

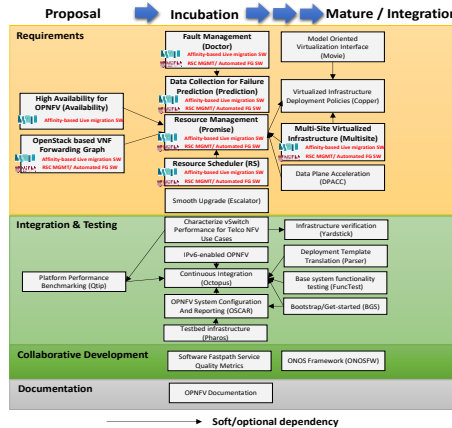
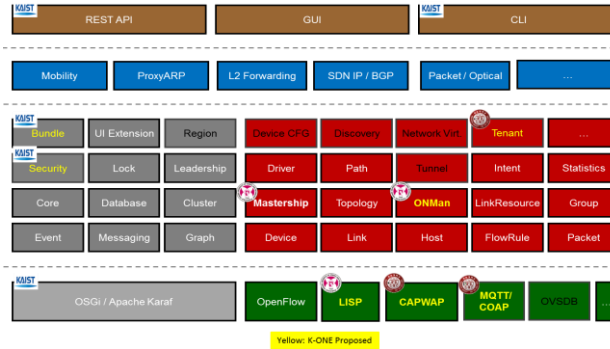
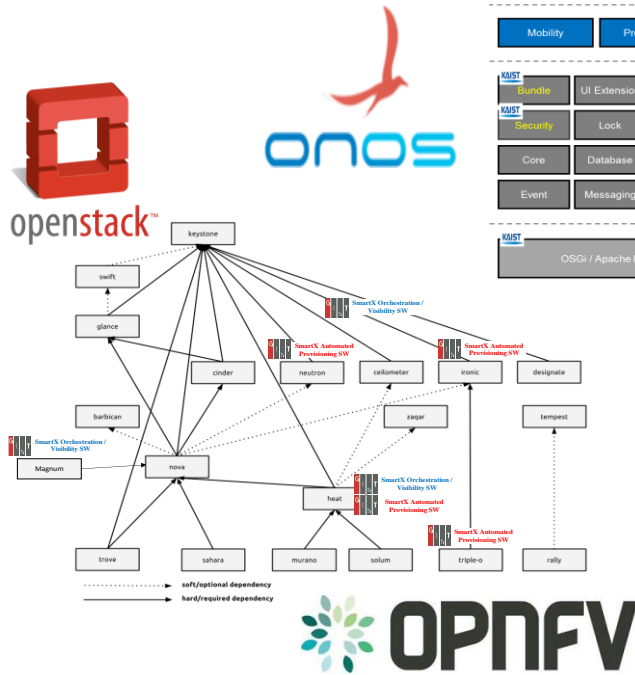
# K-ONE Collaboration and Open-Source-leveraged SDI

## ONK (Open Networking Korea) 2016 Fall

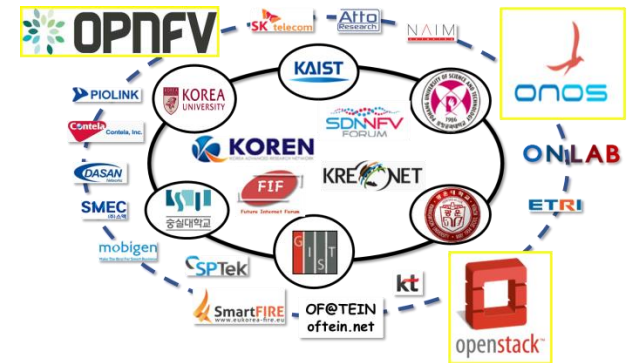
**Dr. JongWon Kim**

**Networked Computing Systems Laboratory  
School of Information and Communications  
Gwangju Institute of Science & Technology (GIST)**

# K-ONE Collaboration for SDN/NFV/Cloud Open-Source Software (2015~2020)



# K-ONE



## Open Networking KOREA

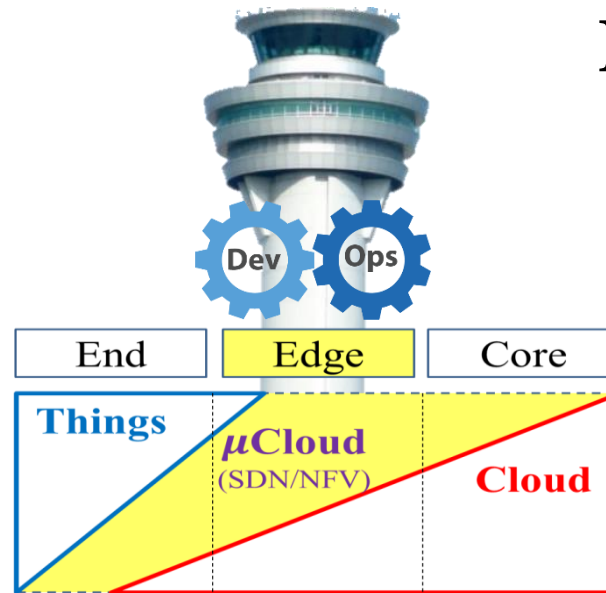
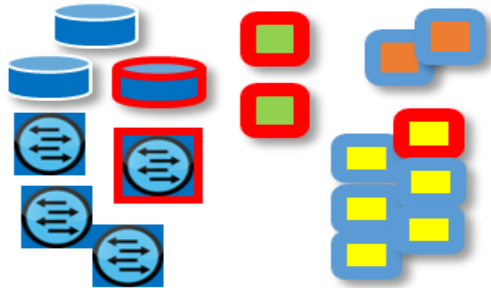
<http://opennetworking.kr>

**K-ONE** **openwincon**  
Single controller for all wired & wireless networks

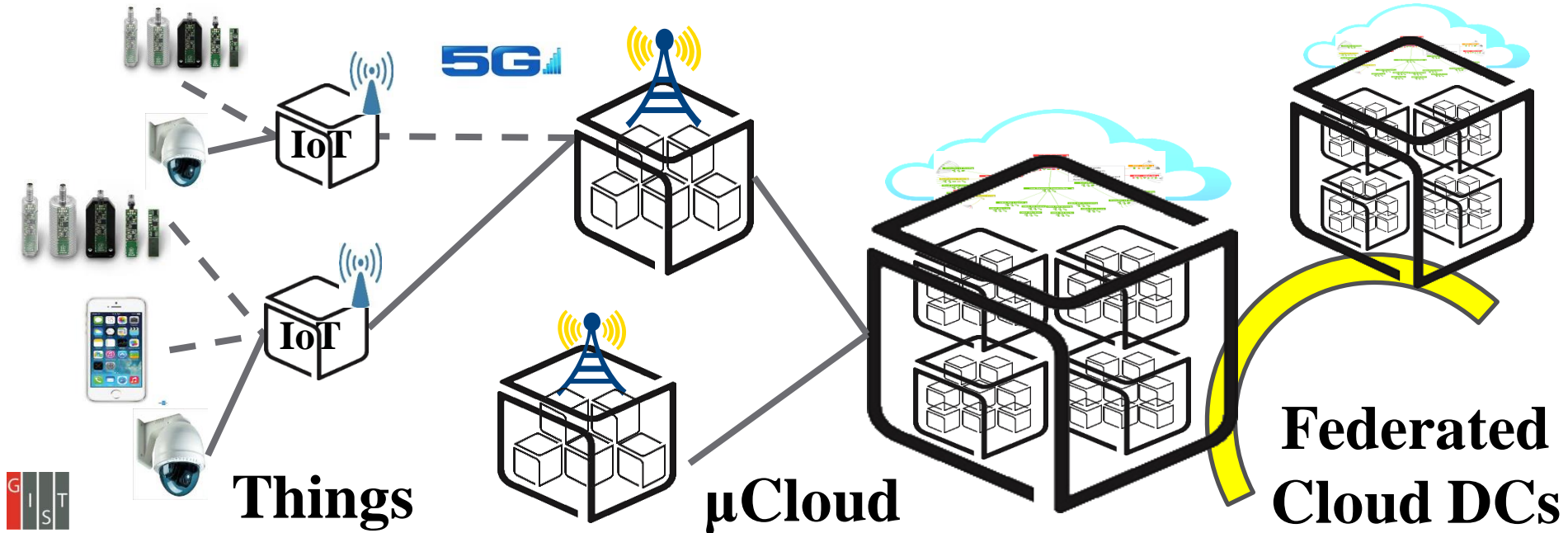
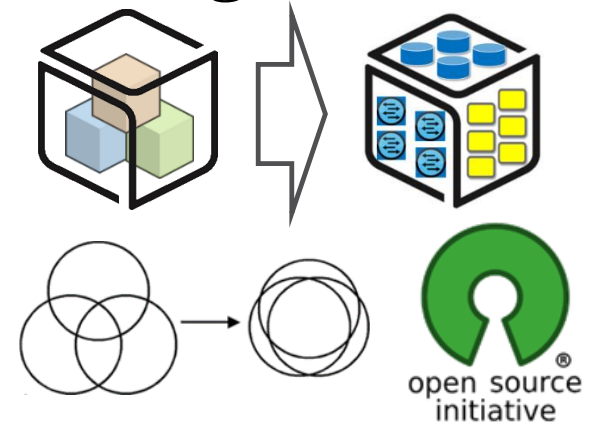
# Open-Source- leveraged SDI

# Converged SDI for Diversified Services

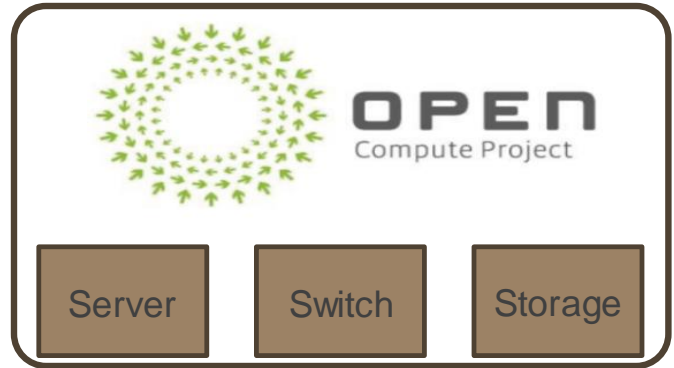
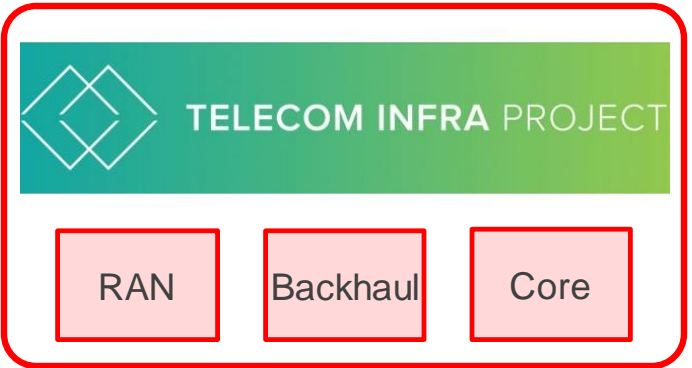
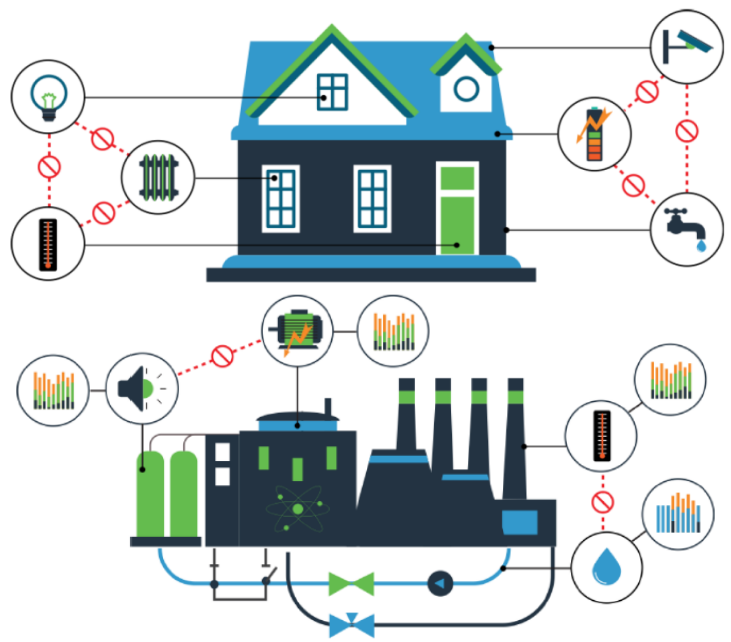
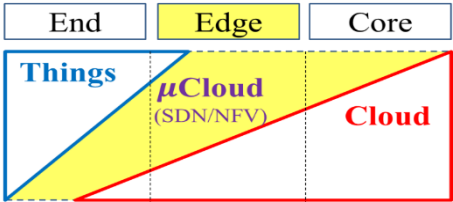
## Diversified **SaaS** Applications



## Resources in Hyper-convergent Boxes



# Open-Source Software/Hardware for Converged SDI

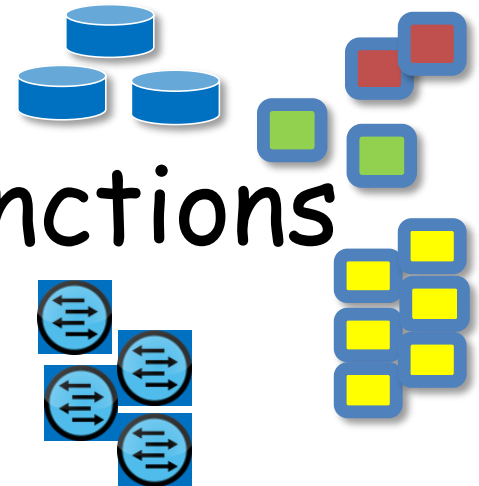
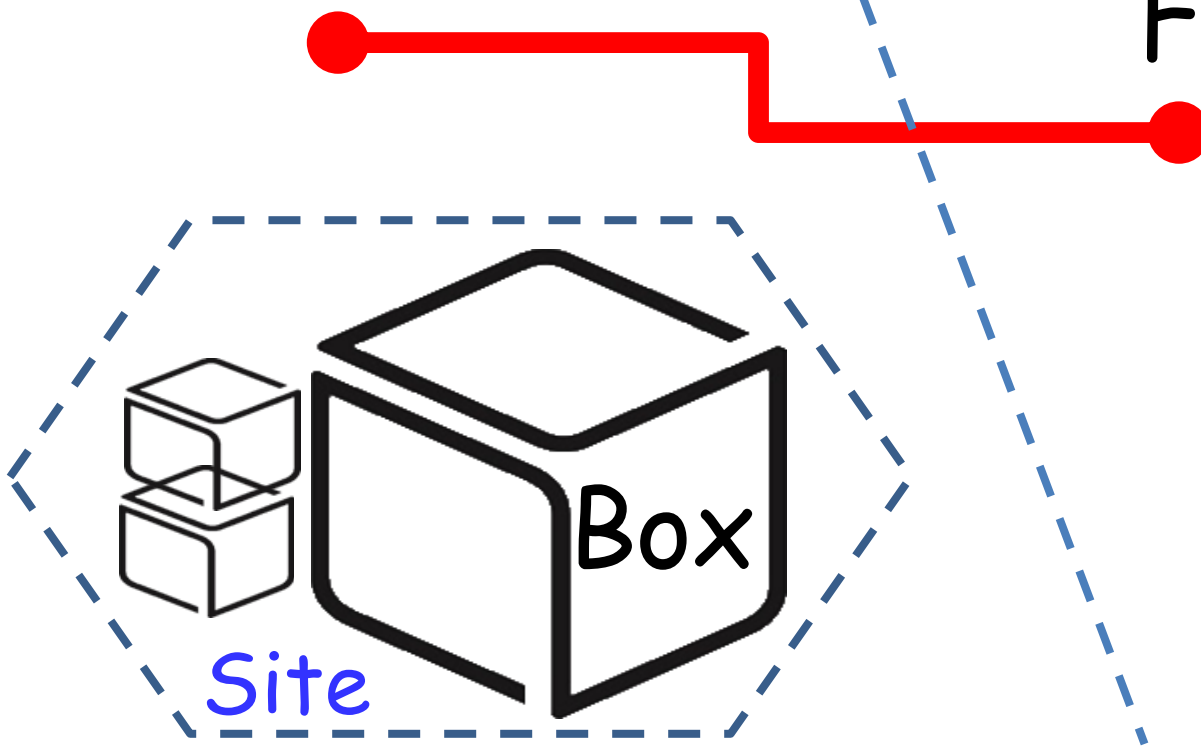


# SmartX Services-Resources Abstraction: Inter-Connected Functions among Boxes

Resources - Workloads - Services

Inter-Connect

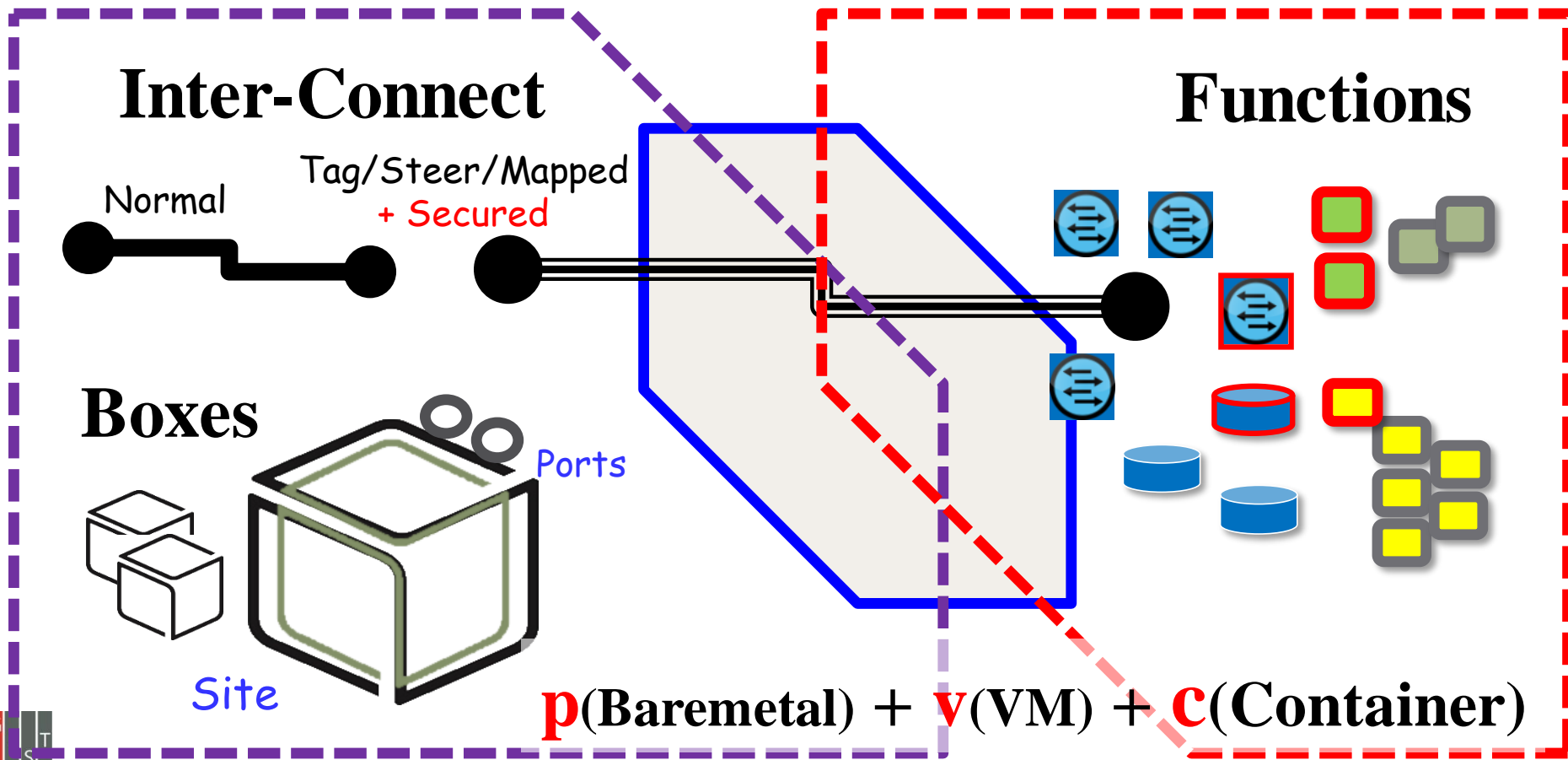
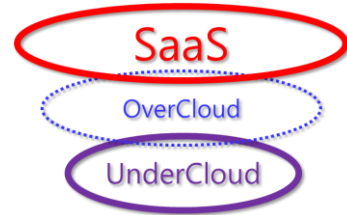
Functions



Concept Only →→→  
Gradually becoming  
feasible due to  
Programmable/Virtualized  
Resources with Container-  
centric Functions

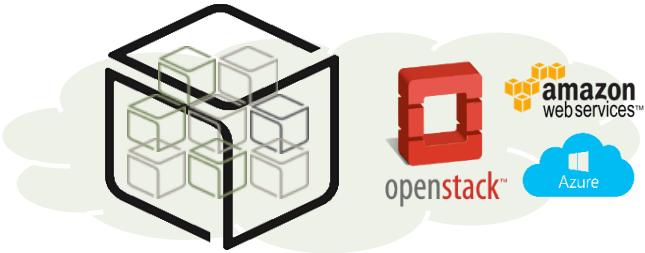
# SmartX Services-Resources Abstraction: Inter-Connected Functions among Boxes

Cloud-native  
Microservice  
Architecture

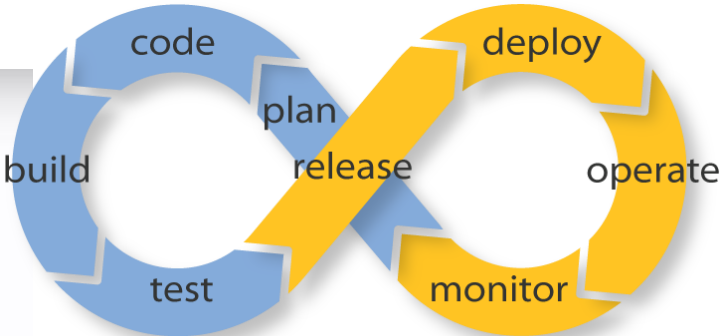
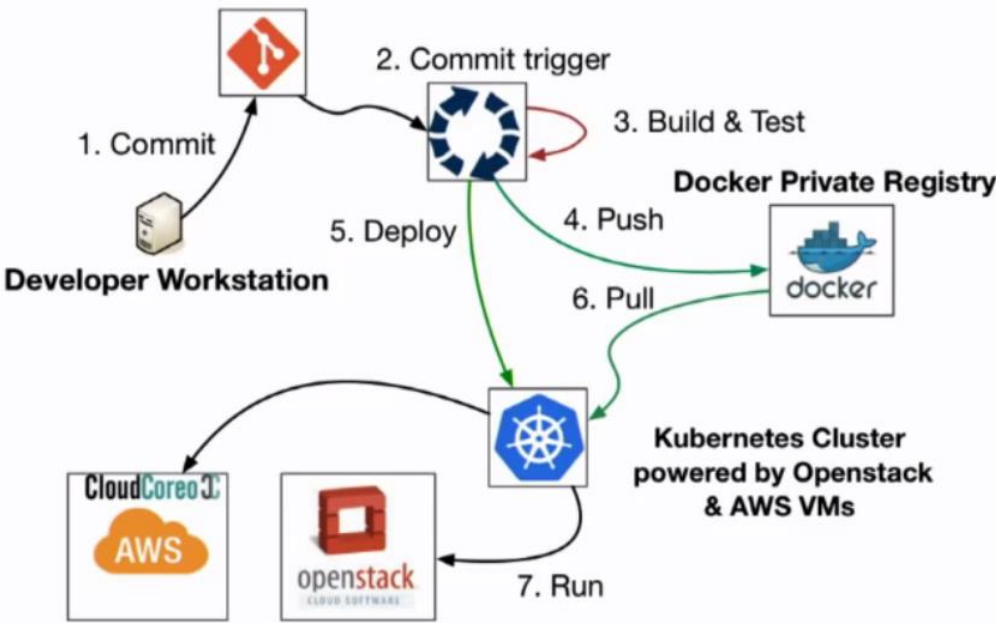


# Automated Deployment of Container-based Services over Converged SDI

Composable Software-Defined Infrastructure



## Microservice Pipeline

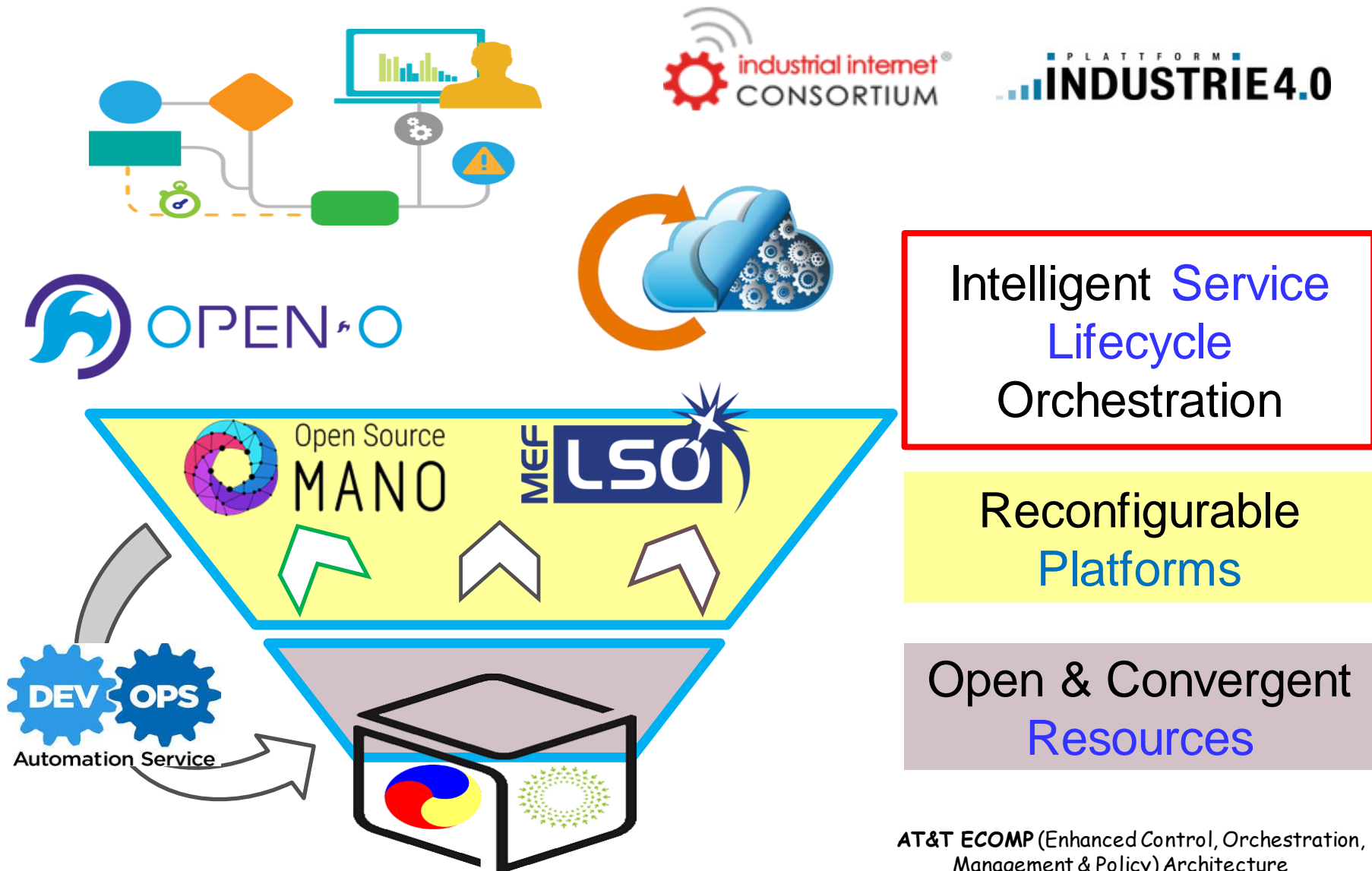


Endless Possibilities: DevOps can create an infinite loop of release and feedback for all your code and deployment targets.

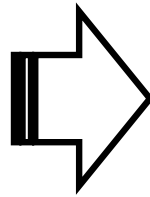


Container-based Orchestration & Dynamic Resource Pooling (Scaling)

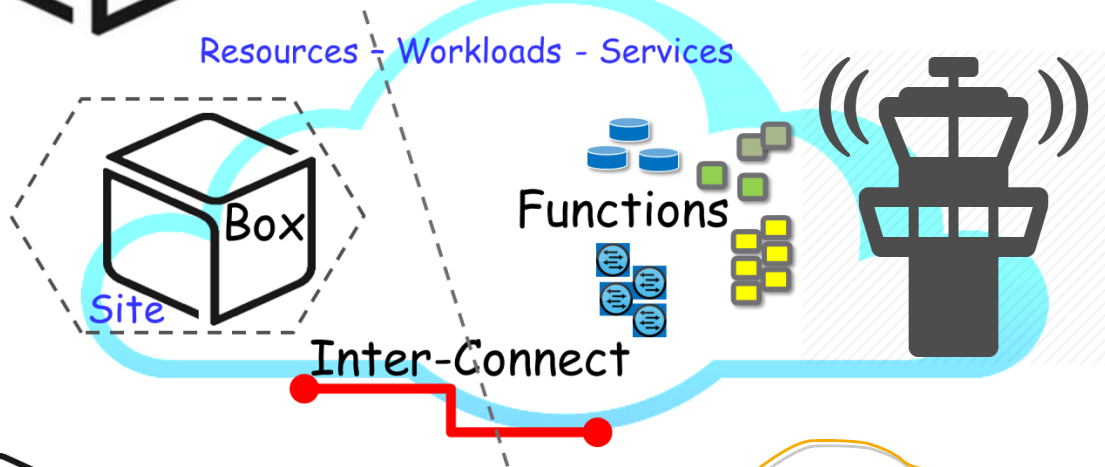
# Open-Source Intelligent Orchestration for Workflow-based Service Lifecycle



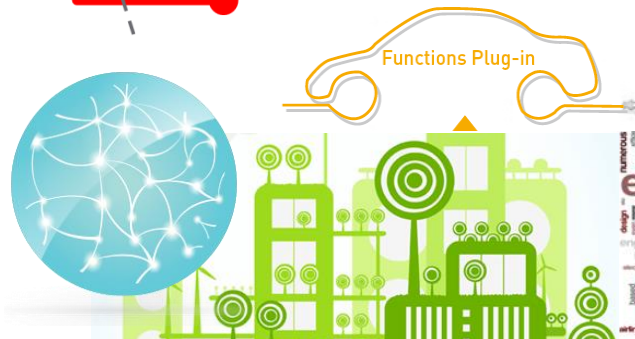
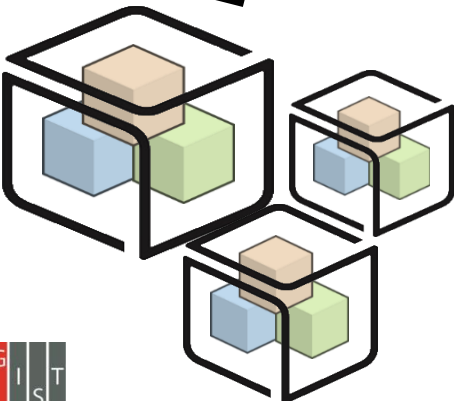
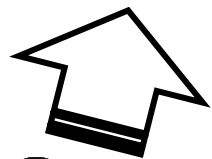
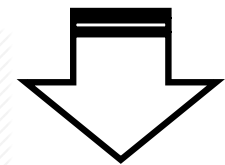
# Prepare Program- mable & Virtualized Resource Pools with Hyper- converged **SmartX Boxes**



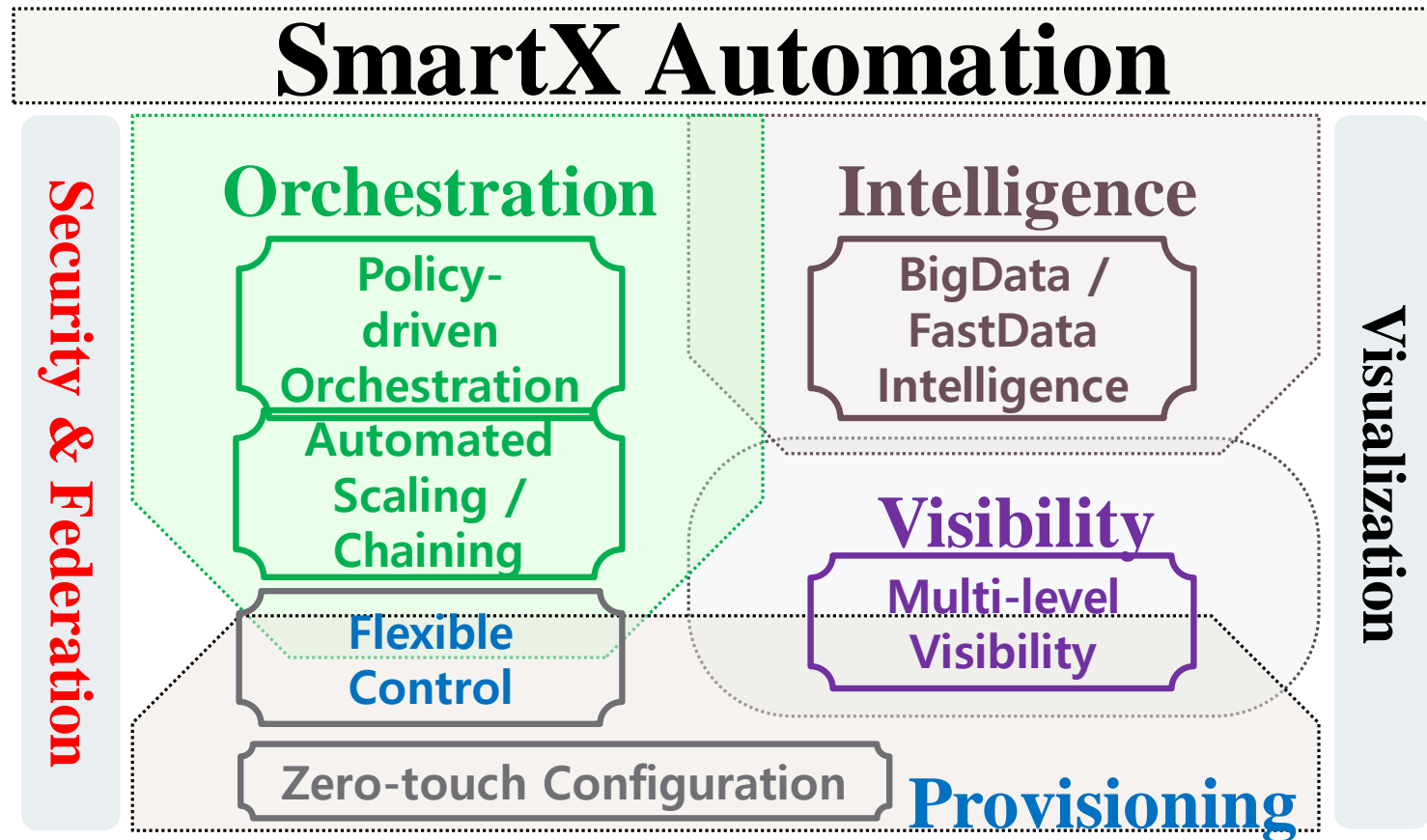
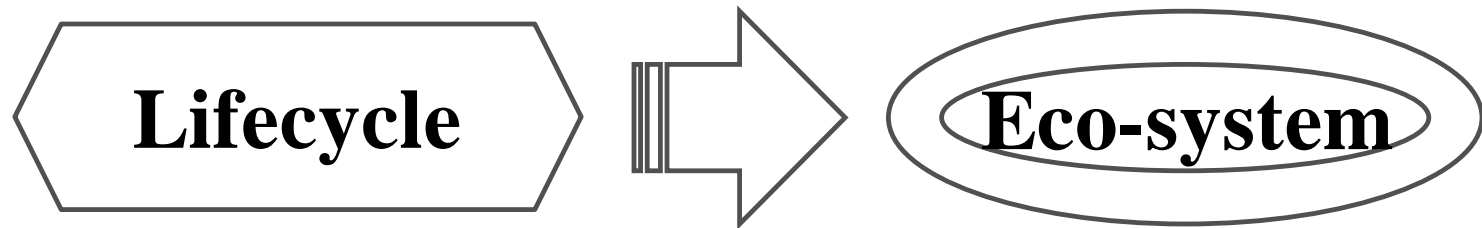
## Resources - Workloads - Services



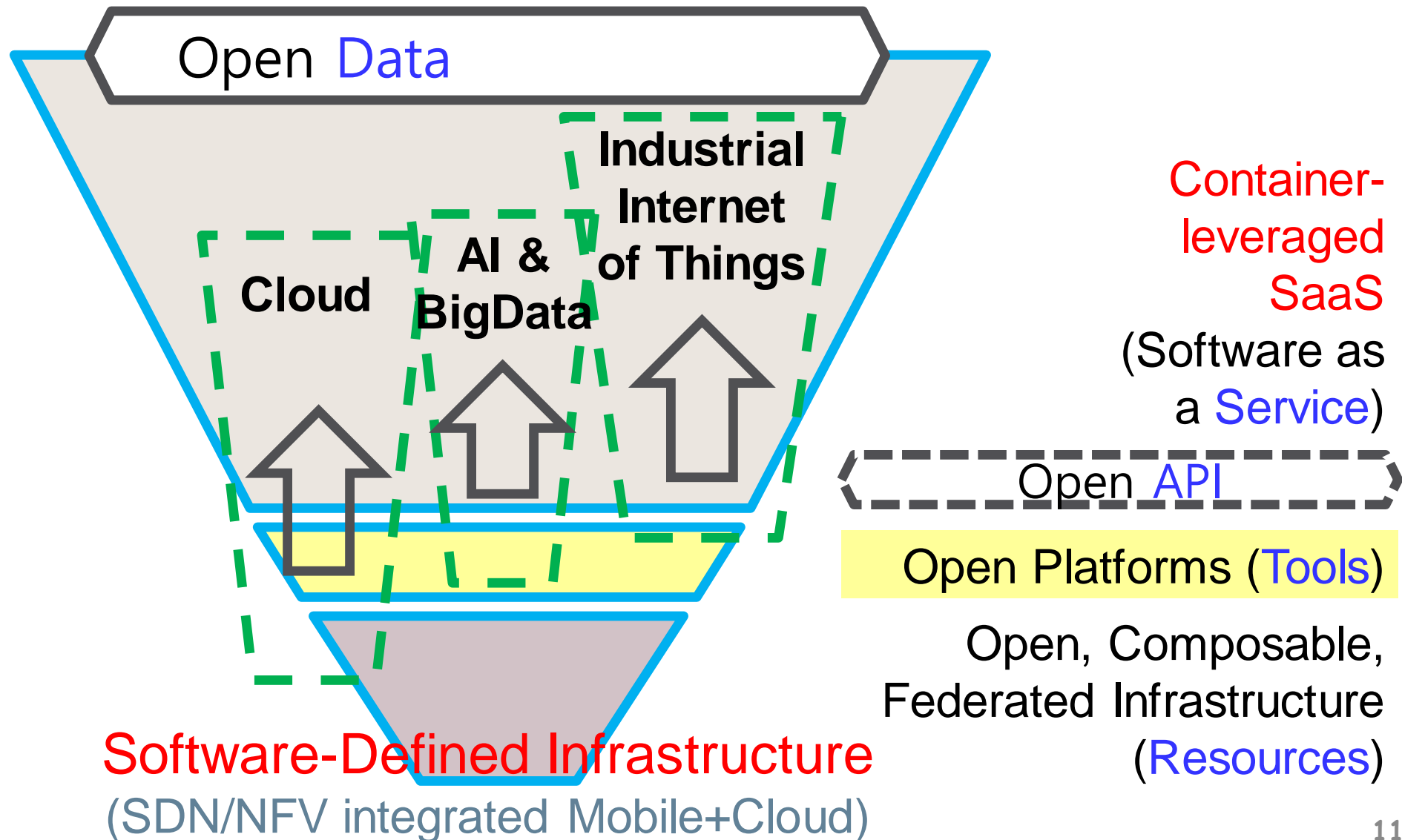
Create  
Smart  
Services  
with **Smart  
Things, API  
Tools, and  
Open Data**



# SmartX Software Abstraction Framework



# Domain-Specialized Diversified Services over Composable Software-Defined Infrastructure

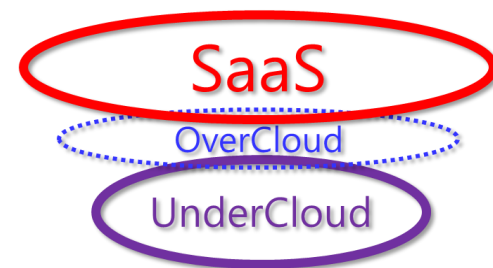


# On-going Evolution toward Simplified Layers

**Container-based abstraction to enable a razor-thin platform layer ...**

- **Diversified Software-based (SaaS-style) Services**

- 1) Microservices architecture with **Inter-Connected** (i.e., Chained) **Functions**: Cloud-native (i.e., Container-centric, agile, and economic) and Cloud-friendly
- 2) Human-defined (i.e., Orchestration-ready) diversified
- 3) Domain-specific IoT-Cloud services with Intelligence



- **Composable/Federated Platform+Infrastructure**

- 1) Open (Inter-operable), I<sup>2</sup>oT-/Container-enabled, Visibility-/Intelligence-ready, and Cloud-leveraged Platform
- 2) Shared/Federated, Open(-Source), Converged/Composable Software-Defined Infrastructure: **Boxes & Inter-Connect** with Smart Things + SDN/NFV/Cloud Integration

Note: Need to overcome **Security** (Privacy) and Federation Challenges

# **Open-Source, Composable, Federated SmartX Playgrounds**

**NET 챌린지 캠프**  
New Entrepreneur Talent Challenge Camp

**SmartX-mini**

**DEV OPS**  
Automation Service

**Open SmartX Portal**  
**OpenNetworking.kr**

**Joint Operation**

**KOREN**

**TEIN**

**Open SmartX Platform**

**KOREN**

**KOREN-NOC**

**GSTEP**

**SKKU**

**Postech**

**GIST**

**Jeju U.**

**PHILIPPINES**

**INDONESIA**

**THAILAND**

**VIETNAM**

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**Joint Operation**

**KOREN**

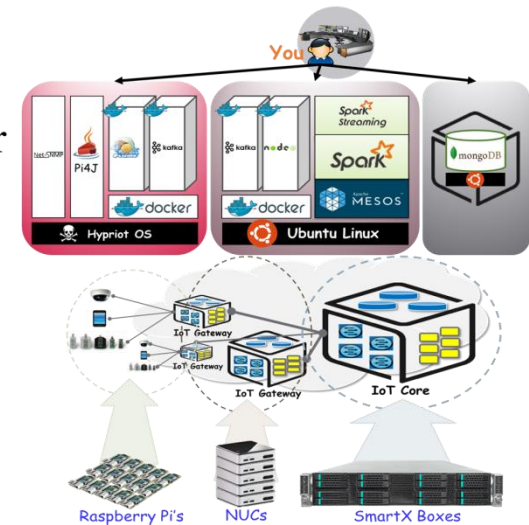
**TEIN**

**Open SmartX Platform**

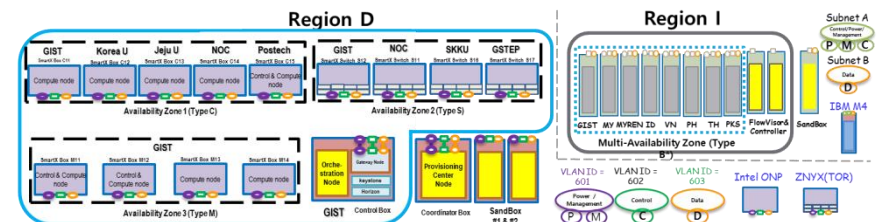
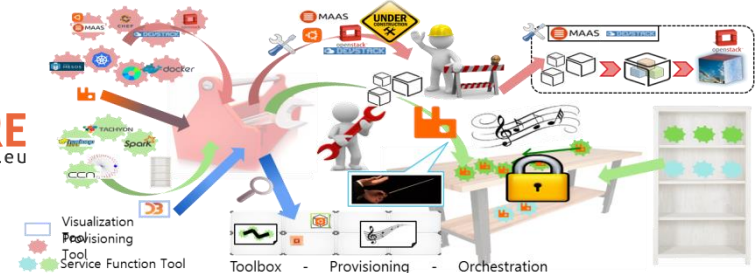
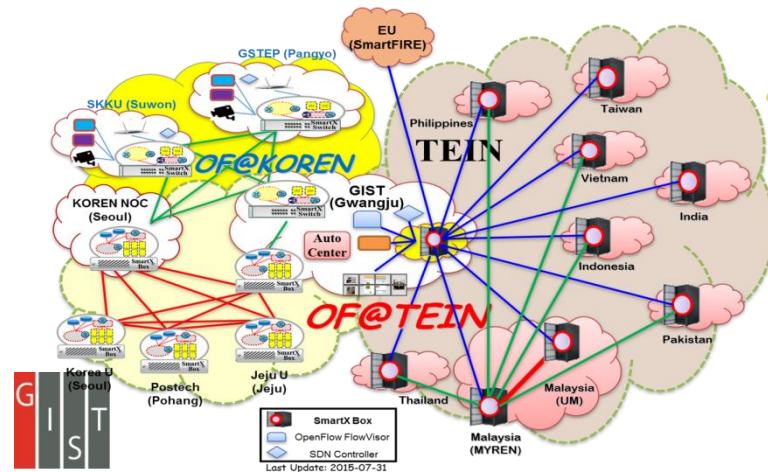
**KOREN**

**KOREN-NOC**

**GSTEP**



## Building/Operating SmartX (OF@KOREN / OF@TEIN) Playground (2012~2015)



# Open PPP & Global Collaboration



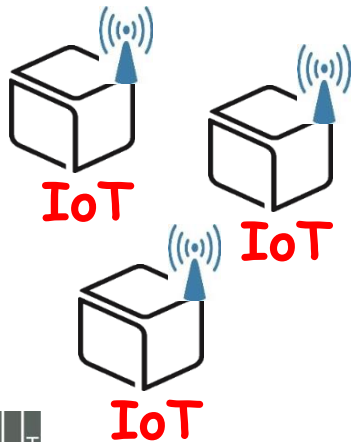
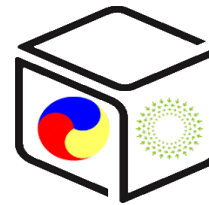
# SmartX Playgrounds #1: Open-Source Leveraged SDI



OF@KOREN & OF@TEIN  
SmartX Playgrounds



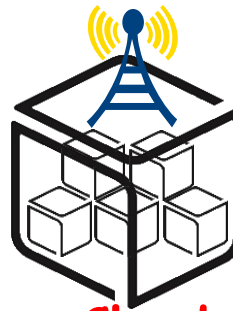
open source  
initiative



OpenFlow



ONOS



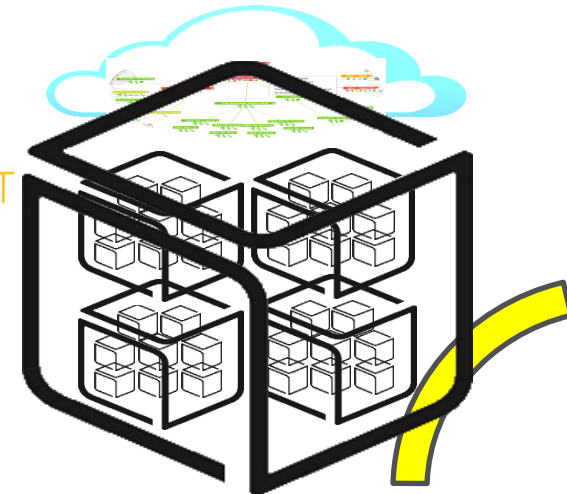
$\mu$ Cloud  
(SDN/NFV/  
FastData)



OpenDaylight

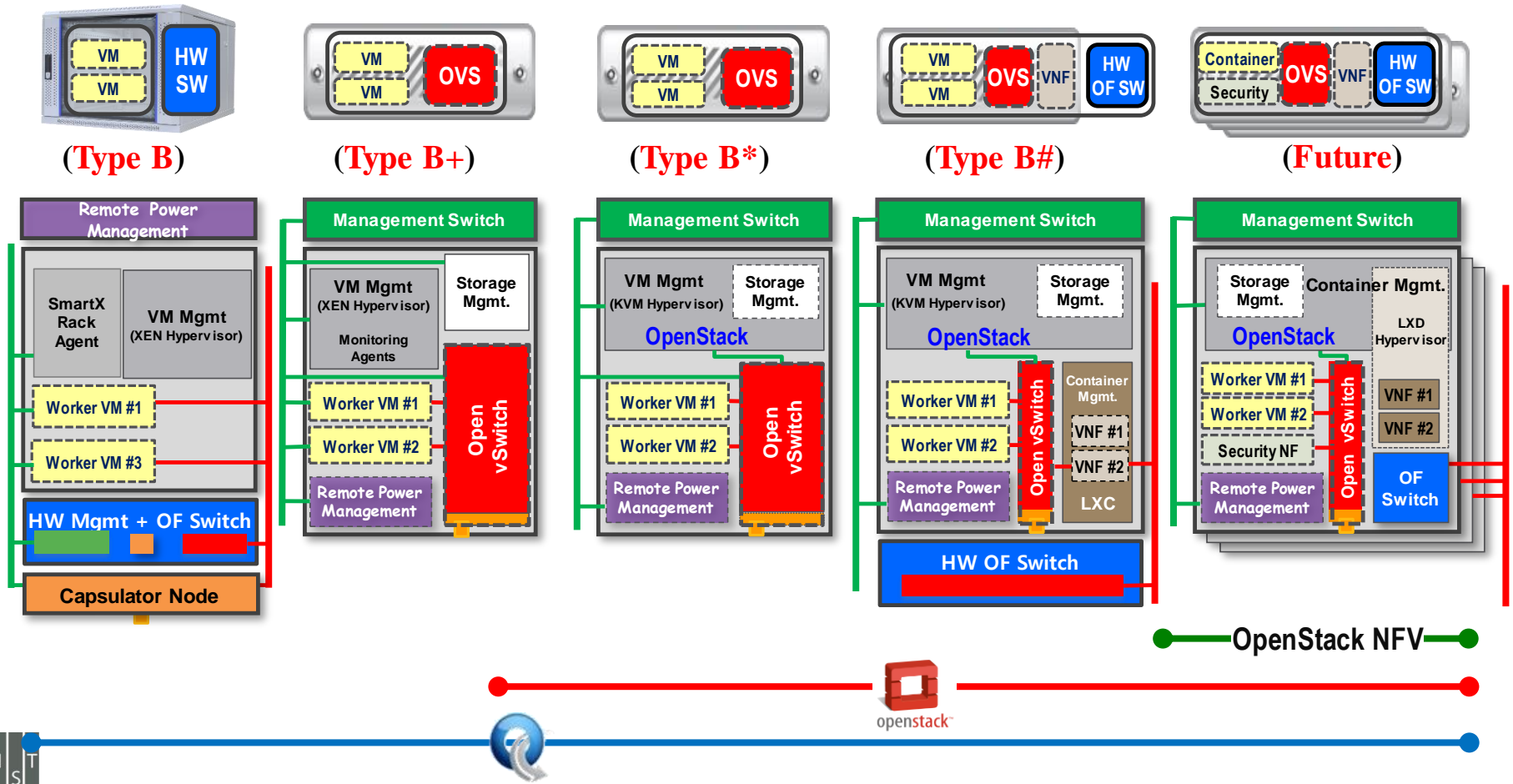


openstack™

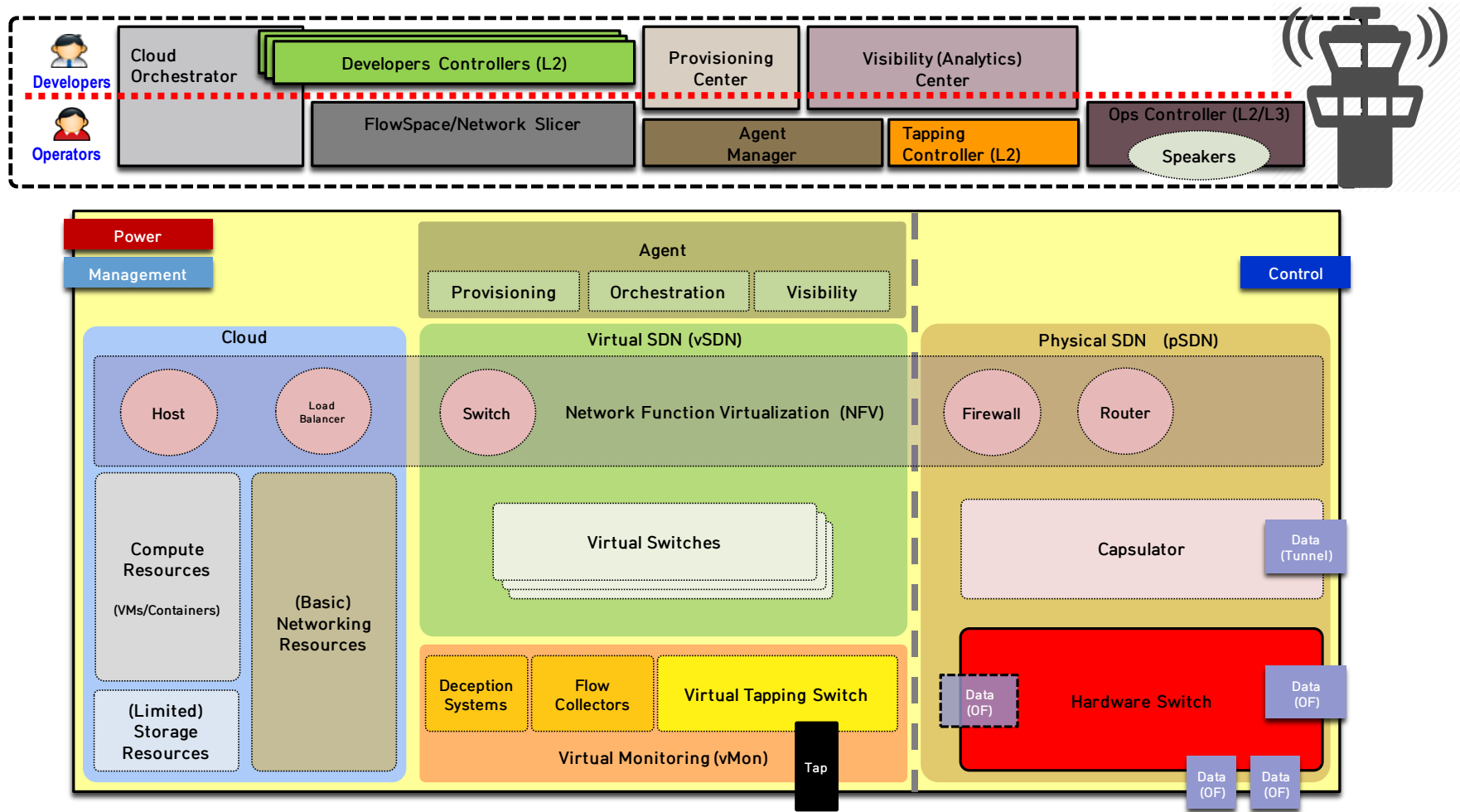


Federated Cloud DCs  
(BigData/HPC)

# SmartX Playgrounds #2: Composable SDI with Affordable, Hyper-Converged, Programmable/Virtualized Boxes (1/2)



# SmartX Playgrounds #2: Composable SDI with Affordable, Hyper-Converged, Programmable/Virtualized Boxes (2/2)

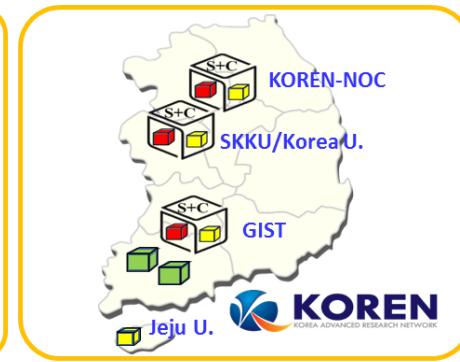


# SmartX Playgrounds

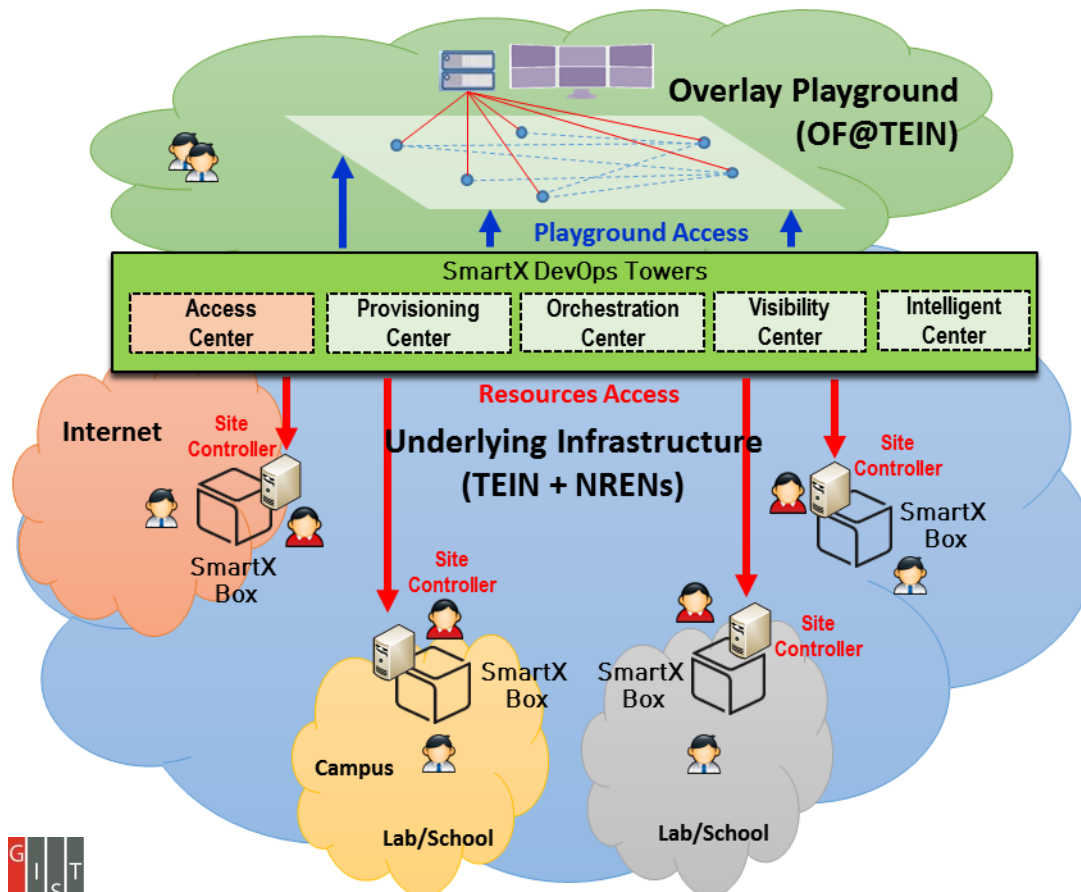
## #3: Federated SDI with Cloud-leveraged Open Federation (1/2)



OF@TEIN Playground



OF@KOREN Playground

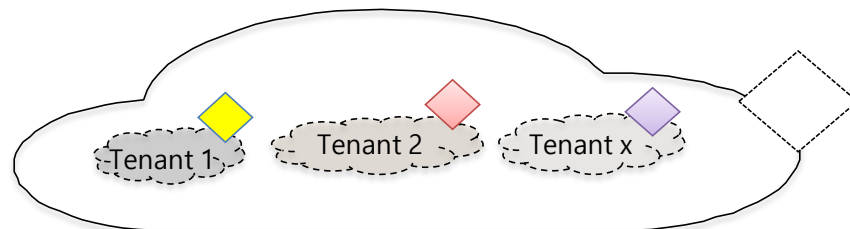


SmartX Playground: Past/**Current**/  
Future

- Distributed SDN Playground →→  
**Distributed Cloud & virtualized  
SDN-Cloud Playgrounds**
- #1: Distributed SDN-Cloud  
Playground with HPC/DataLake  
Capability
- #2: Distributed physical +  
virtualized SDN-Cloud Playground  
toward SDX (SD Exchange)
- #3: Distributed IoT-Cloud  
Playground

# SmartX Playgrounds #3: Federated SDI with Cloud-leveraged Open Federation (2/2)

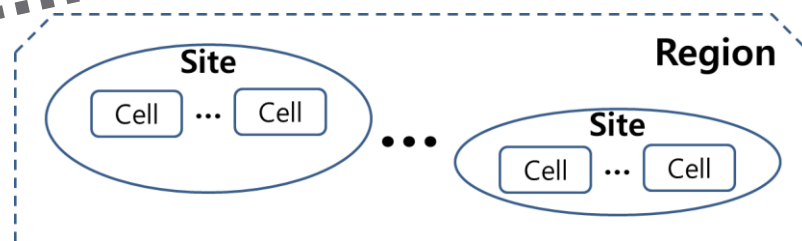
## 1) ID Federation



**Multi-Tenants**

**Multi-Domain**

## 2) Workload Federation

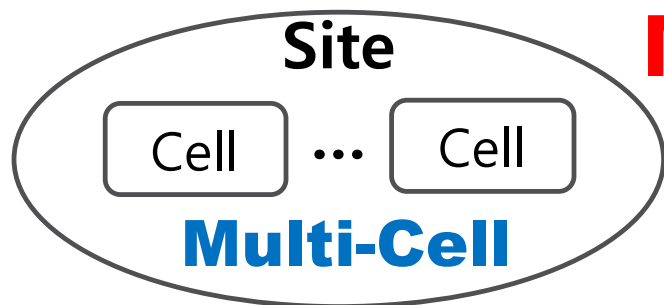


**Multi-Region**

## 3) Resource Federation

**Multi-Site**

**Region**

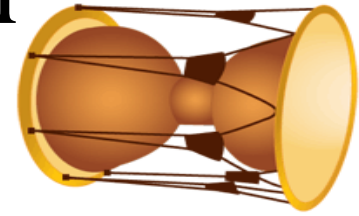


**Multi-Cell**

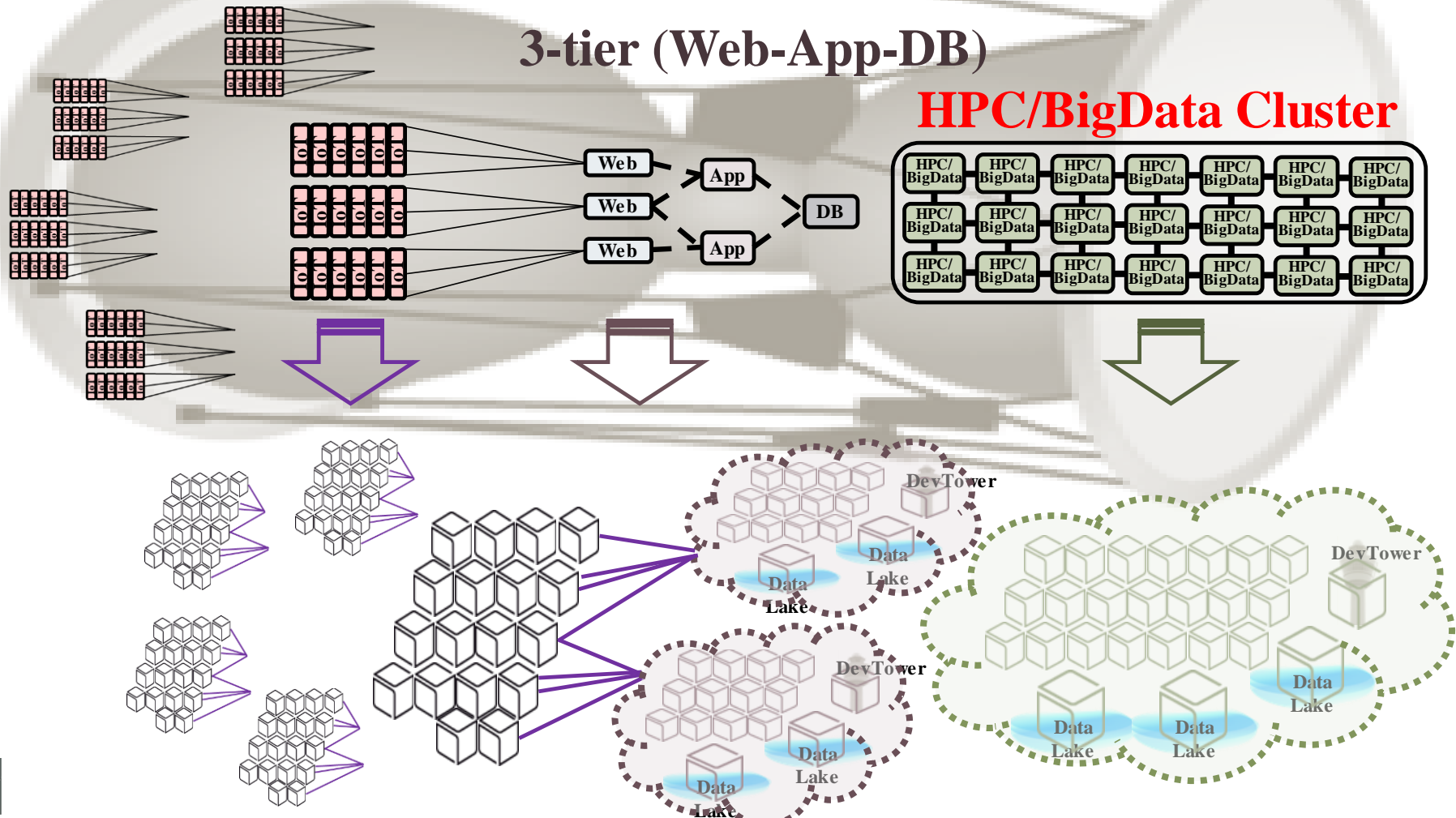


# Multisite Edge Clouds with SmartX K-Clusters

# Intelligent IoT-Cloud Services with Inter-Connected Functions



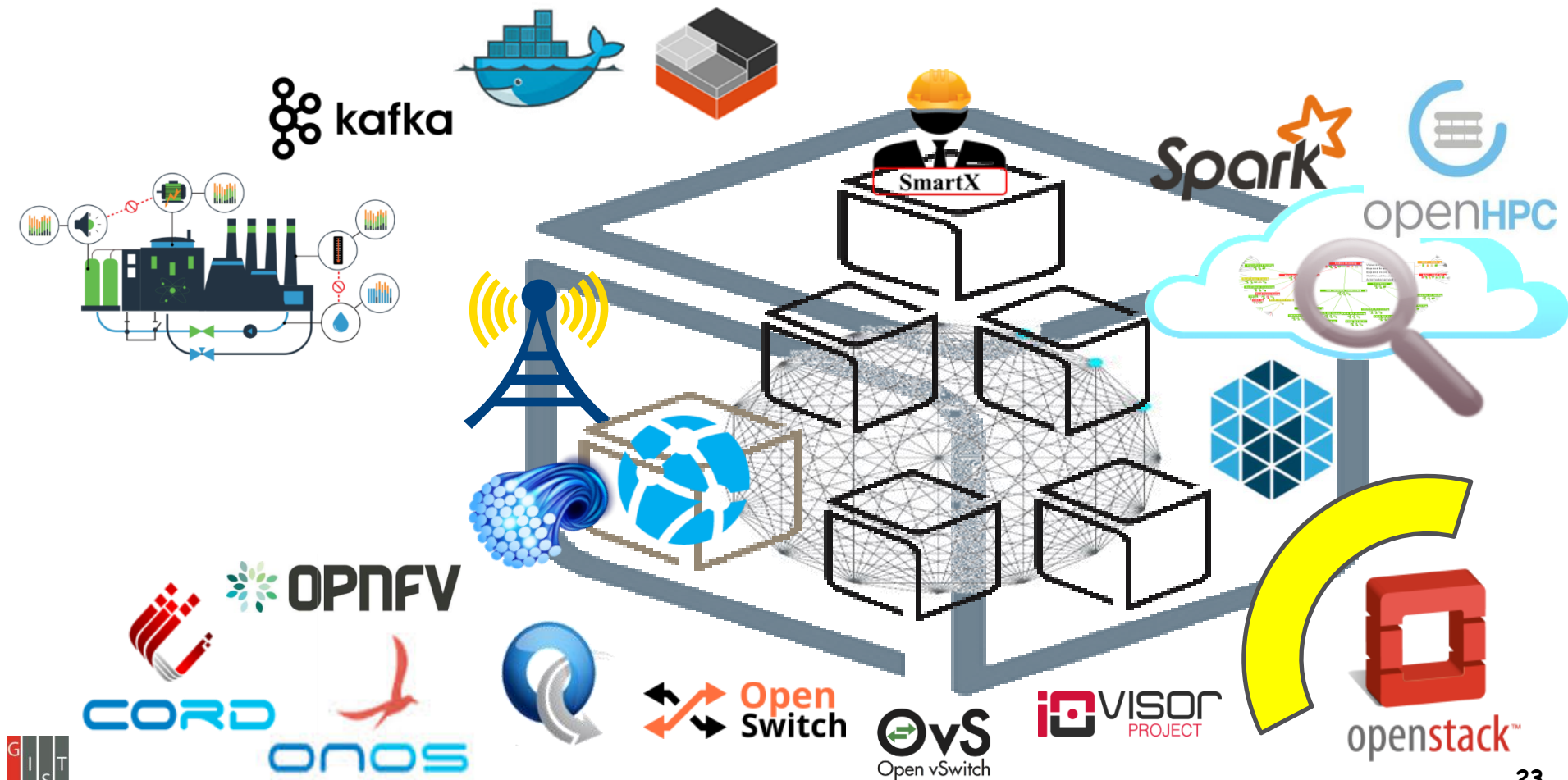
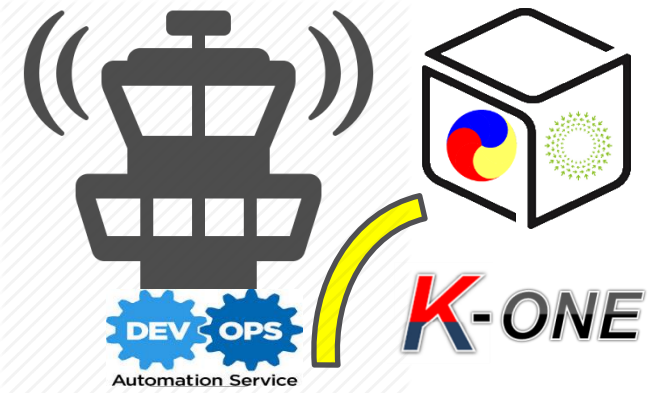
## IoT-----Cloud



(2016.11 - v0.3)

# Federated $\mu$ Clouds

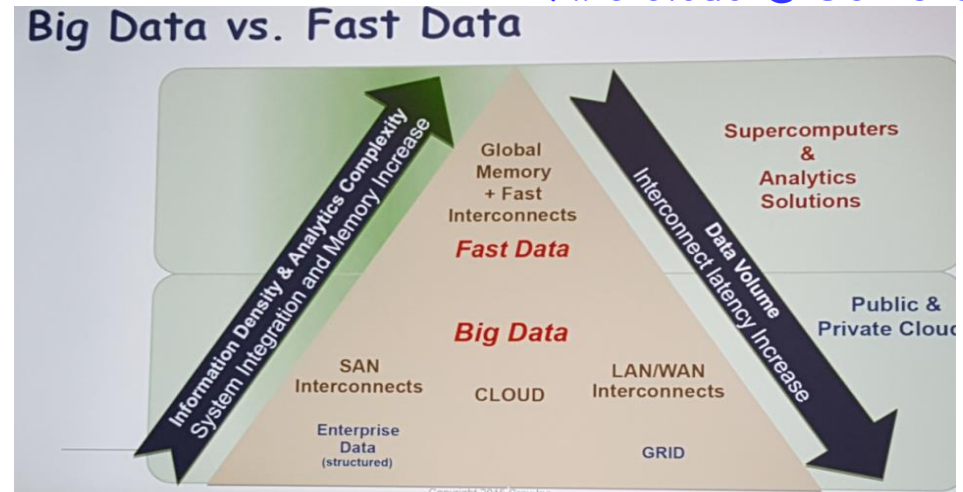
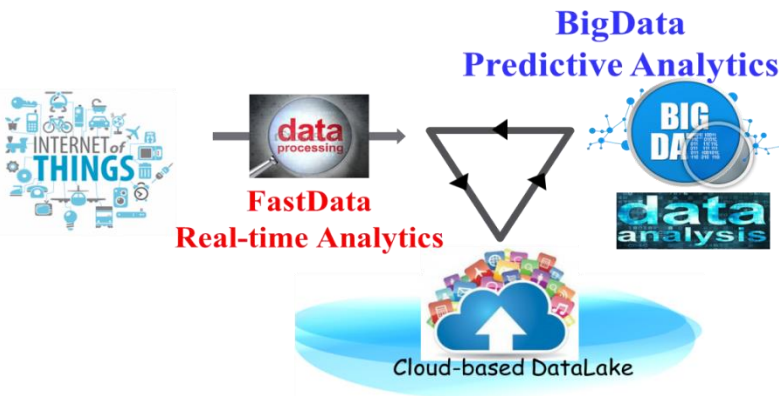
**(IoT-SDN/NFV/FastData-Cloud +HPC/BigData)**



# K-Cluster: HPC-/BigData-based Intelligence with Hyper-Convergent Boxes



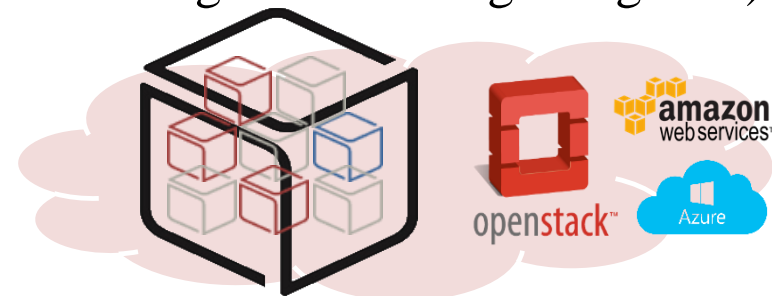
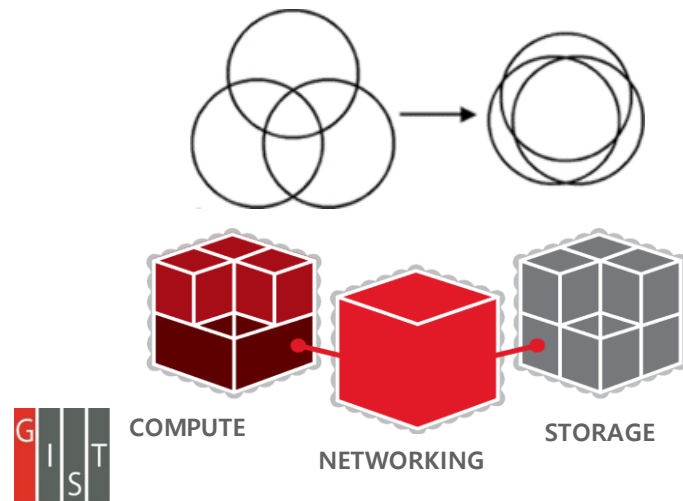
HPC Cloud @ SC 2015



## BigData / FastData & HPC

### → Hyper-Convergent

(Compute/Storage/Networking Integrated)



# K-Cluster: Low-cost Prototyping with Commodity White-Boxes



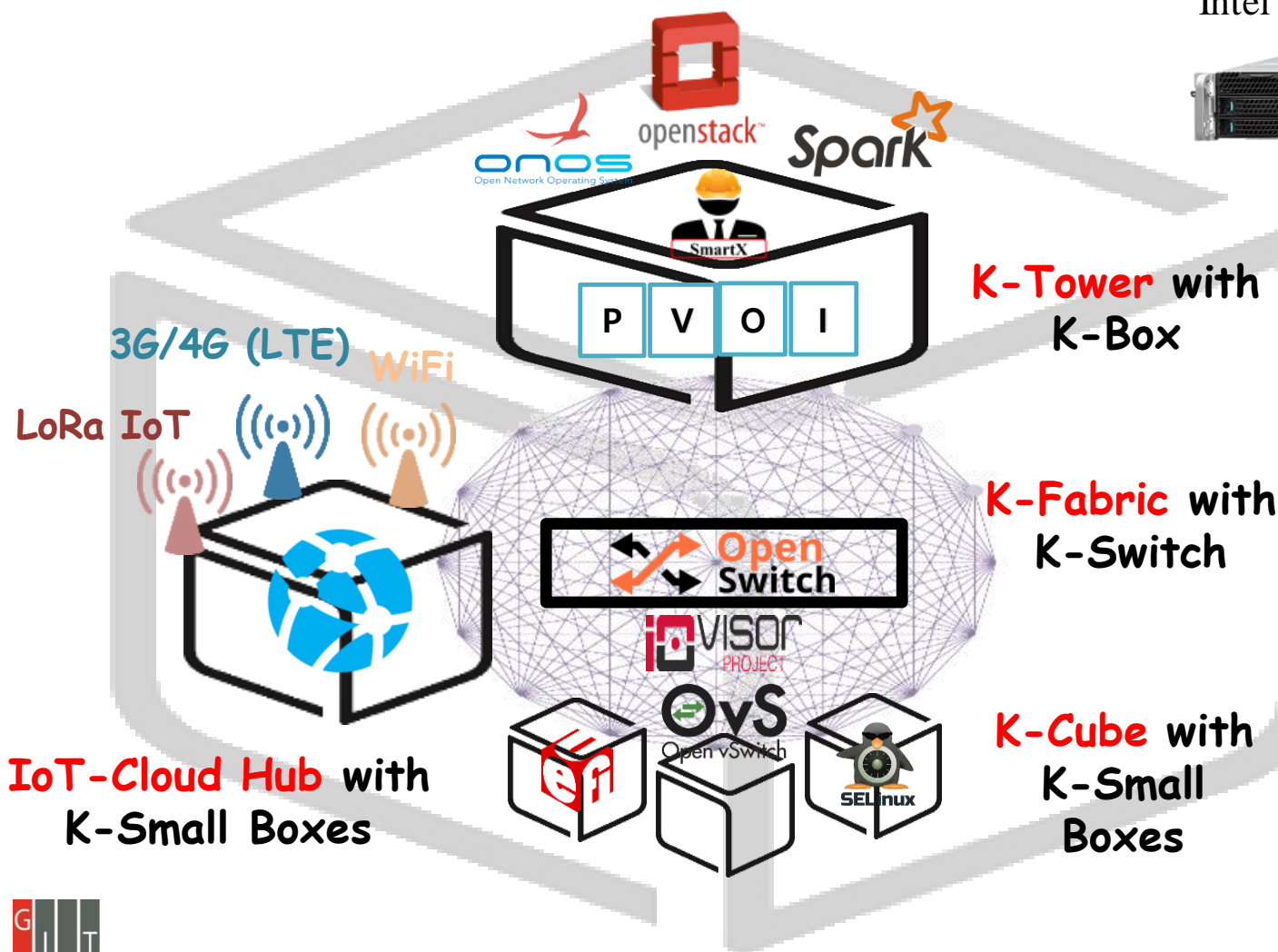
Intel ONP Xeon Server



EdgeCore 5712  
OCP Switch

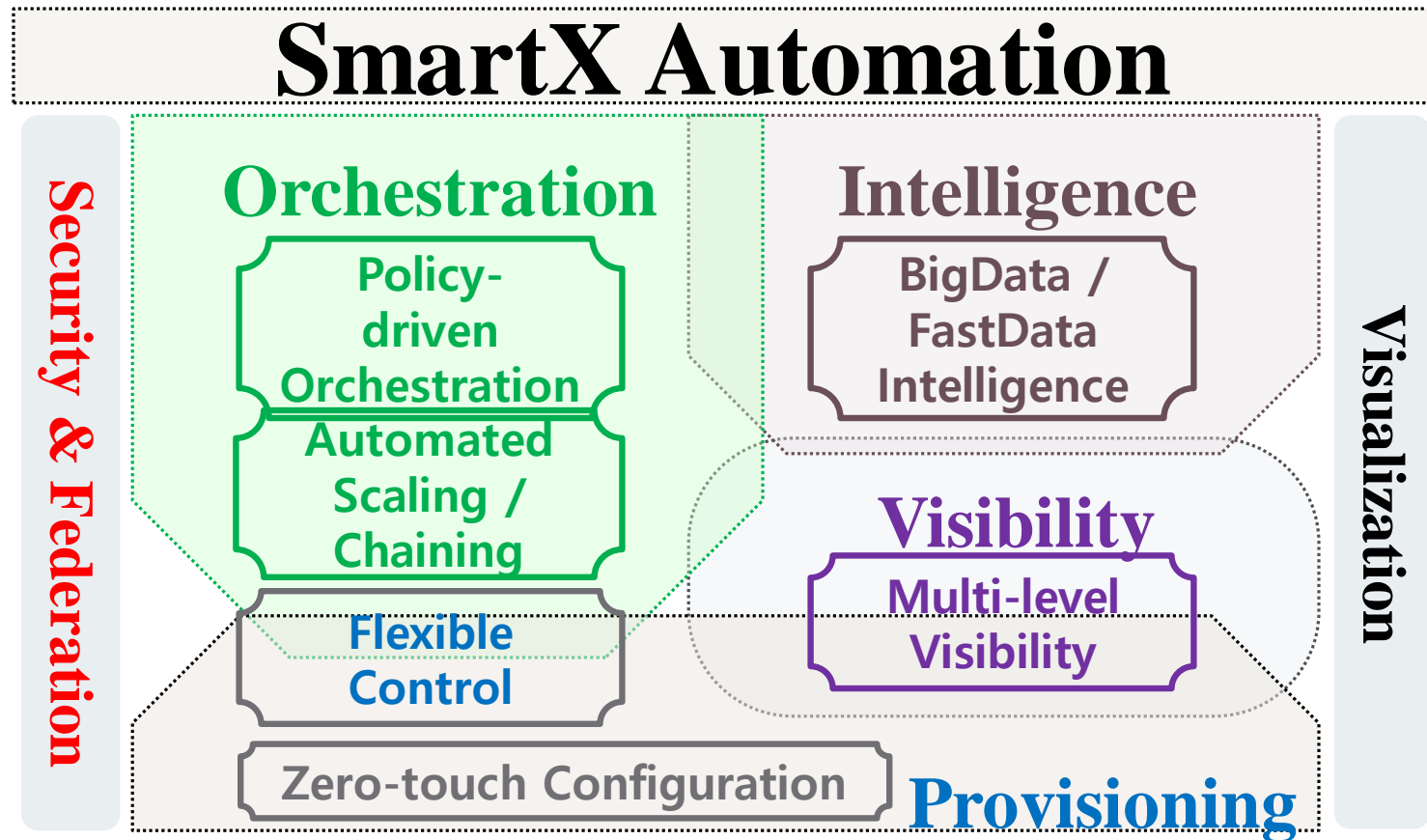
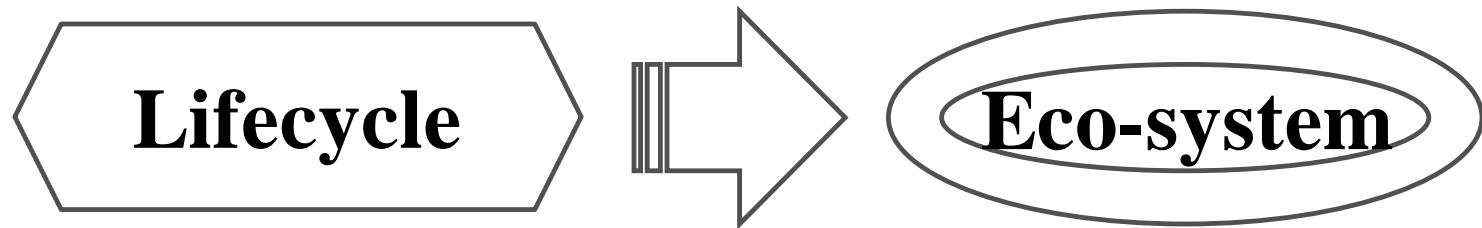


Supermicro SYS-200-8D Xeon-D MiniServer





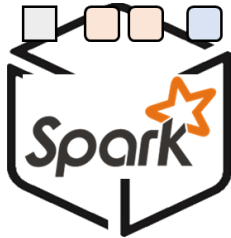
# SmartX Software Abstraction Framework



# SmartX MultiX Playgrounds with Storage: OF@KOREN, OF@TEIN, K-ONE (2016.10)



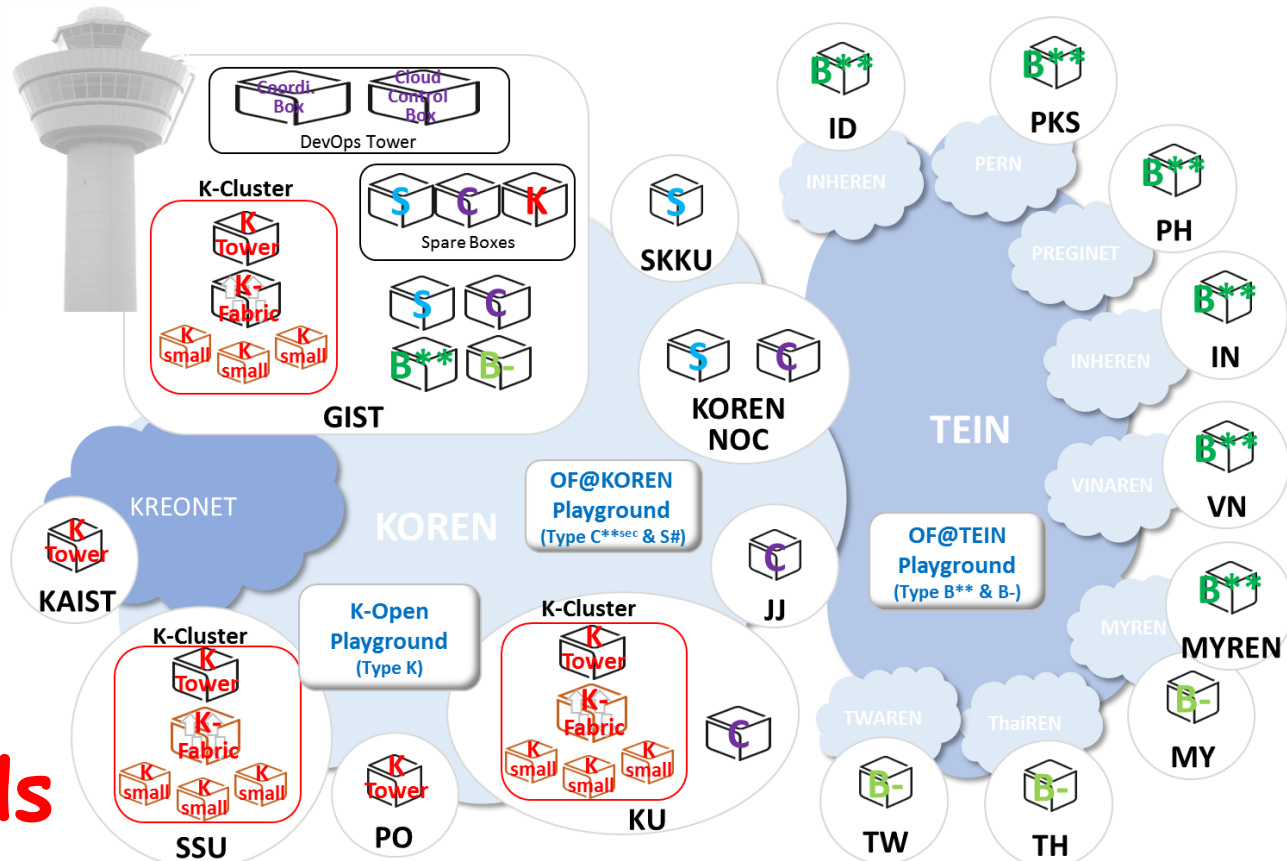
2x Type L Boxes  
(for Cloud Storage)



4x Type D Boxes  
(for DataLake/Analytics)

# SmartX Cloud Storage & Intelligence (DataLake/Analytics)

## MultiX: Multi-domain/Multi-region, Multi-site, Multi-Box, ...

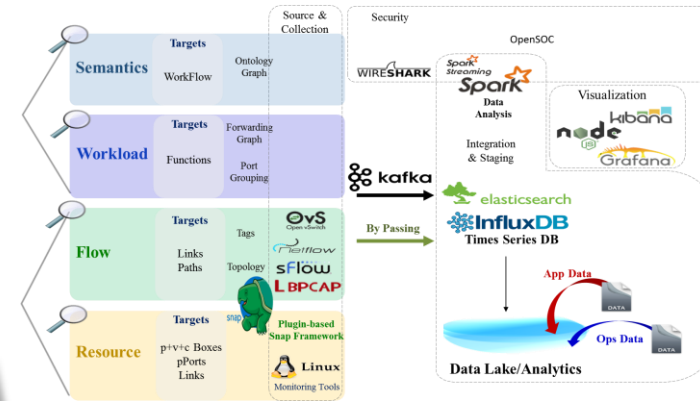
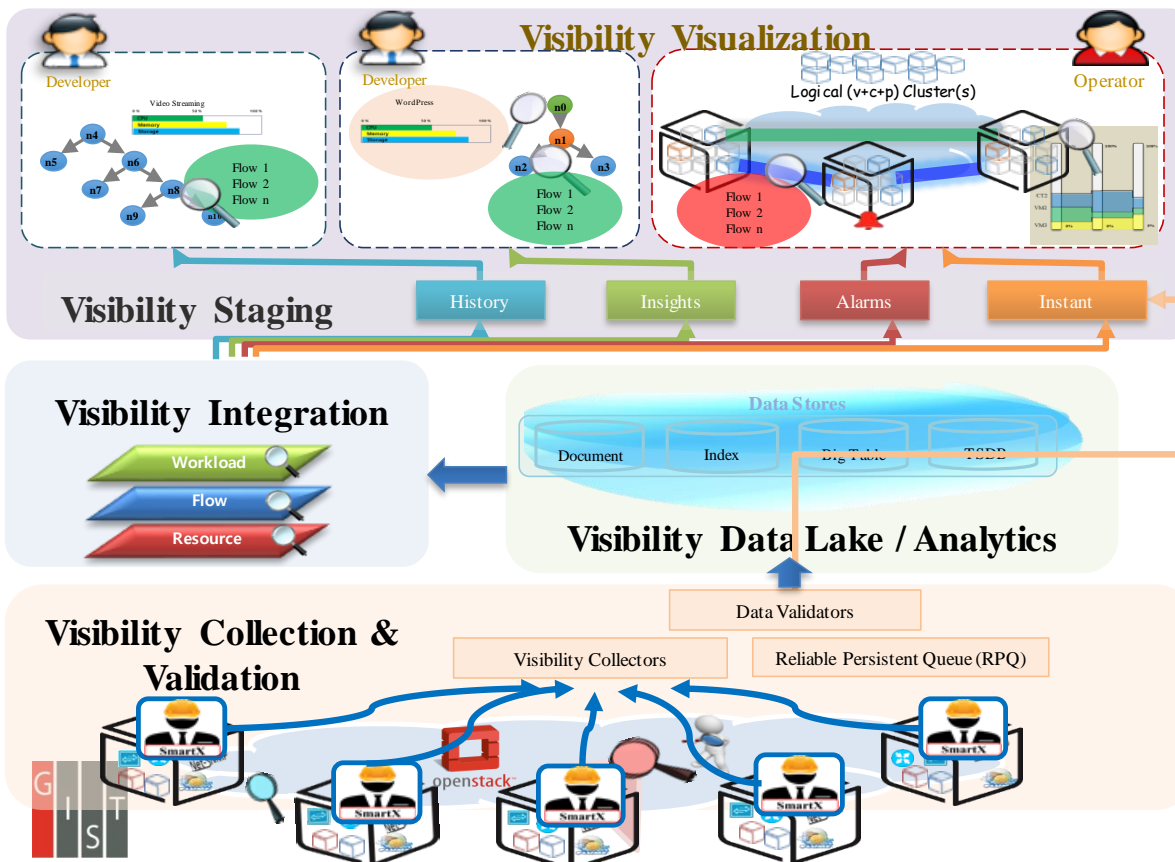


# SmartX Playgrounds

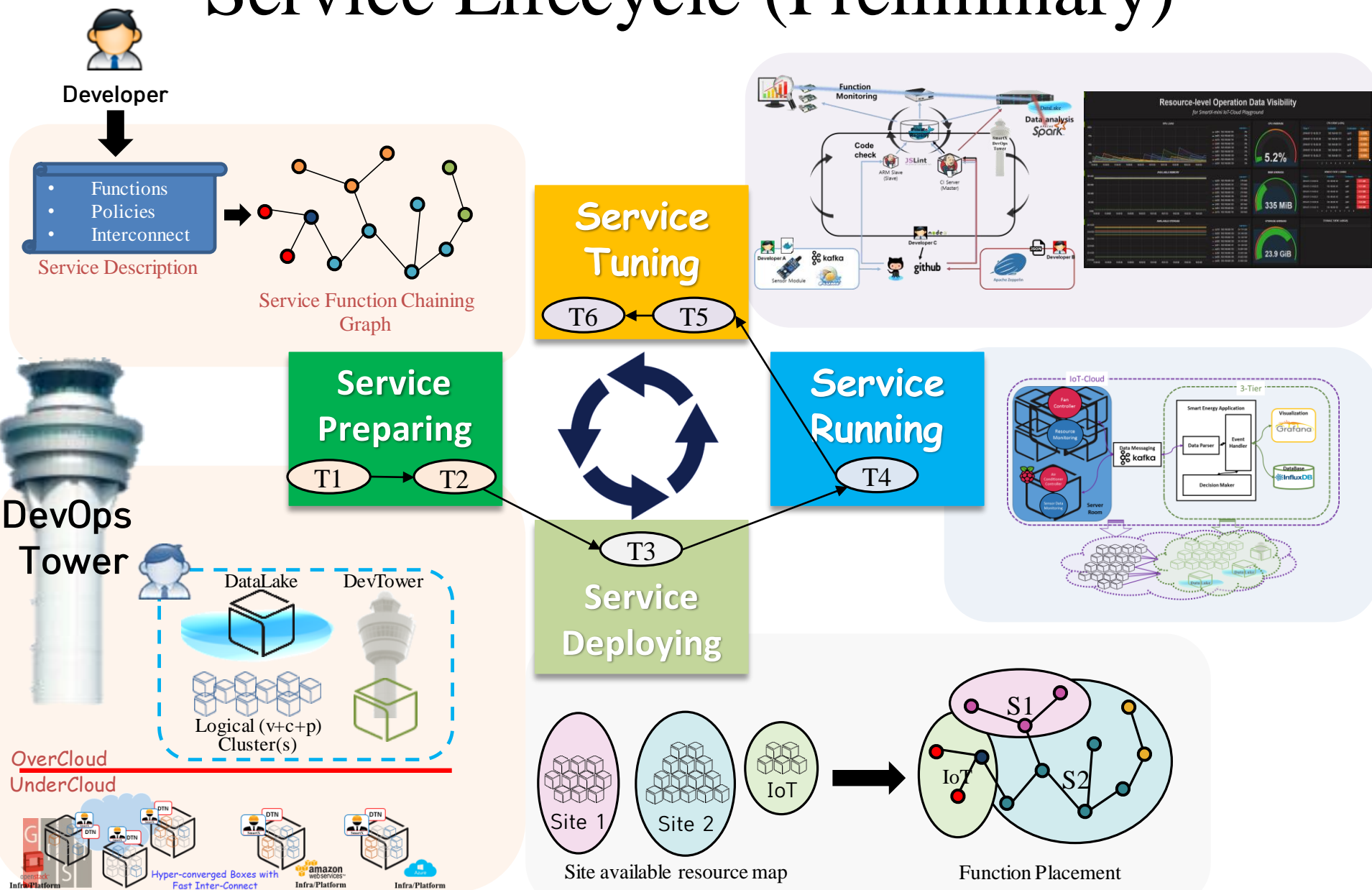


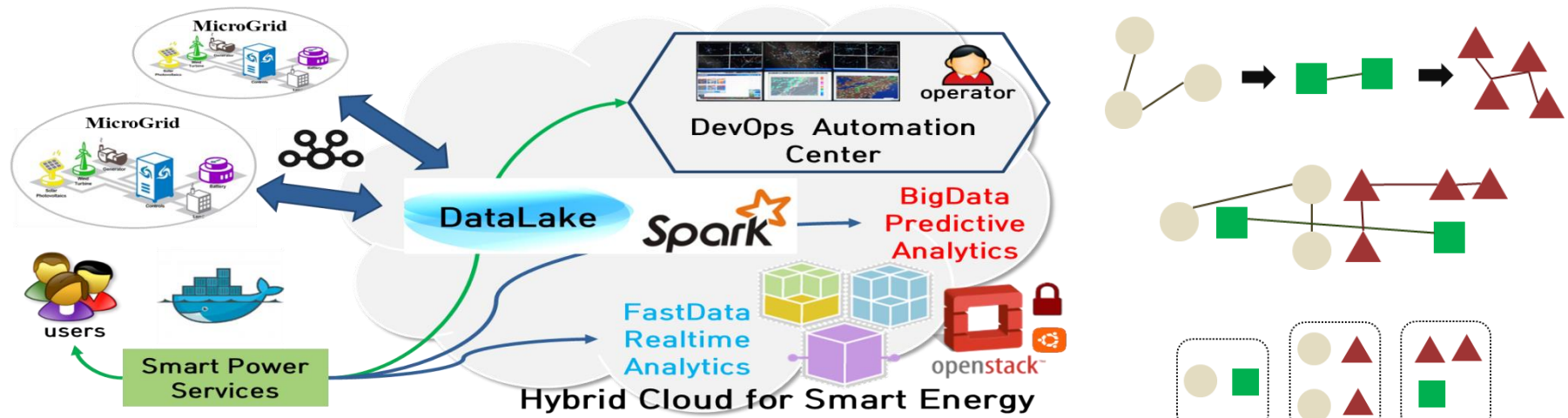
# SmartX MultiView Concept & Progress:

## Multi-layer/Multi-level Visibility for SmartX Playgrounds



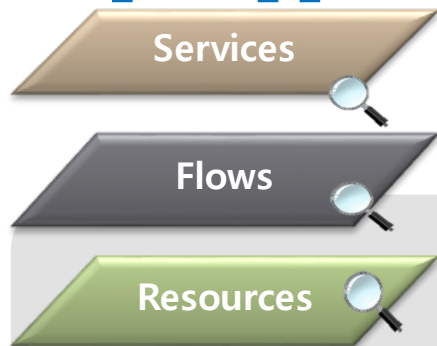
# SmartX Orchestration for Workflow-based Service Lifecycle (Preliminary)





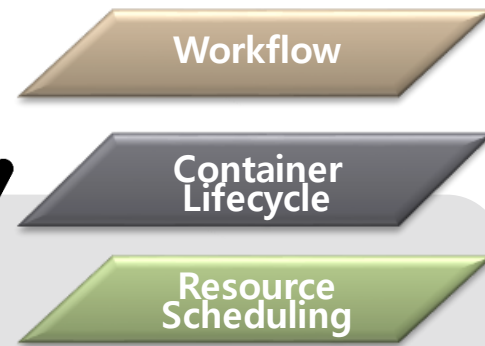
# DevOps-based Automation of IoT-Cloud Services

## Multi-level Ops/App Visibility



Automation Service

## Workflow-based Orchestration



# Infrastructure/Platform with Hyper-converged Boxes



Gwangju Institute of  
Science & Technology



*Thank you!*

*[jongwon@gist.ac.kr](mailto:jongwon@gist.ac.kr)*

# Converged SDI @ Hyper-scale Cloud (Google)

Google Search / Google Maps / MapReduce / Dremel / Gmail



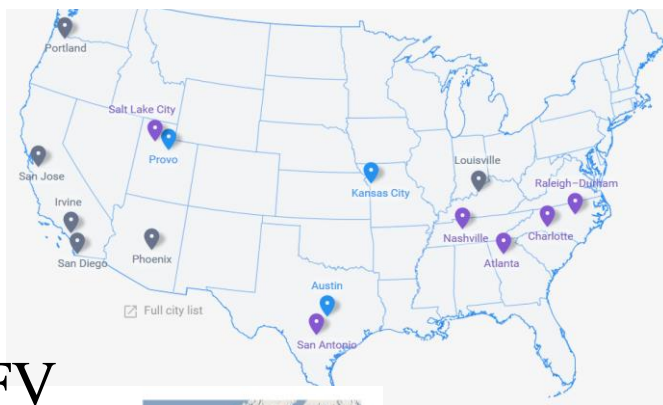
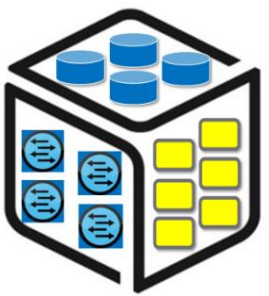
**Omega:** Distributed scheduling

**Kubernetes:**

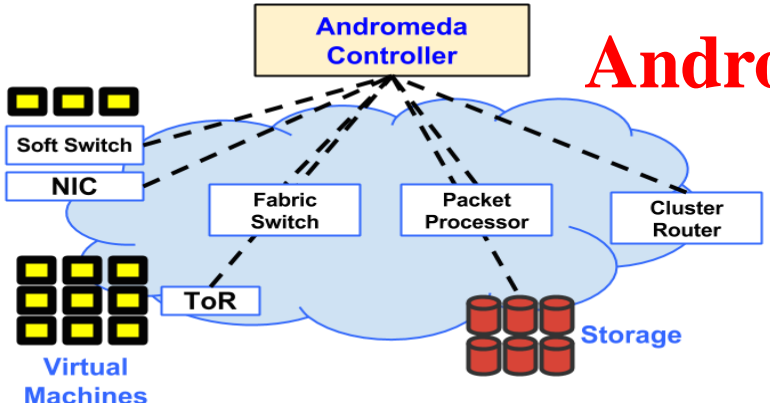
Container orchestration



**Fiber & FI:** Optical & Mobile

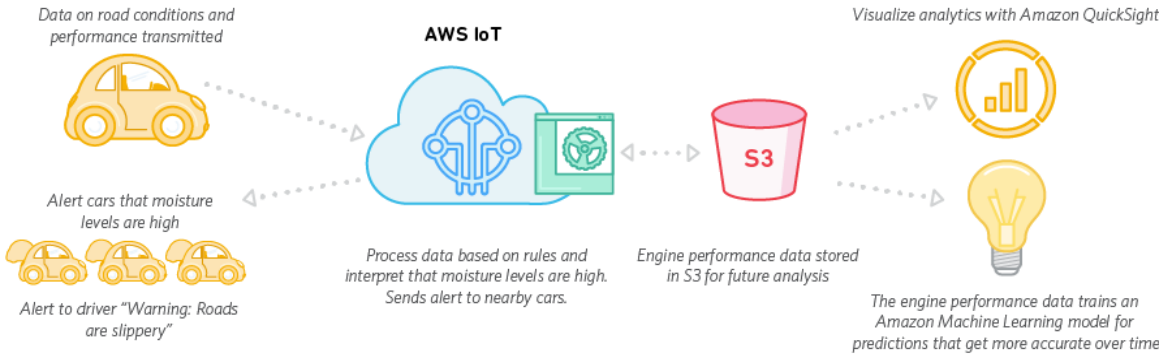


**Andromeda:** SDN/NFV

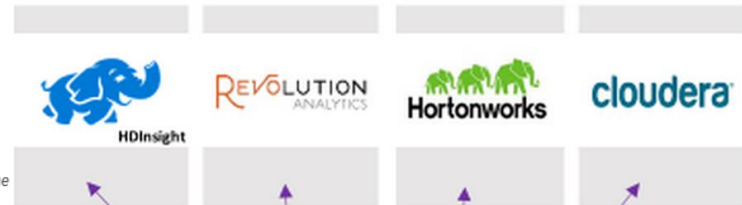


**B4:**  
Global SD-WAN

# IoT-Cloud Services & Hyper-scale Clouds

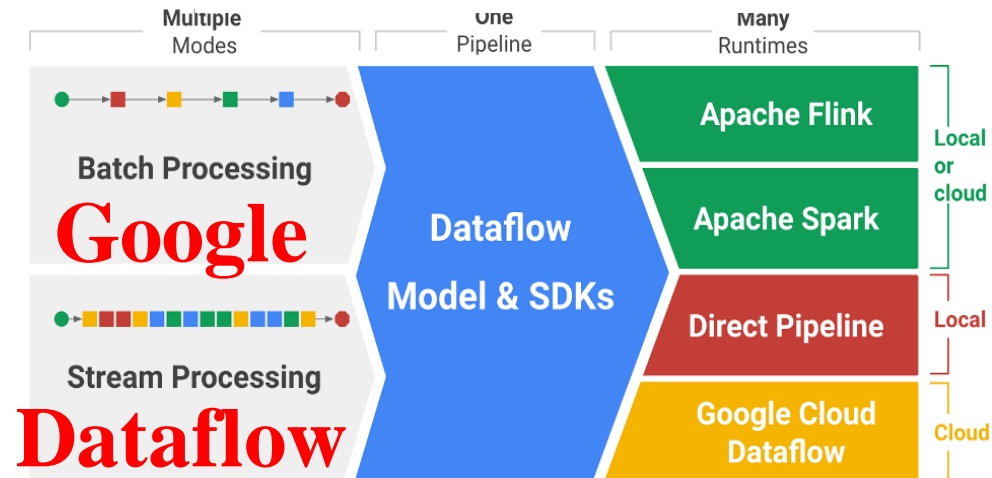
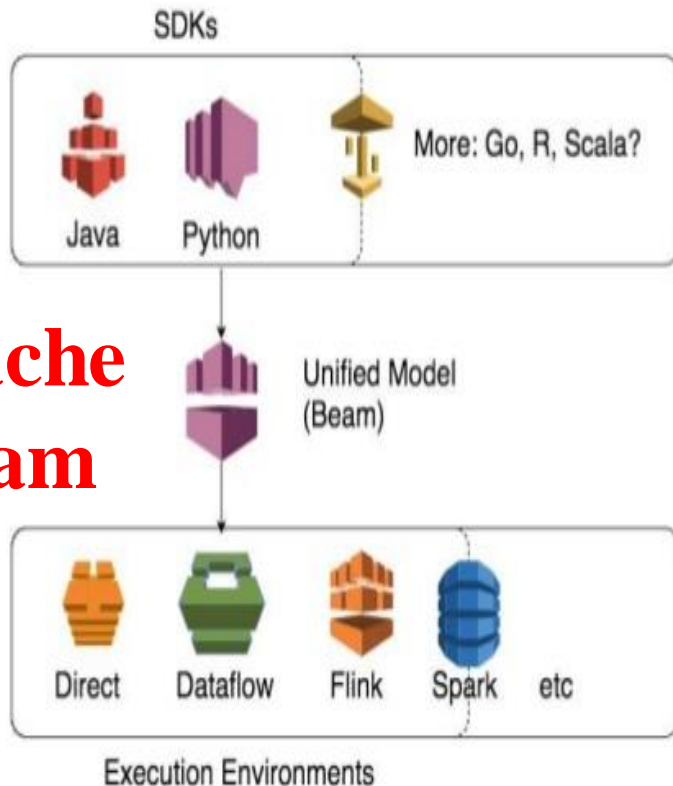


## AWS-IoT



## MS Azure DataLake

## Apache Beam



# HPC Cloud Services from Hyper-scale Clouds

VPC to host  
Commercial  
ISV HPC  
Software

**AWS-HPC**

## MS Azure HPC

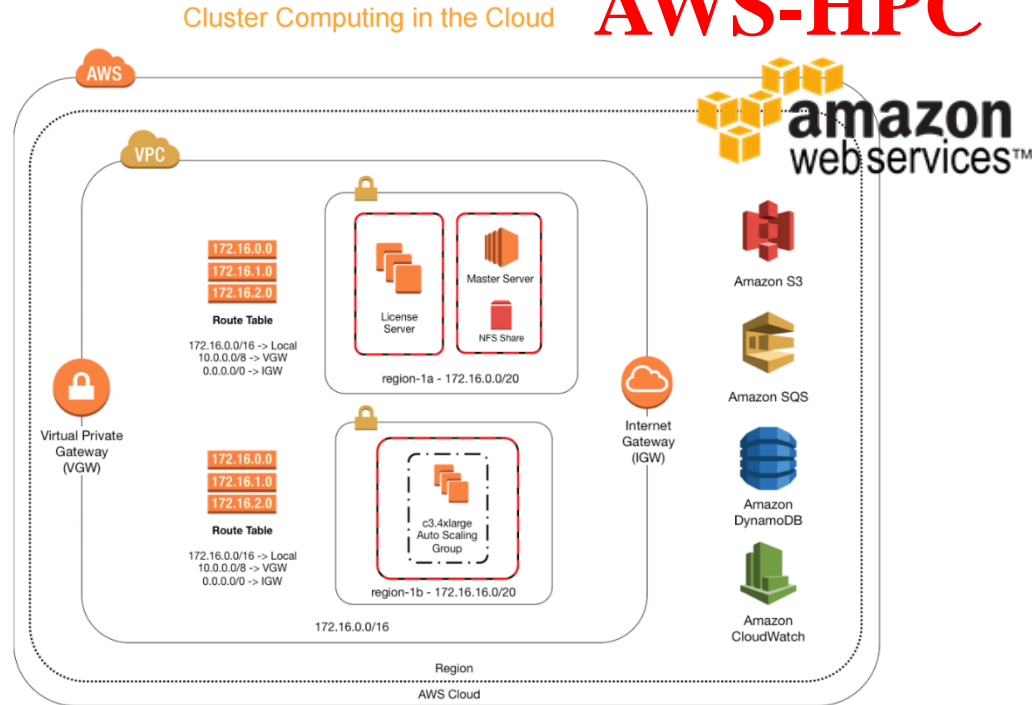
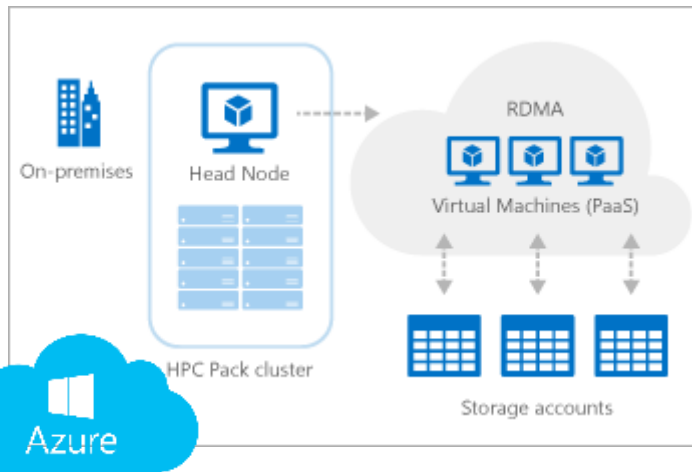


Figure 2: "Tightly coupled" cluster

**AWS P2 Instance with Nvidia upto 16 K80 GPU cards / Azure K80 with RDMA over Infiniband**

### P2 Instance Details

Name	GPUs	vCPUs	RAM (GiB)	Network Bandwidth	Price/Hour*	RI Price / Hour**
p2.xlarge	1	4	61	High	\$0.900	\$0.425
p2.8xlarge	8	32	488	10 Gbps	\$7.200	\$3.400
p2.16xlarge	16	64	732	20 Gbps	\$14.400	\$6.800

\* Pricing for US East (N. Virginia) and US West (Oregon)

\*\*3-Year Partial Upfront RI

Top 5 Cloud  
Storage Options



## Uber Cloud



