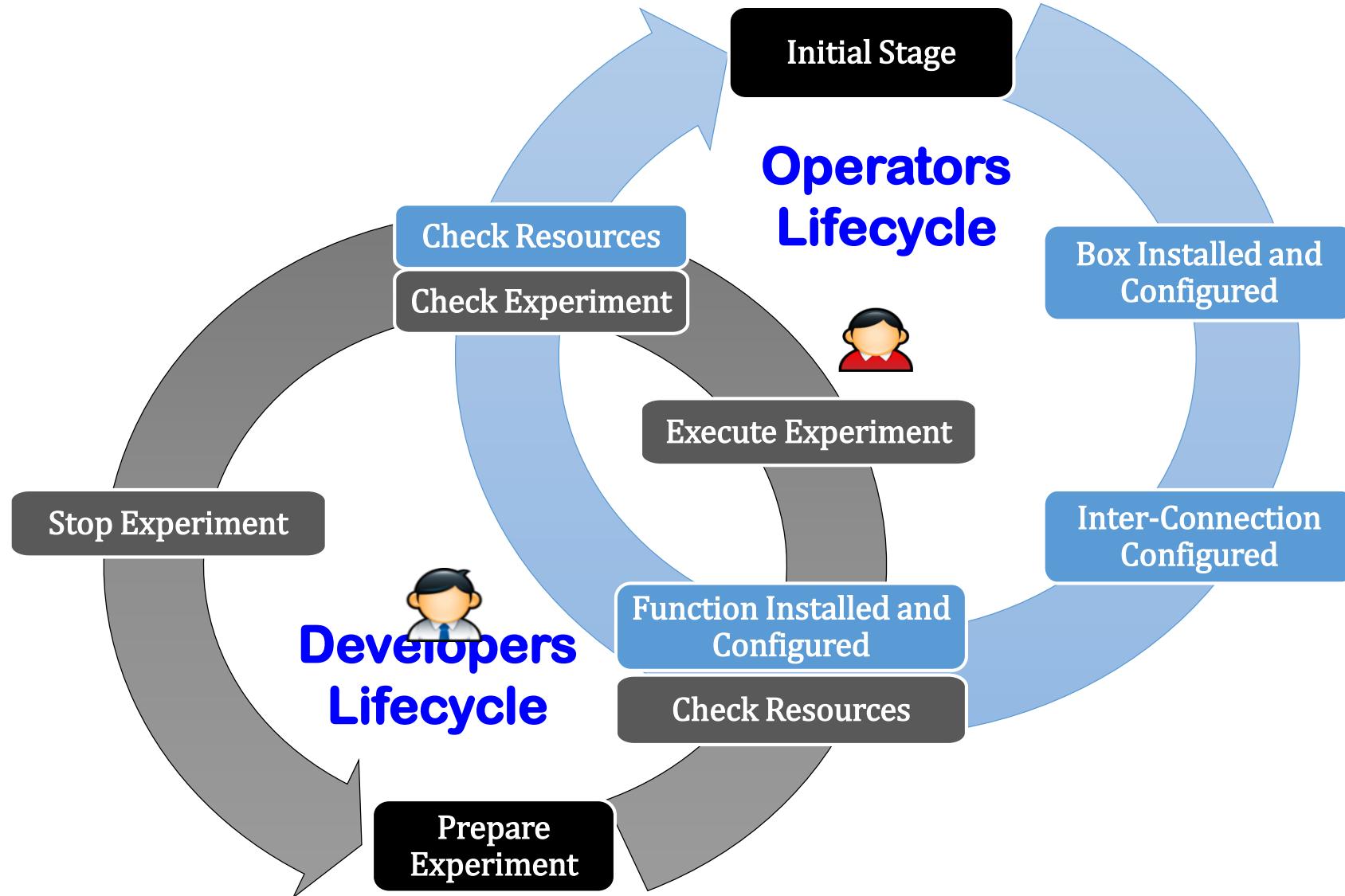
Affordable
Playground
with Hyper-
converged
box-style
resources



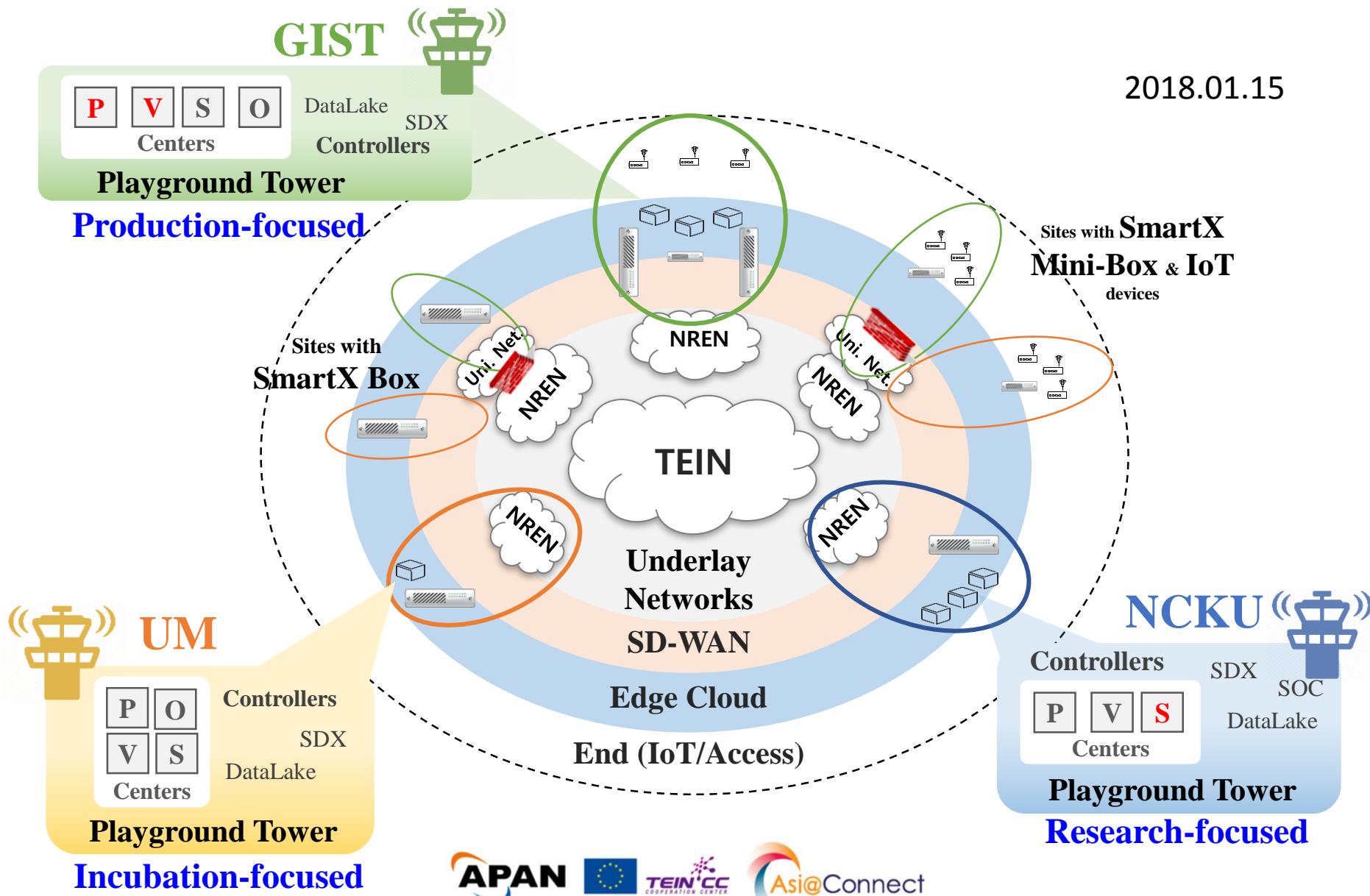
Visible Playground
with MultiView
Visibility



DevOps-automated Playground Operation



OF@TEIN+ Playground: DRAFT Proposal



OF@TEIN+ Playground: Goals / Features

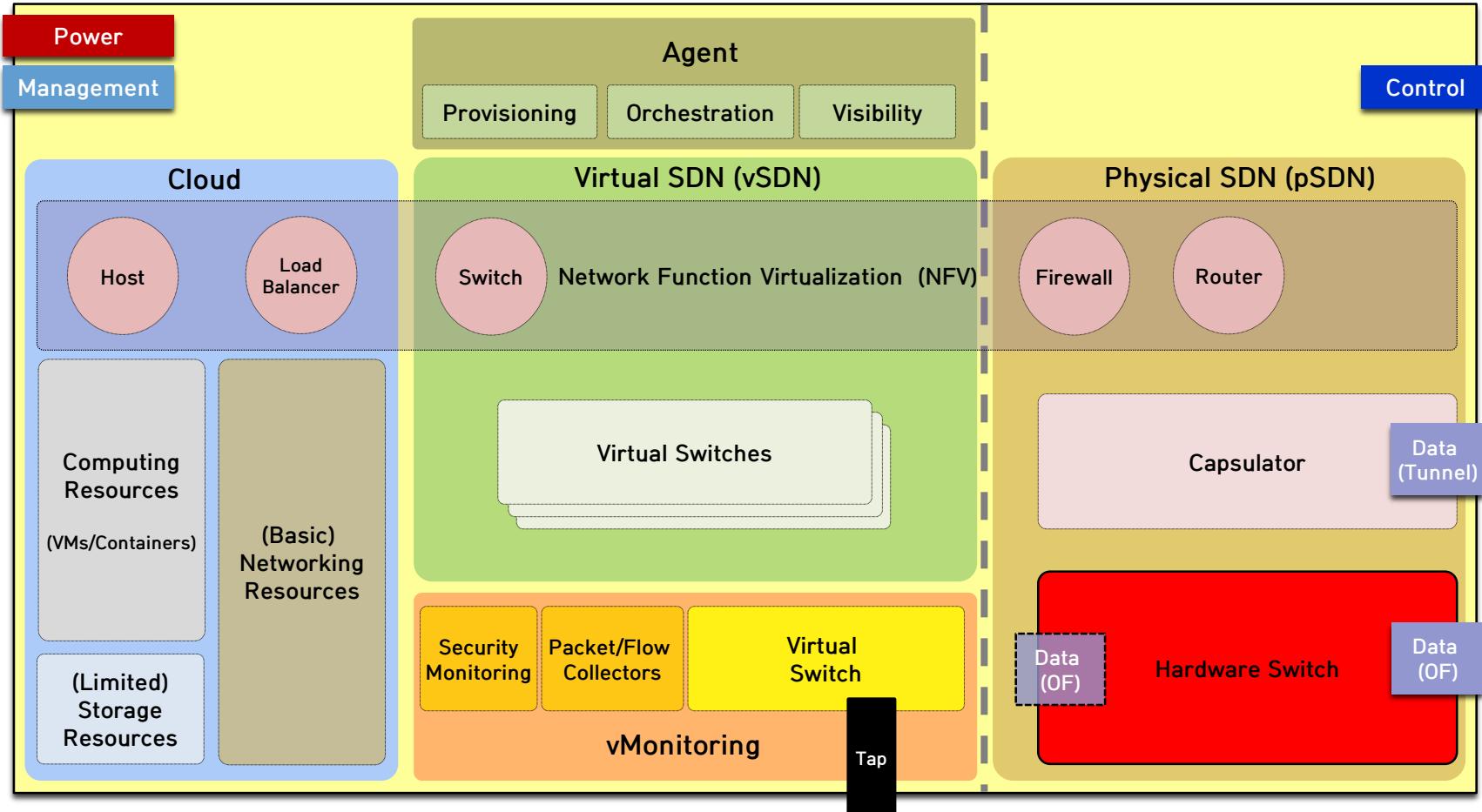
- 1. Affordable → Software-defined (i.e., Composable) Playground**
- 2. Visible Playground with Visibility Support through MultiView Framework**
- 3. Federated Playground with Multiple Playground Towers**
- 4. Introduction of IoT-Cloud Services with Orchestration Capability**
- 5. Secured Playground with Accessibility Support**

OF@TEIN+ Playground: Goals / Features (1/5)

1. Affordable → Software-defined (i.e., Composable) Playground

- Hyper-converged Box-style resource
 - Single-Box with virtualized (Dev + Ops) SDN + Cloud
 - Low-cost commodity (white box) hardware
 - Leverages diversified functionalities, written in open-source software
 - → Composable (software-driven)
- Automated Remote Provisioning (installation + configuration + deployment) from Playground Tower to reduce duplicated and time-consuming operational efforts
- Open-source software (and hardware) development via GitHub shared repository

Hyper-converged Box-style Resources



Software-defined Playground and Open-source Software development via GitHub

<https://github.com/OFTEIN-NET>

GitHub, Inc. (US) | https://github.com/OFTEIN-NET/OFTEIN-Plus

Code Issues Pull requests Projects Wiki Insights Settings

OF@TEIN+ Project GitHub

homepage active Manage topics

3 commits 1 branch 0 releases 1 contributor

Branch: master New pull request Create new file Upload files Find file Clone or download

ariscayahdi Fix the images. Latest commit b27ba48 13 days ago

Images Initial Commit. 13 days ago

Meetings Fix the images. 13 days ago

README.md Initial Commit. 13 days ago

README.md

OFTEIN+ Project (Under Asi@Connect Grant)

OF@TEIN+ : Open/Federated Playgrounds for Future Networks

Building and operating Open and Federated Future Internet (SDN/NFV/Cloud-integrated) Testbed

This project is a response to Asi@Connect WP4 (Future Internet) grant support calling. This document describes the proposed project of "OF@TEIN+: Open/Federated Playgrounds for Future Networks", which will leverage and enhance the successfully completed OF@TEIN project. As OF@TEIN project has completed with many success stories, "OF@TEIN+ : Open/Federated Playgrounds for Future Networks" is proposed to further enhance, extend and expand OF@TEIN. The main purpose of OF@TEIN+ is to build and operate an Open and Federated Future Internet (SDN/NFV/Cloud-integrated) Testbed in further promoting SDN-Cloud R&D collaboration among TEIN partners. As a start, we are seeking for grant support for the first 22 months (March 2017 – December 2108).

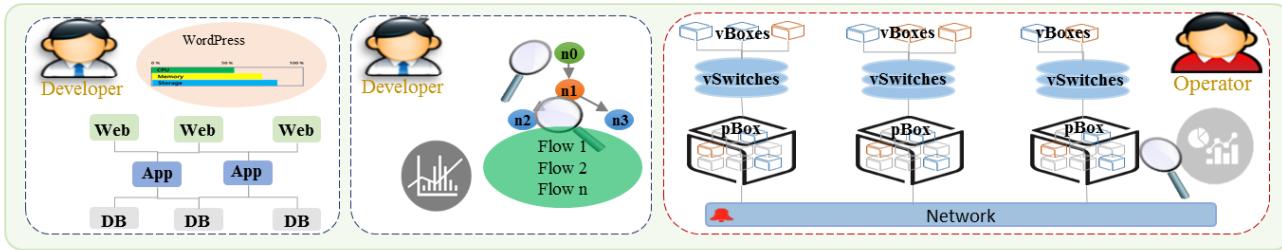


OF@TEIN+ Playground: Goals / Features (3/5)

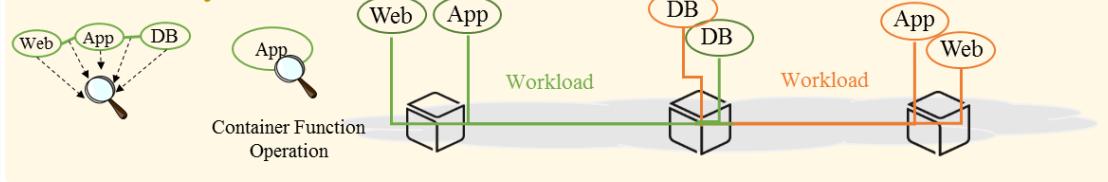
2. Visibility Support with MultiView Framework

- Four layers of Playground → MultiView Visibility
 - Underlay network visibility
 - Playground physical resources visibility
 - Playground virtual resources visibility
 - Flow-layer visibility
- Flow-centric visibility to integrate visibility data between visibility layers
- + Active Monitoring
 - It is required to check the sites status and performance parameters through polling-based collection and measurement

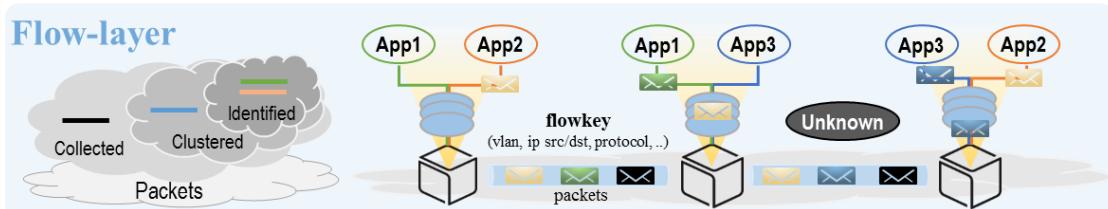
SmartX MultiView Framework



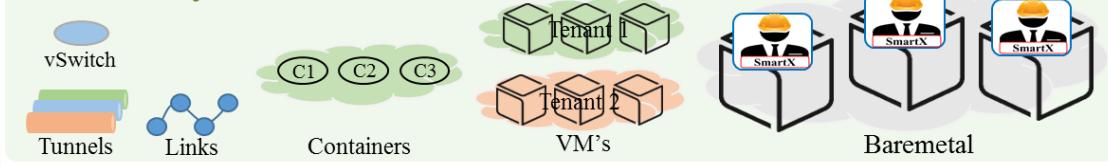
Workload-layer



Flow-layer



Resource-layer



Visibility Collection & Validation

Visibility Integration

Visibility Staging & Visualization

Intelligence

Visibility DataLake & Analytics

OF@TEIN+ Playground: Goals / Features (2/5)

3. Federated Playground with Multiple Playground Towers

- Different level of federation to build federated playground
- OF@TEIN Playground Tower is space/location in OF@TEIN Playground where Provisioning/Orchestration/Visibility/Security centers are deployed to manage the playground
- Multiple Playground Towers with has different goals and centers implementation
 1. [Playground Tower@ GIST for OF@TEIN SDN-Cloud Production-ready Playground](#)
 2. [Playground Tower @ NCKU for Research-focused Playground: SDX and SOC \(Security Operation Center\) focus](#)
 3. [Playground Tower @ UM for Incubation-focused Playground](#)
- Limited Collaboration of Developers and Operators through playground towers assisted by controllers

Different Level of Federation to Build A Federated Playground

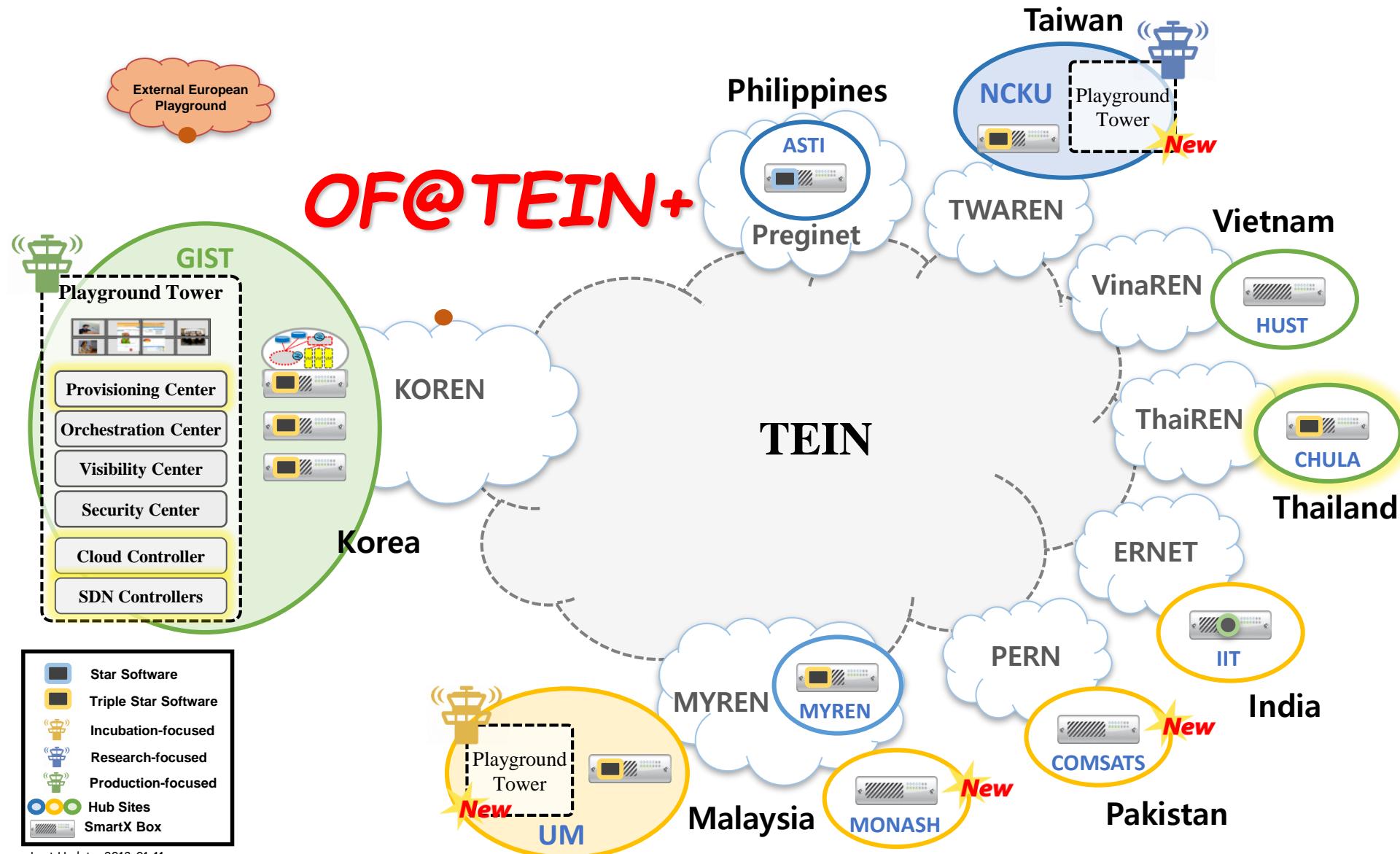
Resources Federation is a concept to share resources beyond the administrative domain where at least one resource manager is associated with more than one physical resources for providing a logical aggregate view of all resources of the federation.

Workload Federation/Federation of Workload is an illustration of resultant topology between all the users service request with specific service level agreement (SLA) and providers resource provisioning results in optimistic resources reservation scheme.

ID Federation is a set of agreements, standards and technologies which enable users to use their digital identities and attributes to access group of services within a federated domain regardless of organizational borders.

Federated Playground is a group of open playgrounds whose owners choose freely to share resources across their user communities, according to mutually agreed rules and limits, and it intentionally to implement an open resource hardware with open source software and shareable set of configurations.

Multiple OF@TEIN Playground Towers with Different Centers Implementation for Different Playgrounds



OF@TEIN+ Playground: Goals / Features (4/5)

4. Introduction of IoT-Cloud Services with Orchestration Support

- Expansion for IoT devices/sensors through multiple access technology (e.g., Wi-Fi, 5G, ...)
- Data collection from the IoT devices/sensor into DataLake
- Specific visibility analytics to support specific IoT-Cloud service orchestration

OF@TEIN+ Playground: Goals / Features (5/5)

5. Secured Playground with accessibility support

- Apply/comply network security policies from the network administrator
- Provide flexible accessibility to the playground through any possible secure connection (e.g., SSH, HTTPS, ...)

Thank You

ops@oftein.net

