

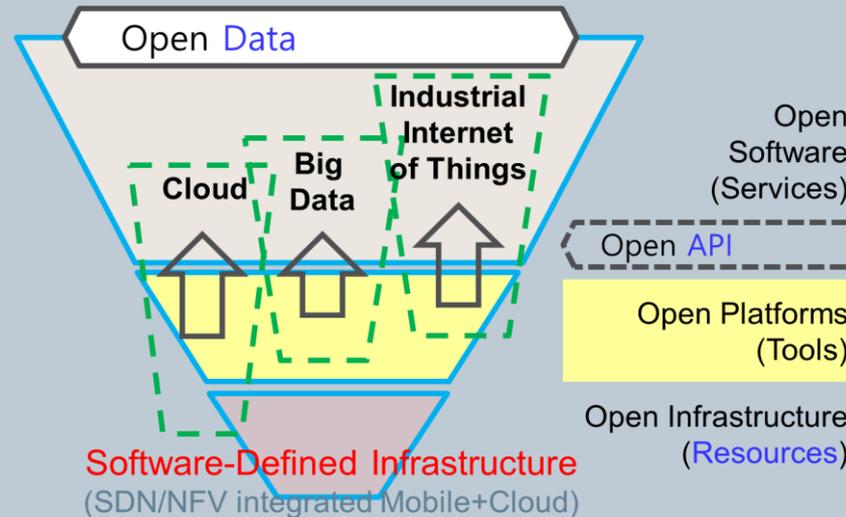
# Enabling Open Networking with SmartX Shared Playground

Open Networking Korea 2016 Spring  
(DevCon)

Dr. JongWon Kim

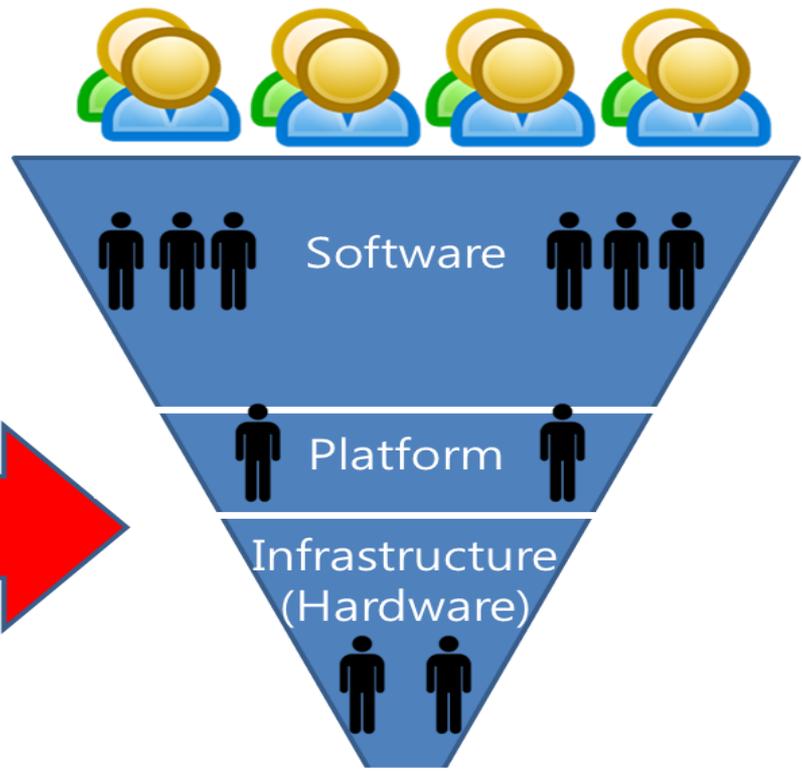
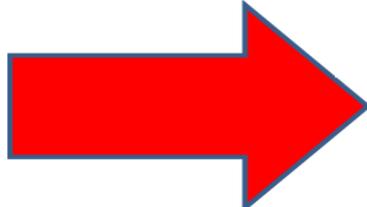
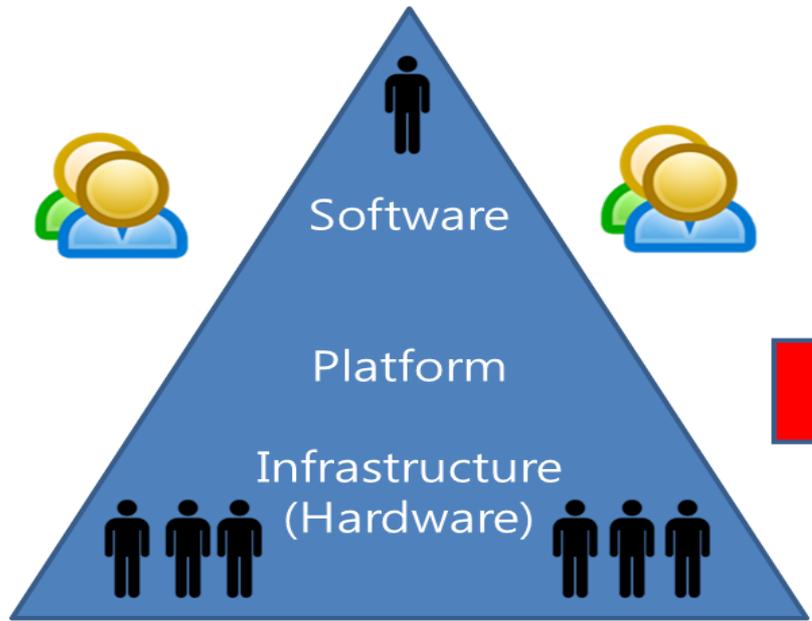
Networked Computing Systems Laboratory  
School of Information and Communications  
Gwangju Institute of Science & Technology (GIST)

# Hyper-convergent Software-Defined Infrastructure



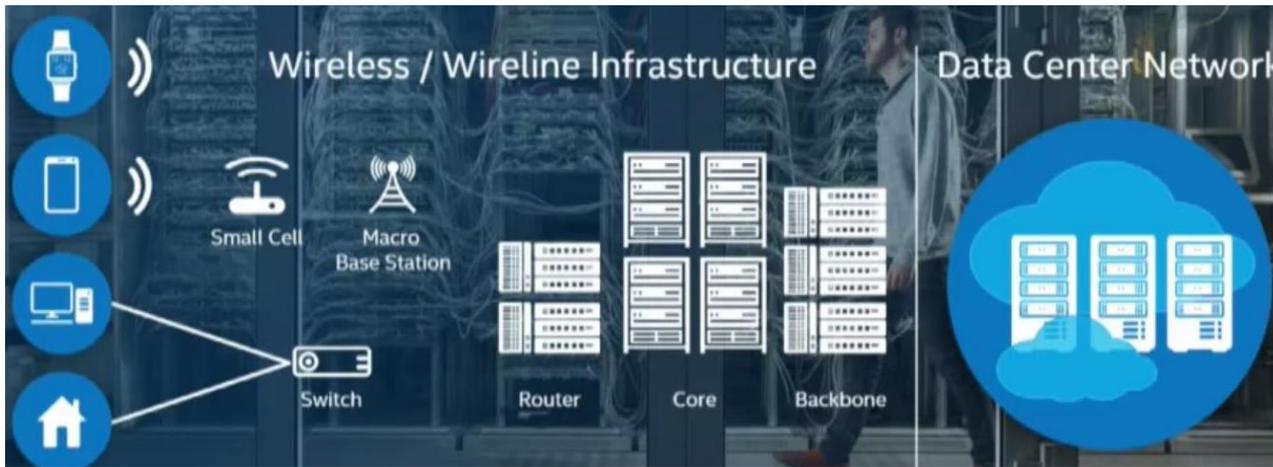
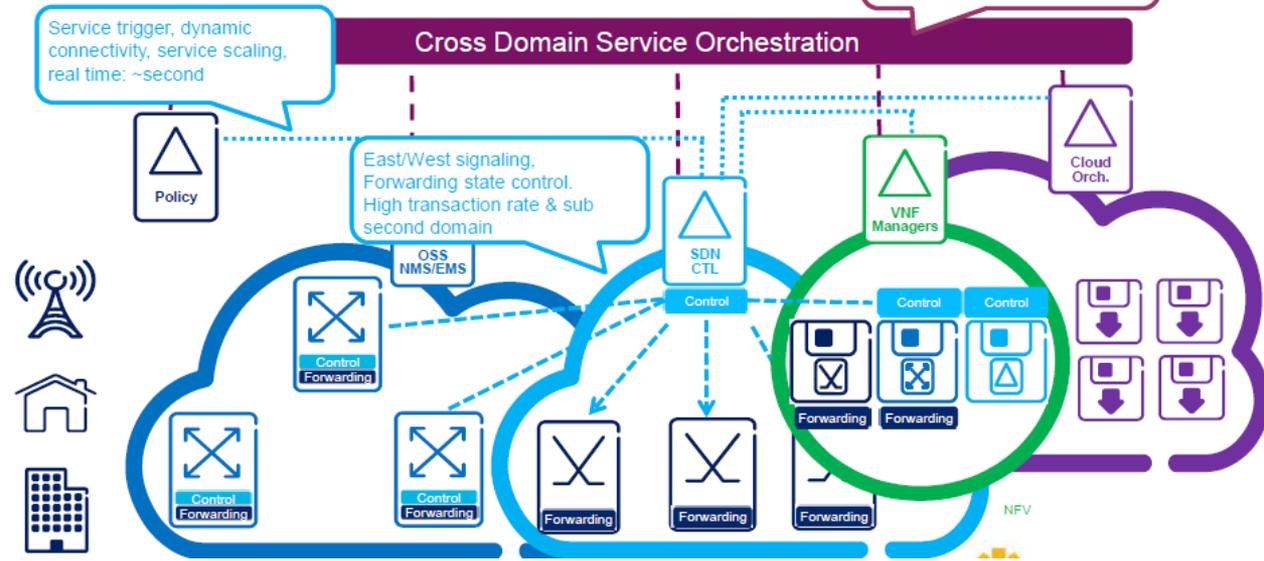
# Software-centric Vision for ICT Infrastructure

**Reset, Rebuild,  
Run!**



# Converged Software- Defined Infrastructure (SDN/NFV/Cloud Integration)

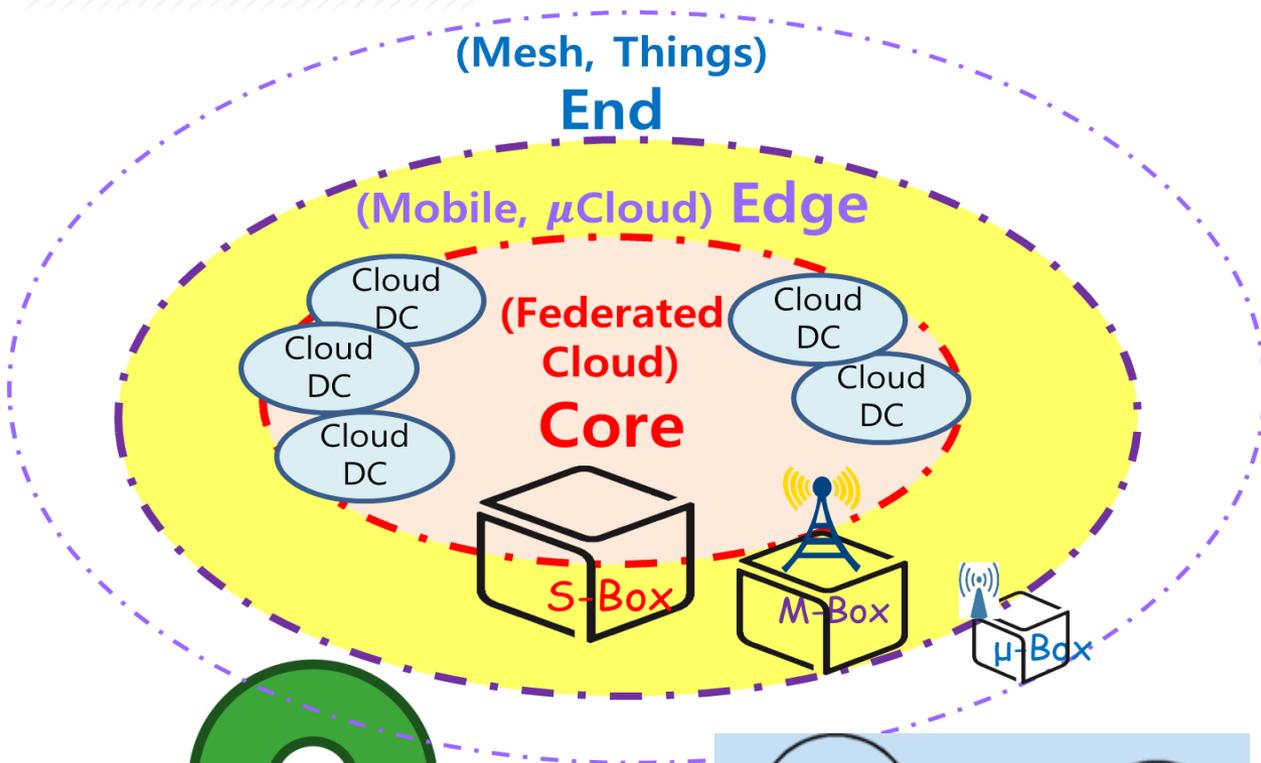
CLOUD, SDN & NFV  
NFV IN SDN CONTROL DOMAIN



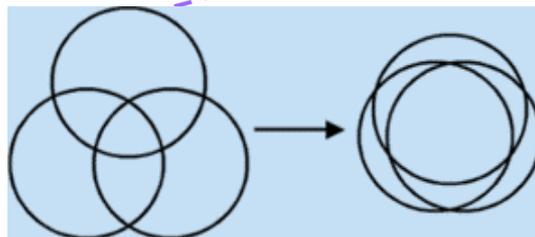
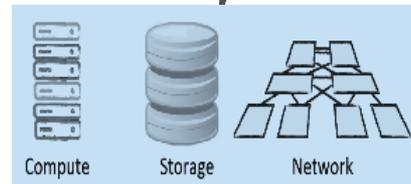
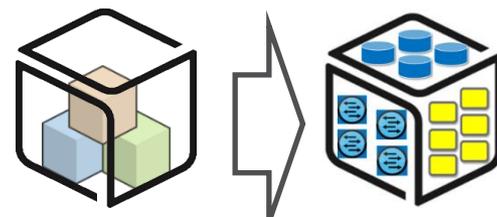
- Amazon AWS / Microsoft Azure / Google Cloud Engine
- OpenStack (IBM, RackSpace, HP, Cisco, AT&T, Verizon, NTT, ...)
- VMware Hybrid



# Hyper-converged Software-Defined Infrastructure (SDN/NFV/Cloud Integrated)

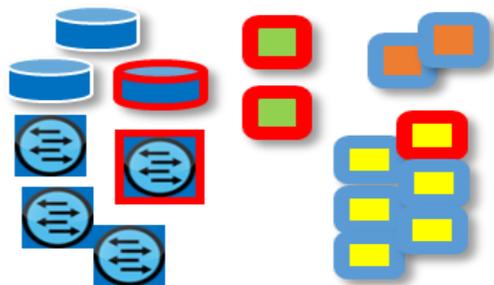


End	Edge	Core
Things	$\mu$ Cloud (SDN/NFV)	Cloud

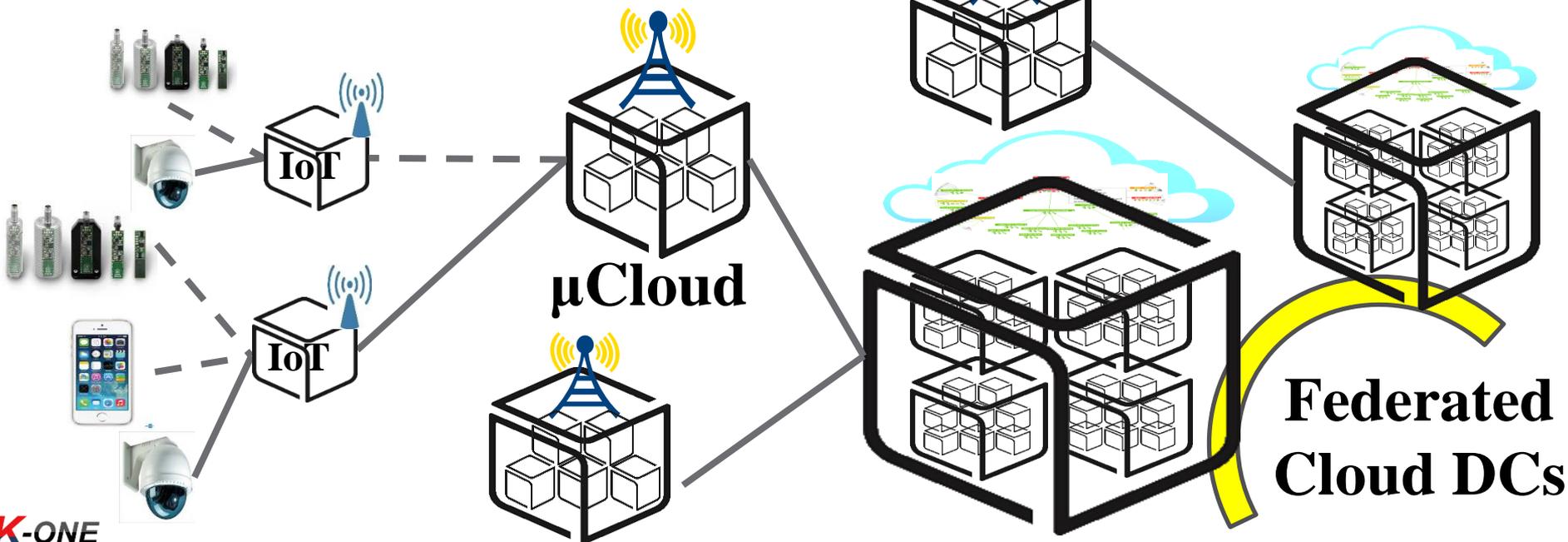
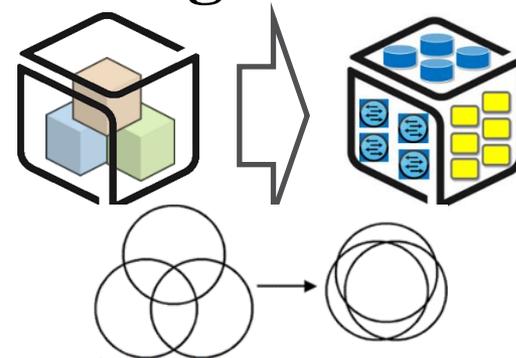


# Hyper-convergent SDI for Diversified Services

## Diversified SaaS Applications

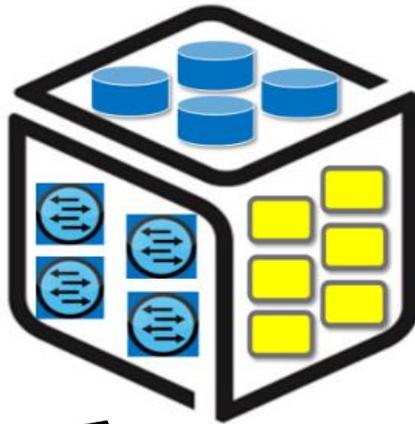


## Resources in Hyper-convergent Boxes



# Realize SmartX Services with Open APIs enabled by SmartX Boxes

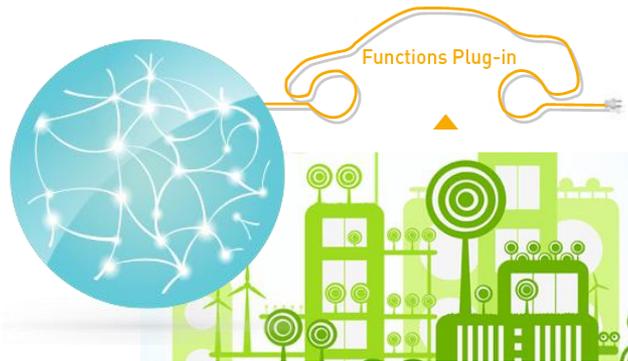
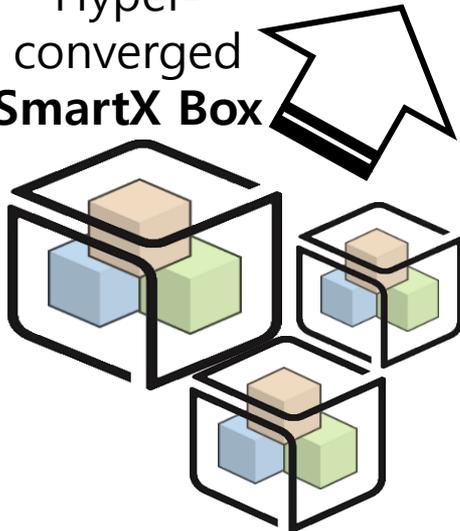
Prepare Programmable & Virtualized Resources with Hyper-converged SmartX Box



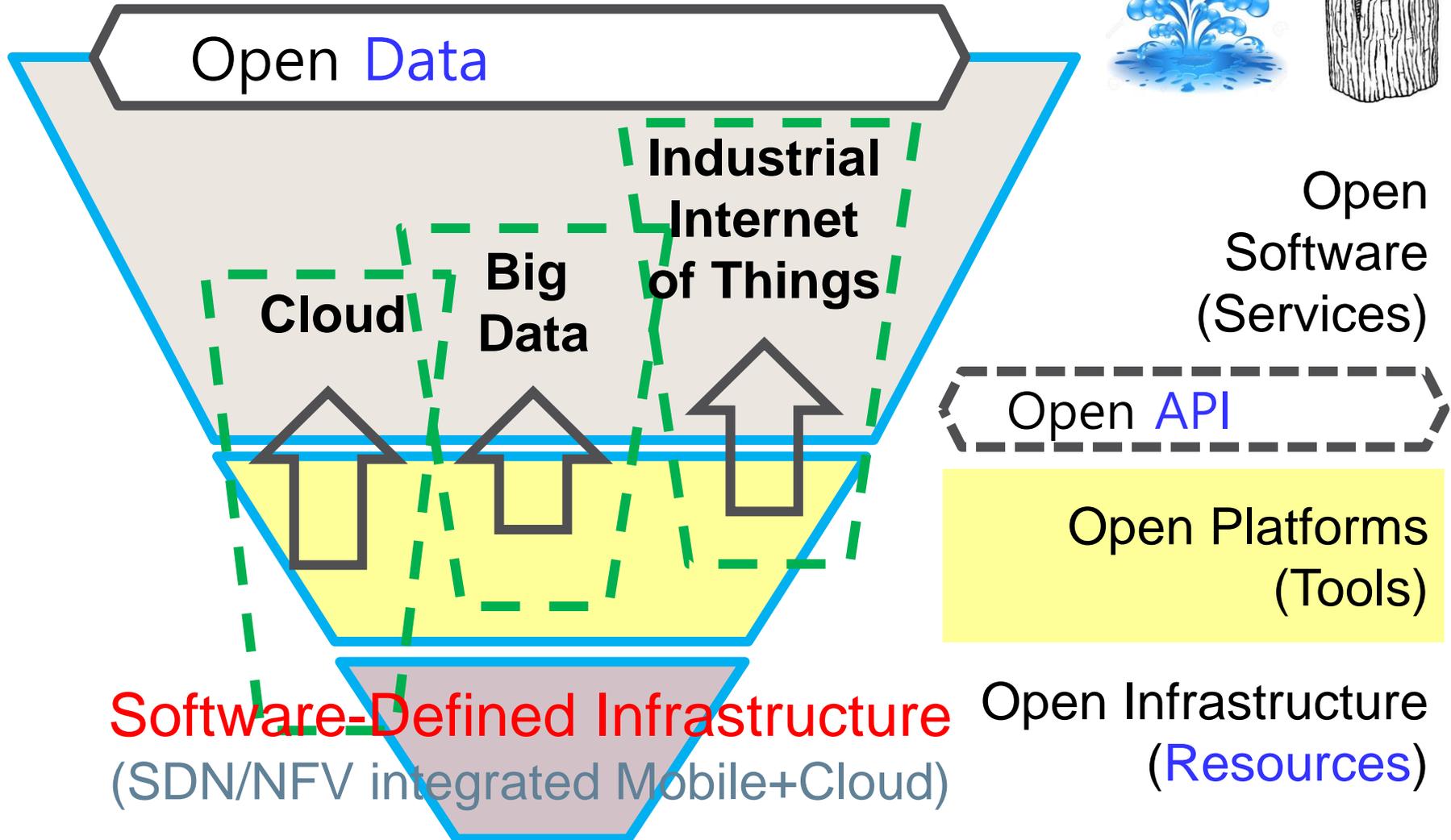
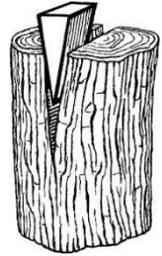
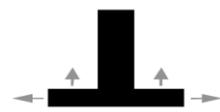
Build **Open APIs** with Inter-connected Functions



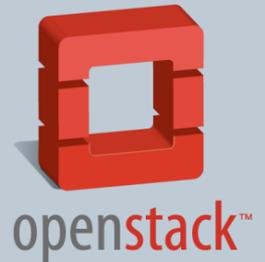
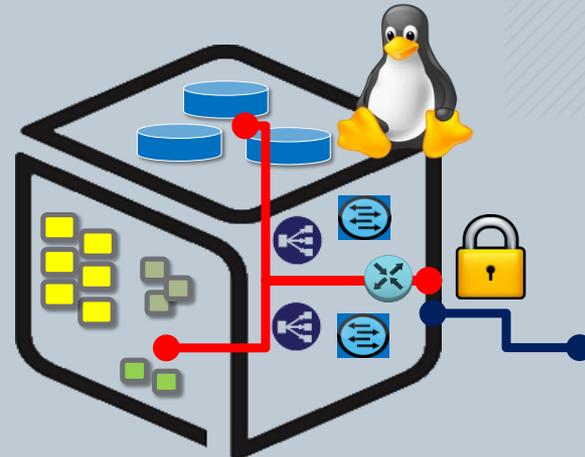
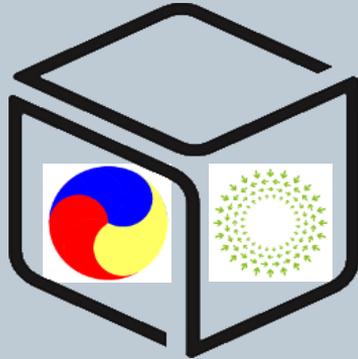
Create Smart Services with **Smart Things, API Tools, and Open Data**



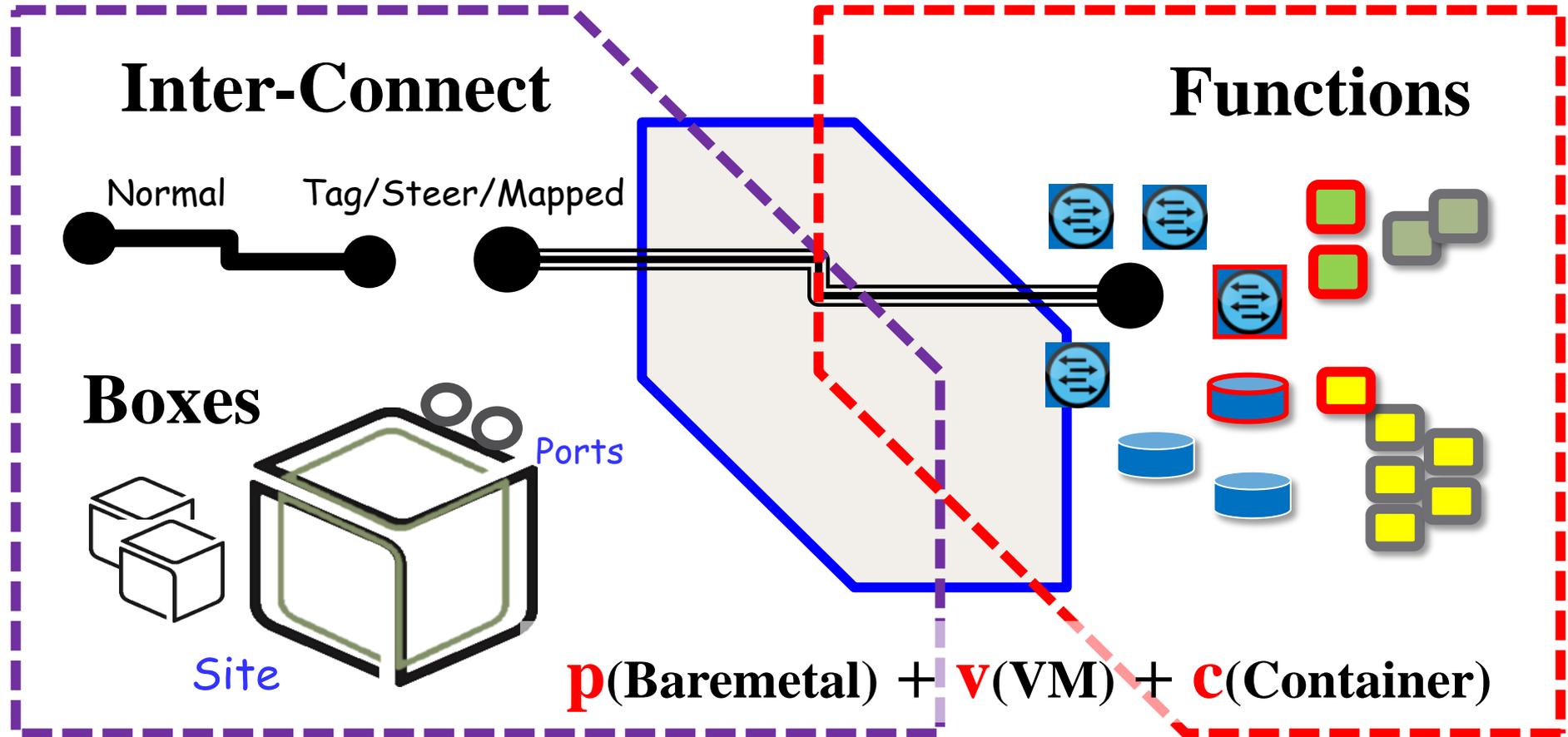
# Human-Defined Services over Software-Defined Infrastructure



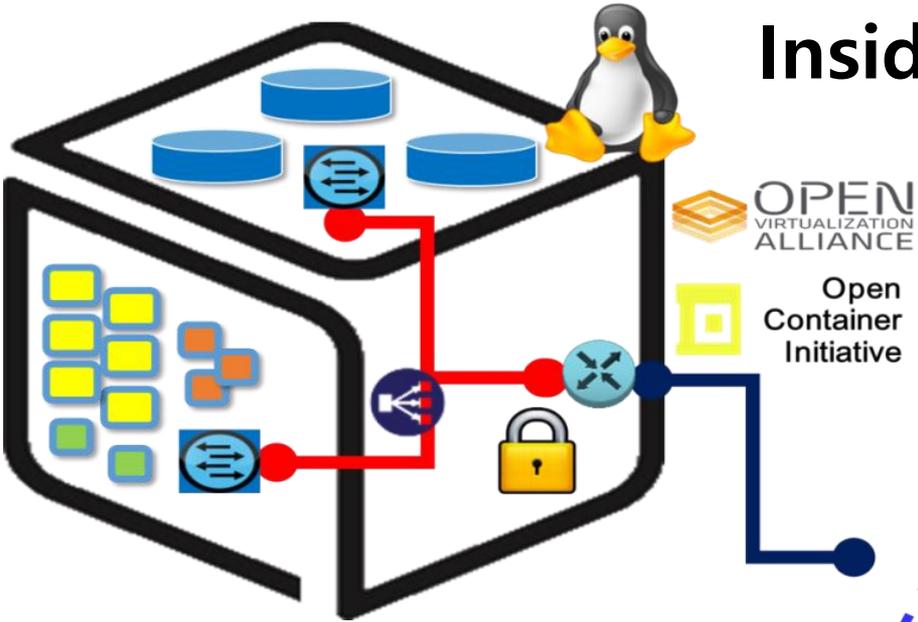
# Open-Source Software/Hardware & SmartX Boxes



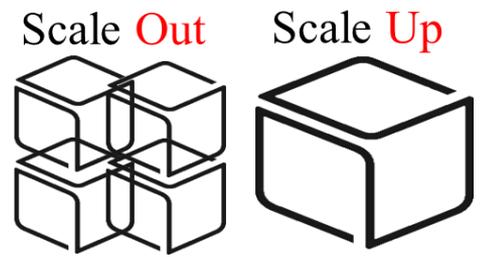
# Inter-Connected Functions (Microservices) inside SmartX Boxes/Sites



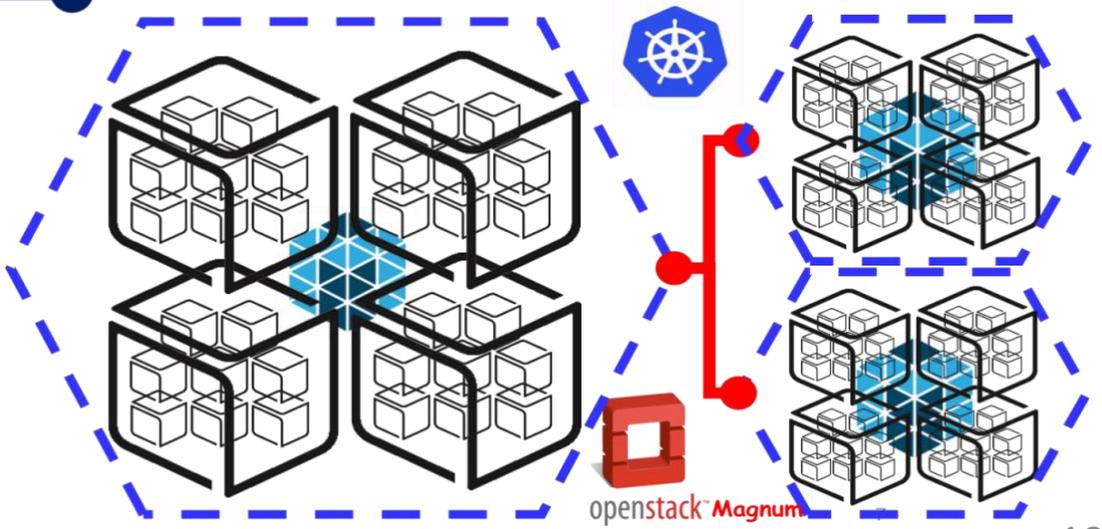
# SmartX Box: Inter-Connected Functions inside/among Boxes/Sites



## Inside a Box



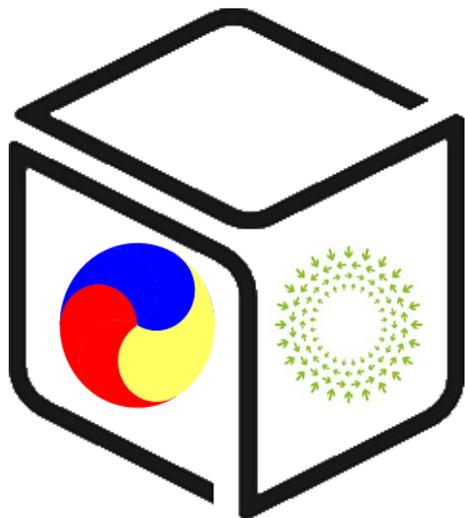
## Across Clusters



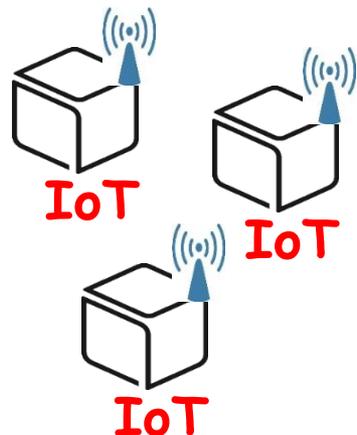
### p+v+c Challenge:

- p**(Baremetal)
- + **v**(VM)
- + **c**(Container)

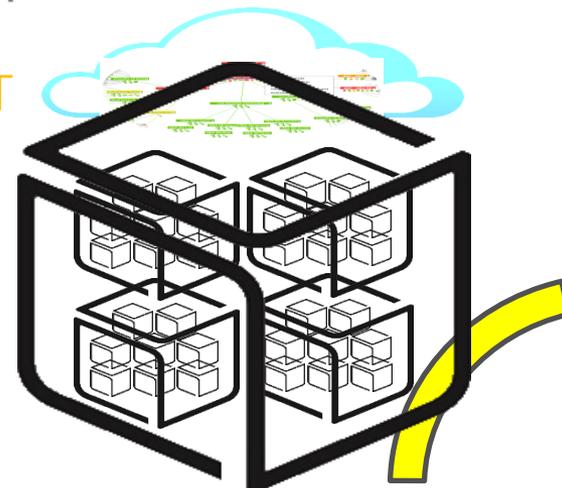
# Convergent SDI & Open-Source Software



OPNFV

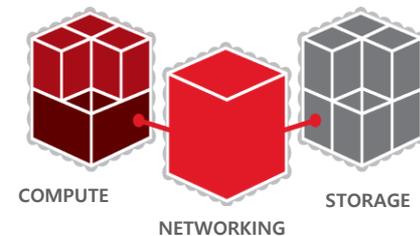


$\mu$ Cloud  
(SDN/NFV/  
FastData)

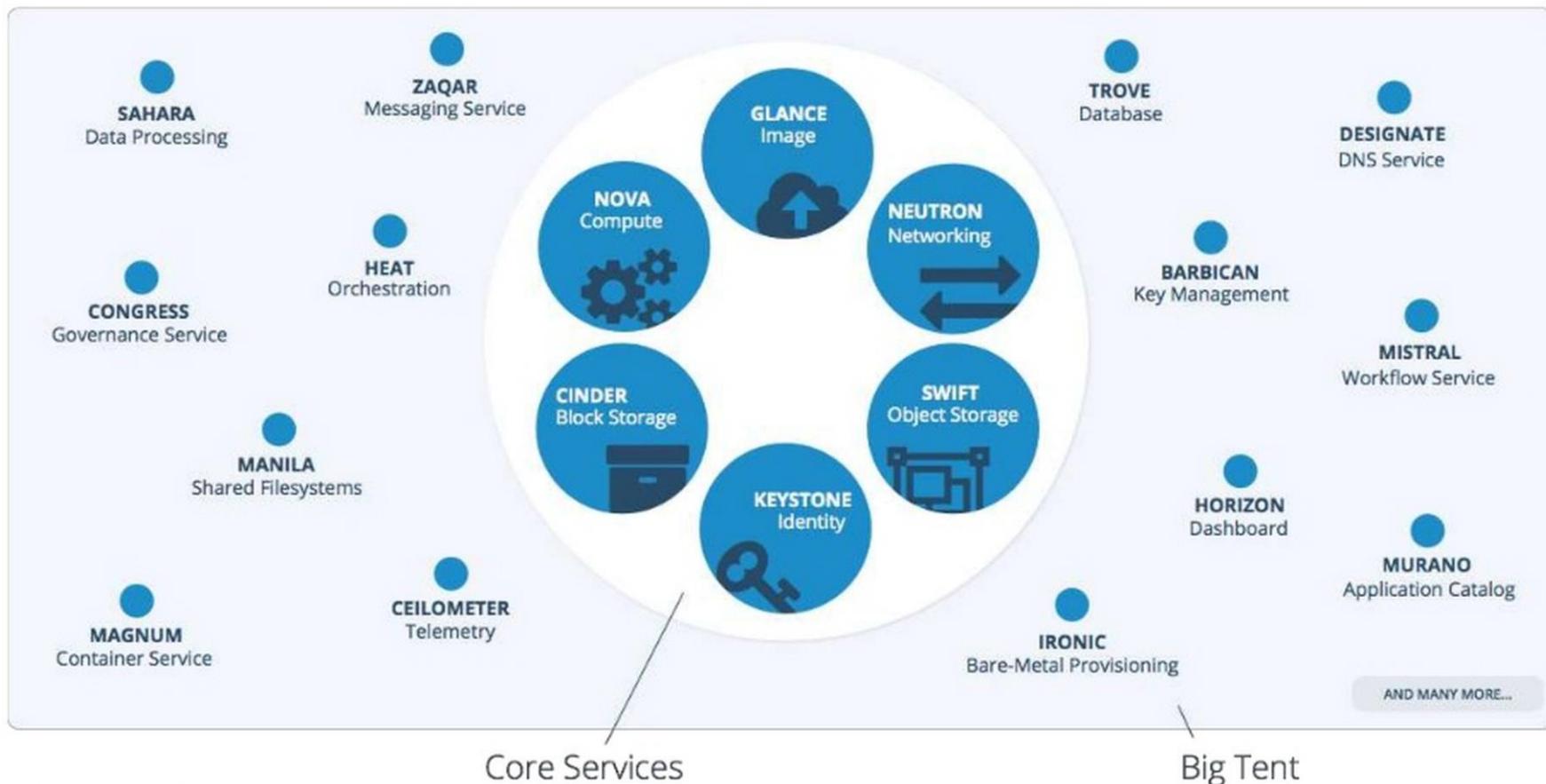


Federated Cloud DCs  
(BigData/HPC)

# Open-Source Cloud OS: OpenStack



## The “big tent” and “core services”



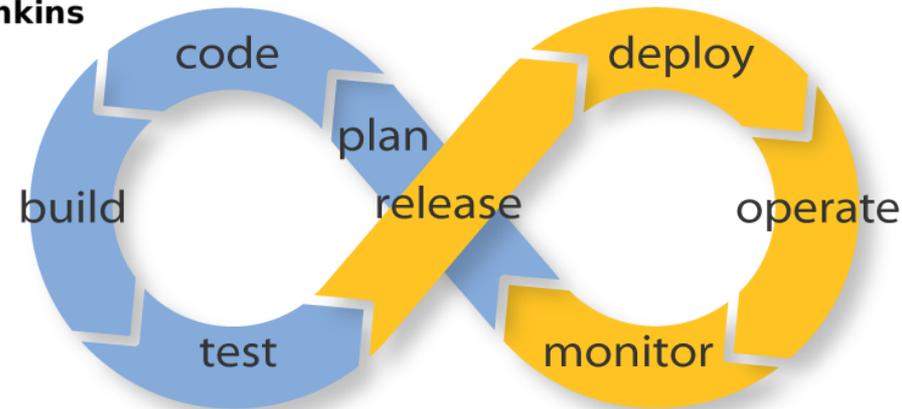
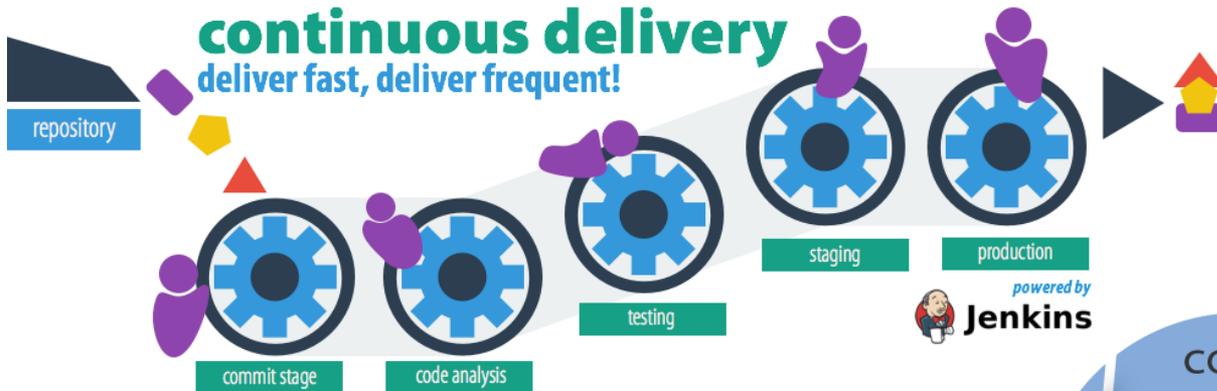
# DevOps Automation & Continuous Integration/Delivery



## DevOps (Development & Operation, 개발운영병행체제)

Building Software-based Automation over Overall Lifecycle:

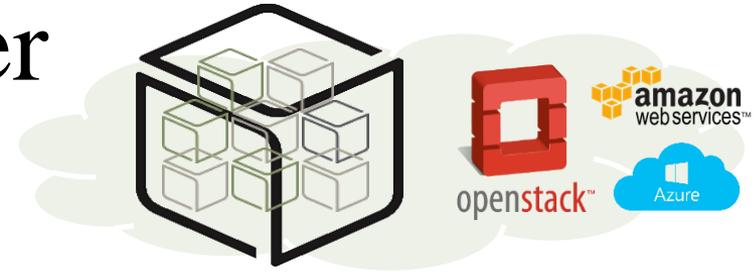
Development (Plan, Code, Build) → Test (QA & Staging) → Production (Deployment, Operation, Evaluation)



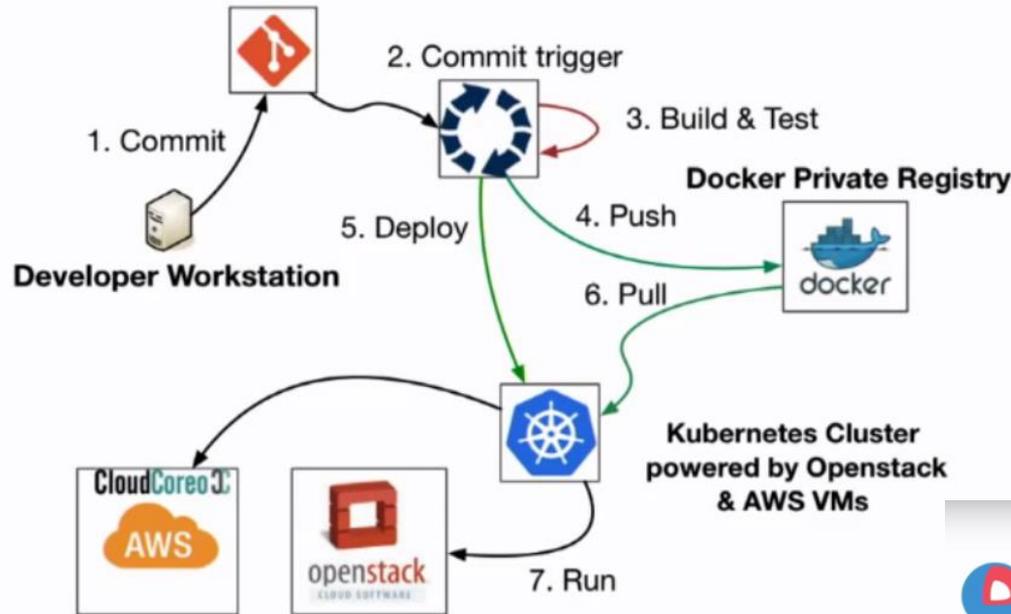
Endless Possibilities: DevOps can create an infinite loop of release and feedback for all your code and deployment targets.

# Container-based Automated Service Deployment over Hybrid Cloud

Composable/Software-Defined Infrastructure

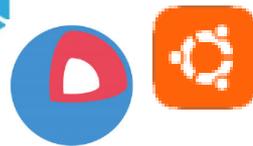
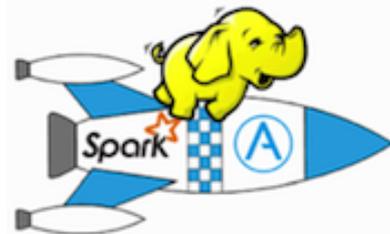
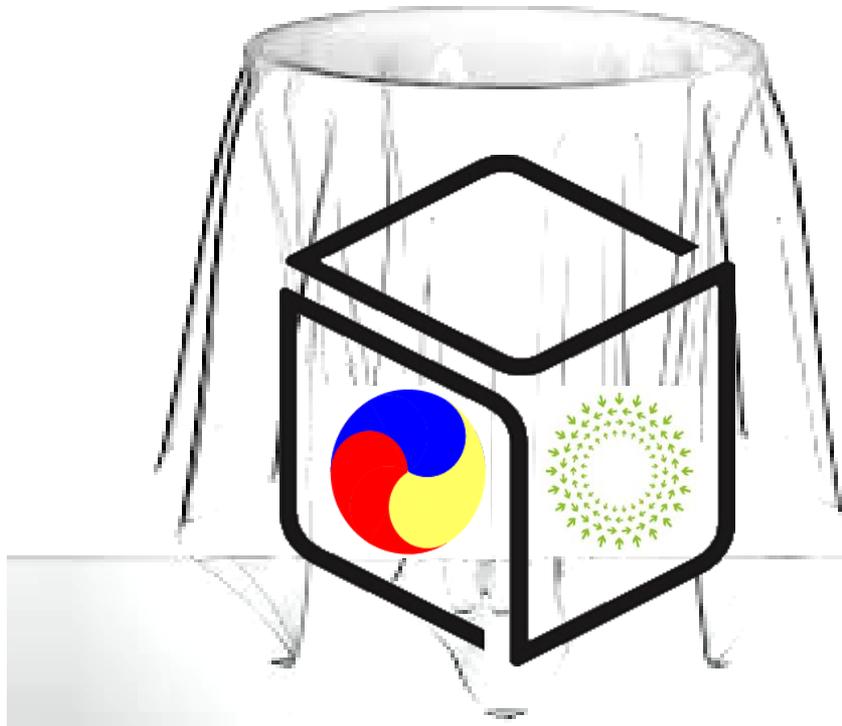
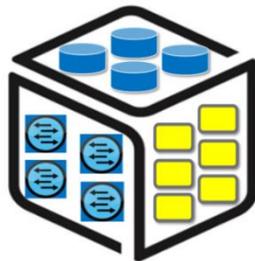


## Microservice Pipeline



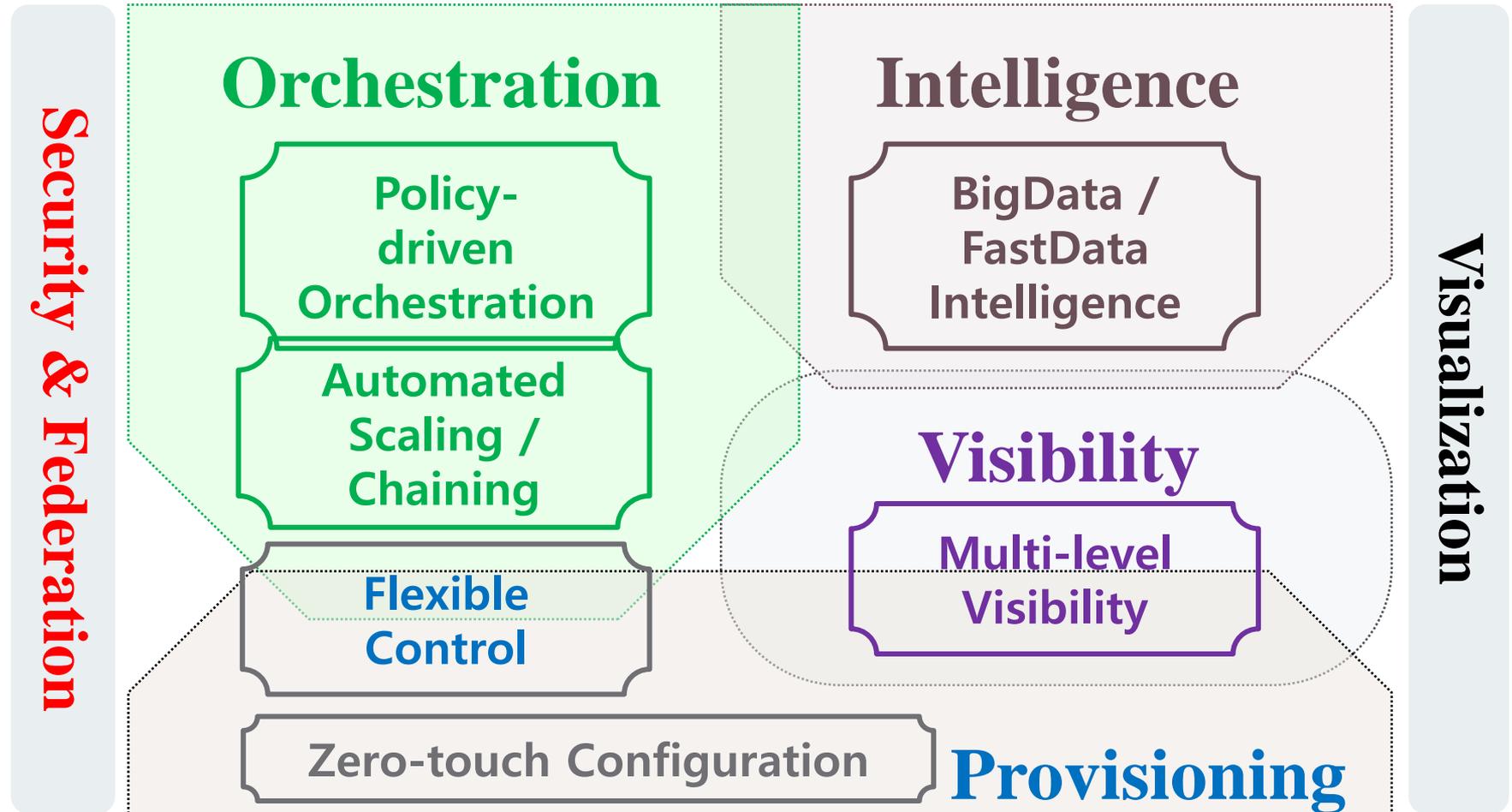
Container-based Orchestration & Dynamic Resource Pooling



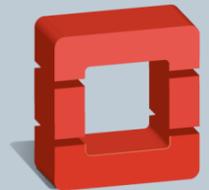


# SmartX Software Framework

## SmartX Automation



# Open Networking Collaboration with SmartX Shared Playground



openstack™

# Open Networking KOREA

***K-ONE***

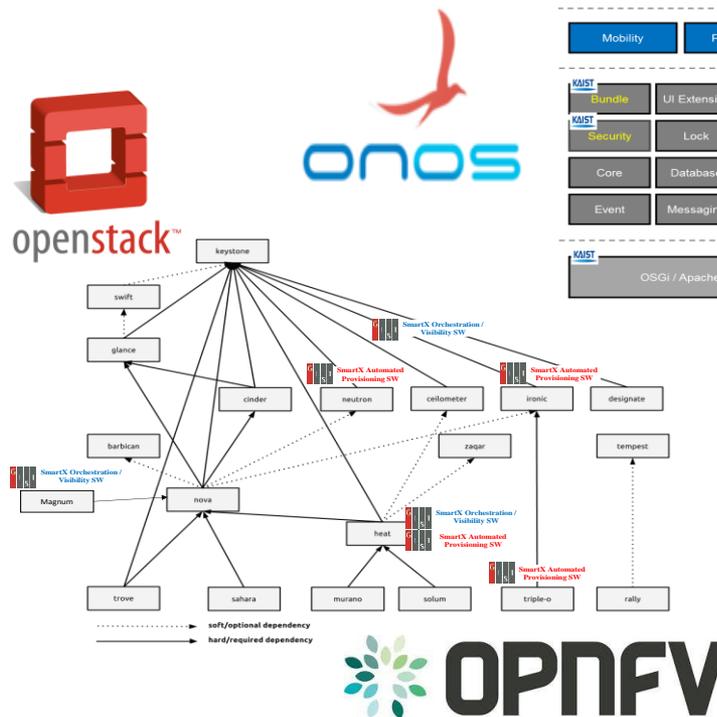
**openwincon**

Single controller for all wired & wireless networks

<http://opennetworking.kr>

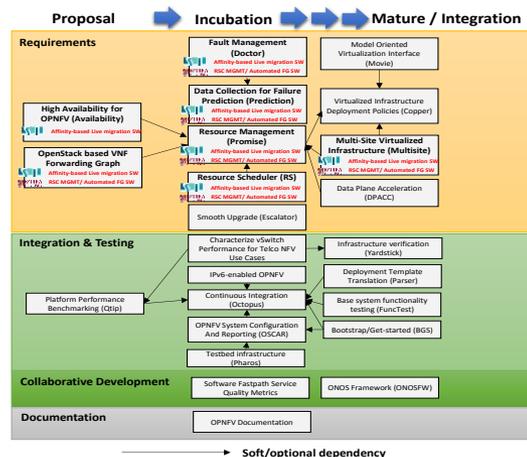
# K-ONE (Korea – Open Networking Everywhere)

SDN/ NFW/  
Cloud 통합  
차세대  
네트워킹  
공개  
소프트웨어  
개발



KAIST	REST API	GUI	KAIST	CLI							
-----											
Mobility											
ProxyARP											
L2 Forwarding											
SDN IP / BGP											
Packet / Optical											
-----											
KAIST	Bundle	UI Extension	Region	Device CFG	Discovery	Network Vrt	Tenant	...			
KAIST	Security	Lock	Leadership	Driver	Path	Tunnel	Intent	Statistics			
Core		Database		Cluster		Mastership		Topology	ONMan	LinkResource	Group
Event		Messaging		Graph		Device		Link	Host	FlowRule	Packet
-----											
KAIST	OSGI / Apache Karaf		OpenFlow	LISP	CAPWAP	MQTT / COAP	OVSD	...			

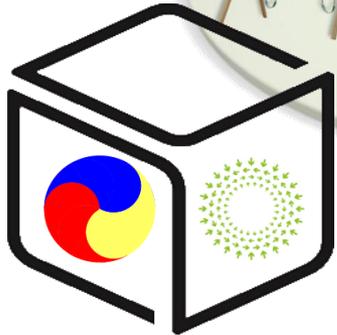
Yellow: K-ONE Proposed



# K-ONE

K-ONE  
공용개발환경

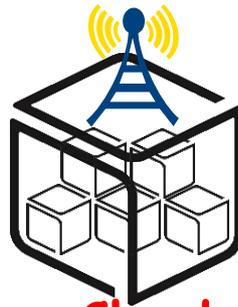
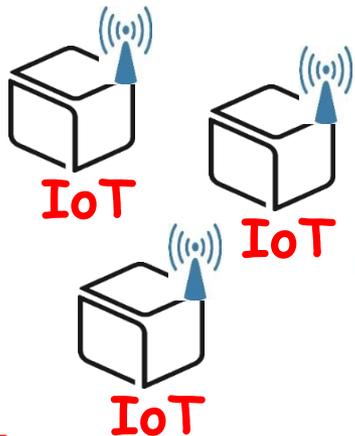
# How to Build and Operate Convergent SDI



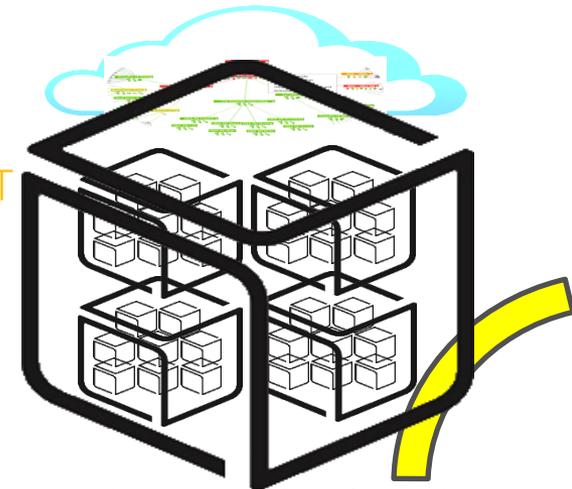
**openwincon**

Single controller for all wired & wireless networks

**K-ONE**

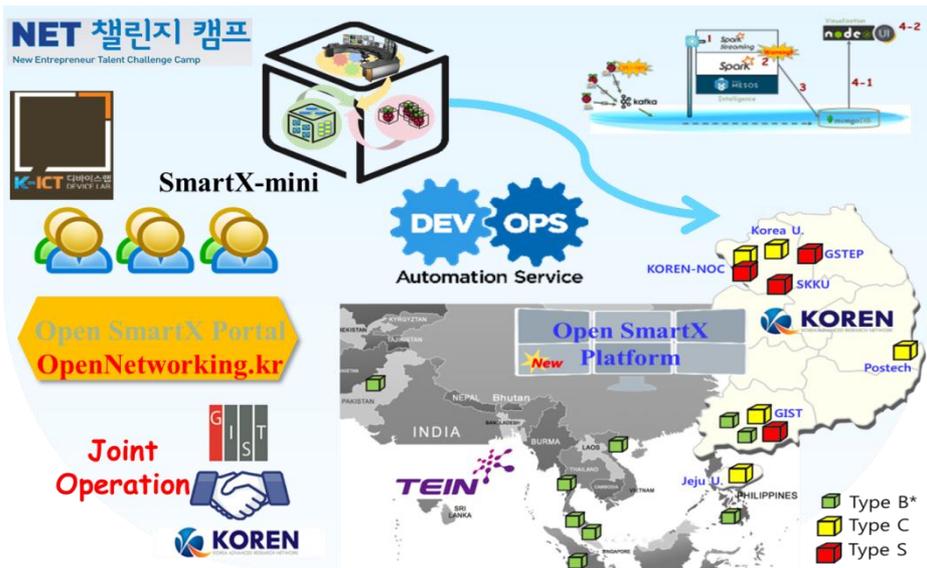


**μCloud  
(SDN/NFV/  
FastData)**

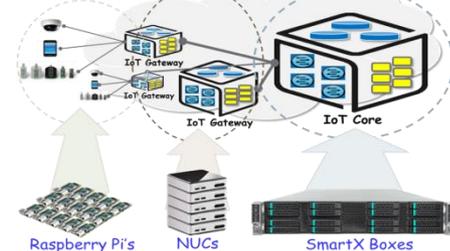
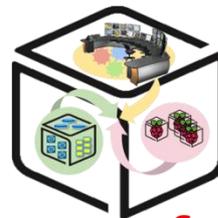
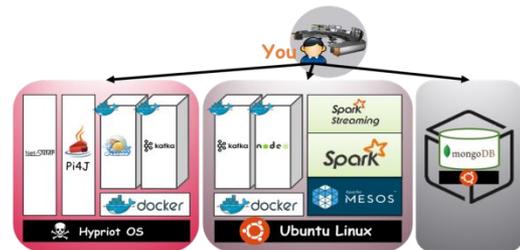


**Federated Cloud DCs  
(BigData/HPC)**

# SmartX Playgrounds & Open SmartX Platform



SmartX  
Playground  
Expansion for  
IoT—Cloud  
(2015~)

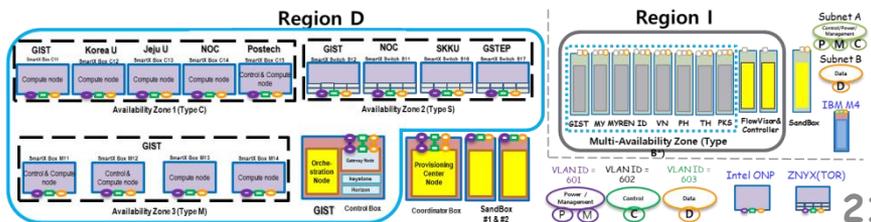
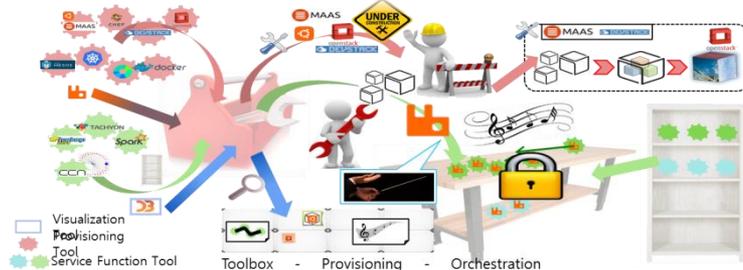
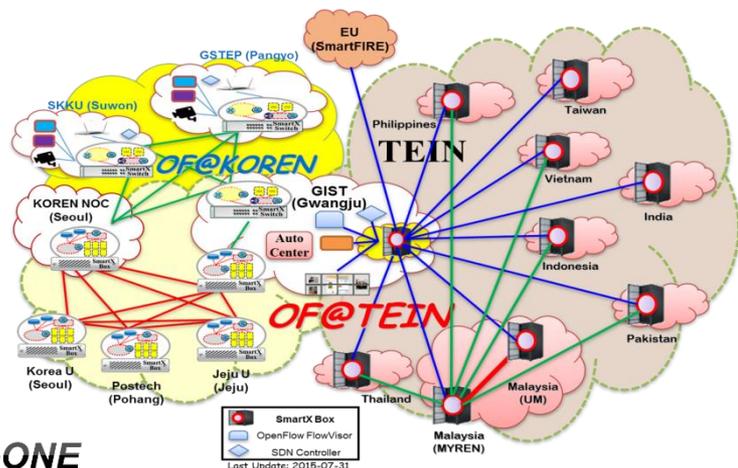


**SmartX & SmartX-mini IoT-Cloud**

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



SmartX Playground & Operation Tower (2012~2015)



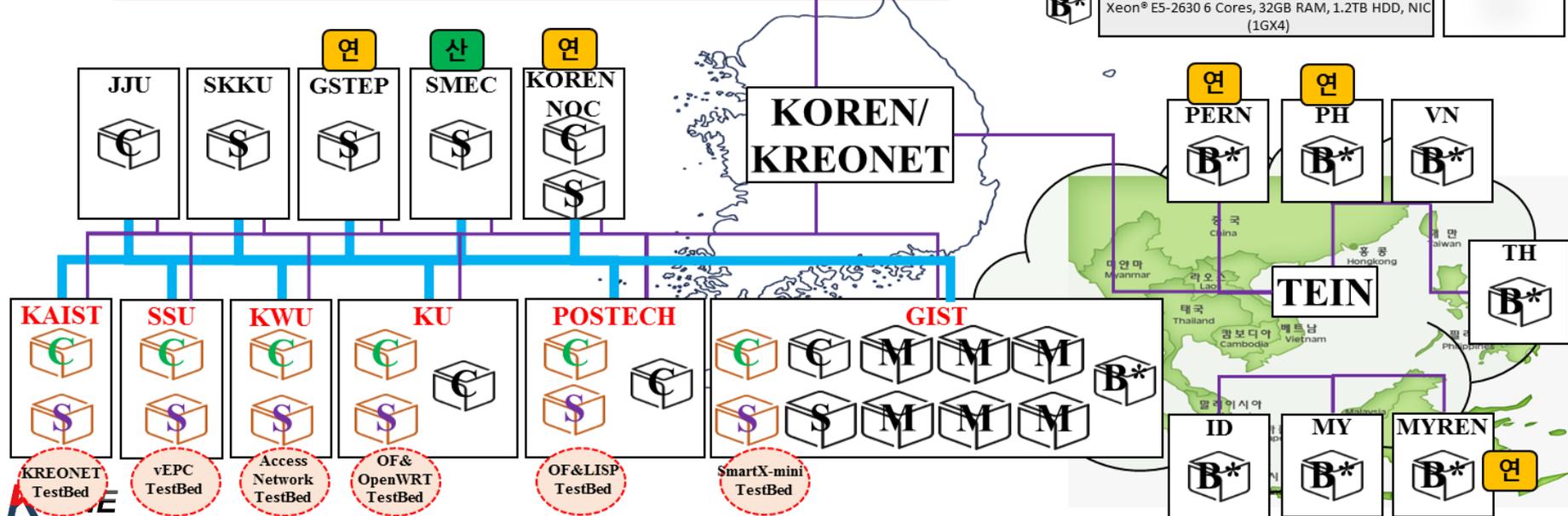
# Open Federated Playground for SDI R&D (2015 Initial Plan)



- 분산 Cloud 환경을 지원하는 ONP Box (SmartX Box Type C)
- Cloud 스토리지 실증을 위한 ONP Box (SmartX Box Type M)
- SDN/NFV에 대응되는 Znyx Server-Switch (SmartX Box Type S)
- SDN-Cloud 실증을 지원하는 IBM Box (SmartX Box Type B\*)

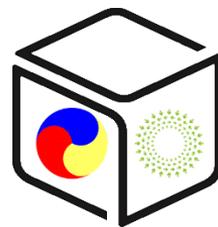


SmartX Box HW		Legend
	<b>ONP Box (High-Power Cloud)</b> Xeon® E5-2690 v2 20 cores, 96GB RAM, 1.3TB SSD, 3TB HDD, NIC(10GX2, 1G X4)	
	<b>ONP Box (Cloud Storage)</b> Xeon® E5-2650 v3 20 cores, 128GB RAM, 120GB SSD, 8 TB HDD, NIC(10GX2, 1GX4)	
	<b>Server-Switch Box (SDN/NFV)</b> ATOM C2558 4 Cores(Sw)/Xeon® E5-2600 v2 16 Cores(Server), 40GB RAM, Ports(10G X 24, 40G X 4)	
	<b>IBM Box (SDN-Cloud)</b> Xeon® E5-2630 6 Cores, 32GB RAM, 1.2TB HDD, NIC (1GX4)	

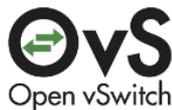


# K-Cluster Concept Design (2016. 01 - v0.1)

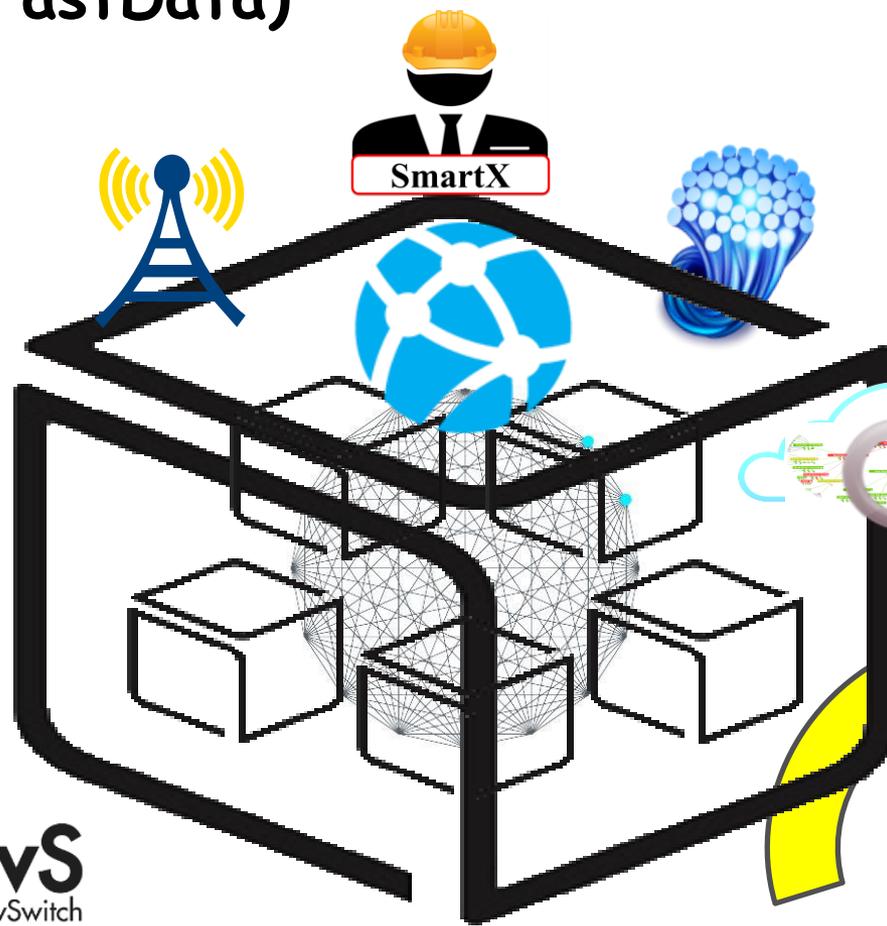
## Federated $\mu$ Clouds (SDN/NFV/FastData)



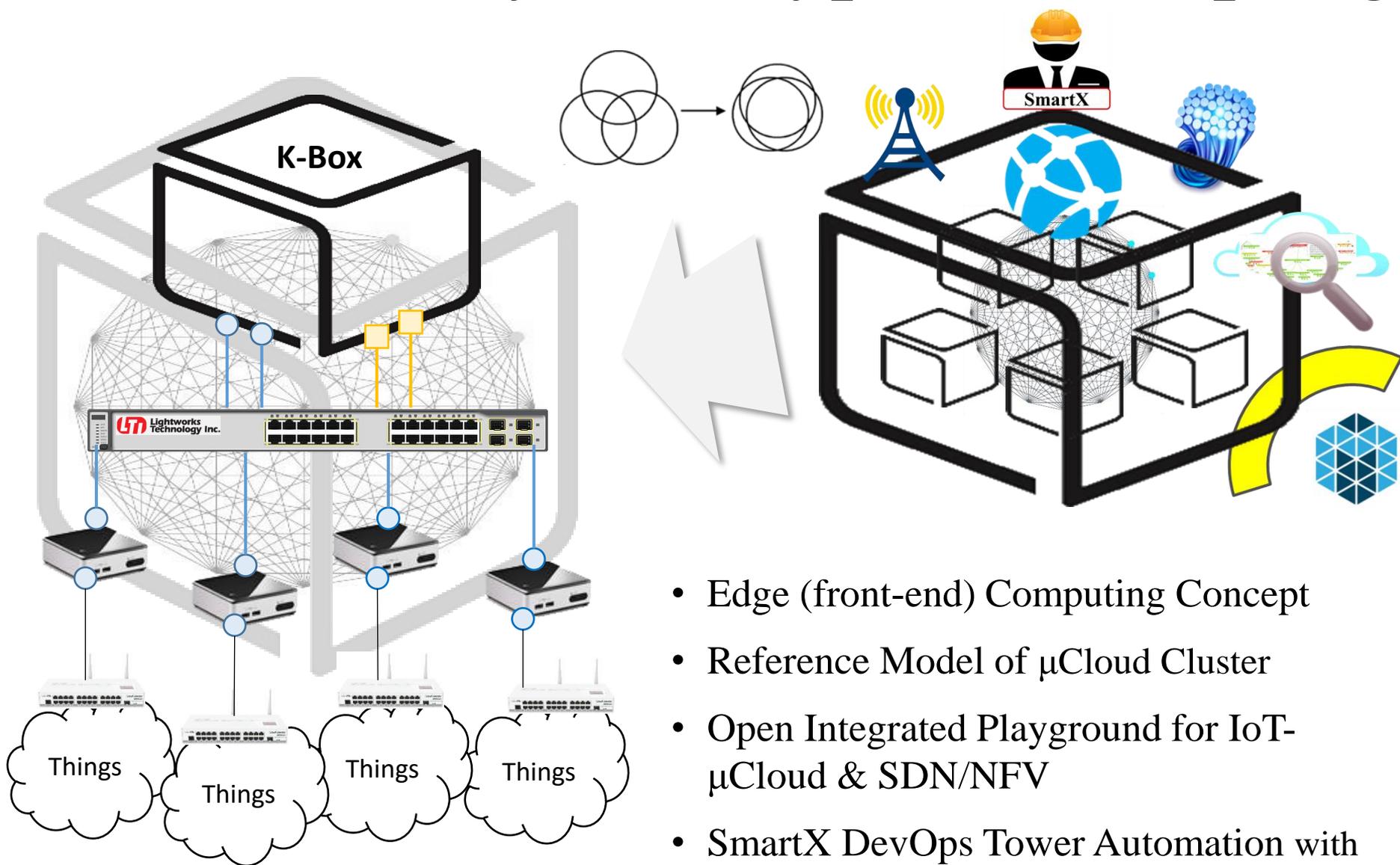
**K-ONE**  
**OF@TEIN**



**K-ONE**

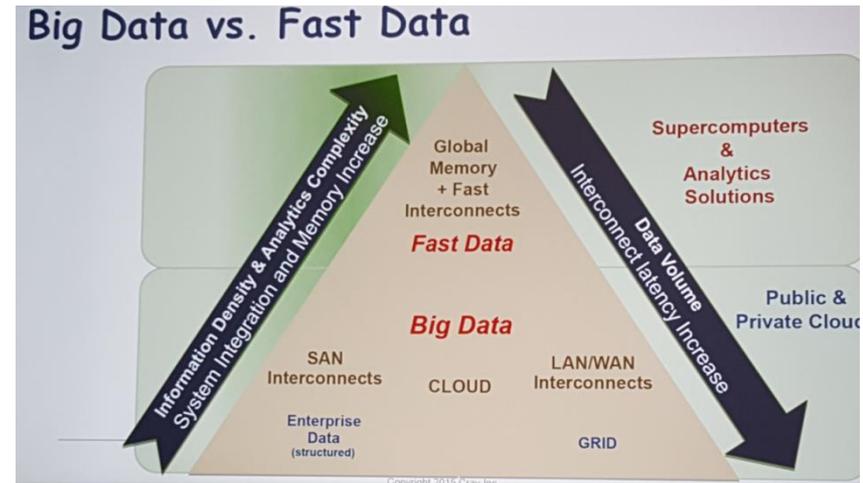


# K-Cluster Early Prototype (2016 Spring)



- Edge (front-end) Computing Concept
- Reference Model of  $\mu$ Cloud Cluster
- Open Integrated Playground for IoT- $\mu$ Cloud & SDN/NFV
- SmartX DevOps Tower Automation with Provisioning / Visibility / Orchestration / Intelligence

# SmartX IoT—Cloud Services with FastData/BigData Analytics



## BigData Predictive Analytics

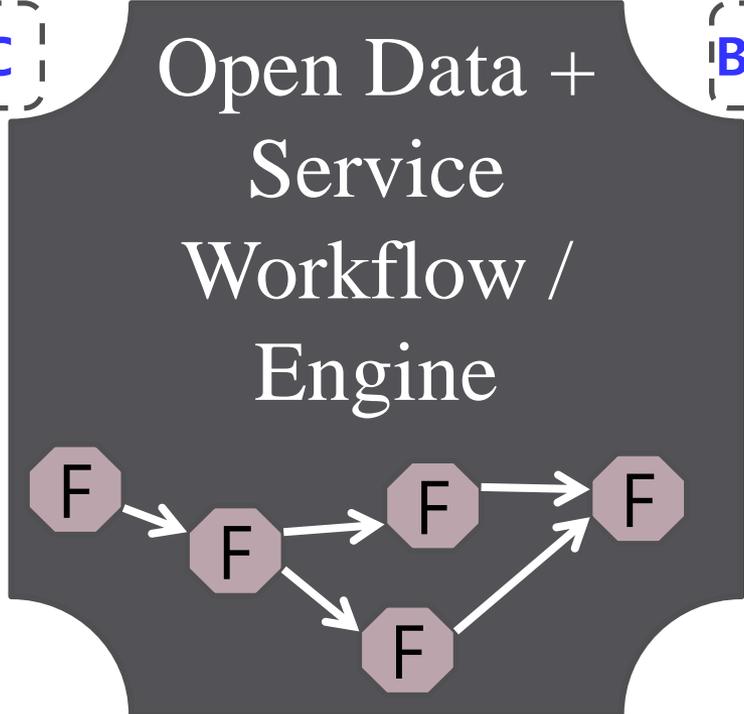


# SmartX Services with Open Data & Lifecycle Orchestration

**F** Functions = MicroServices

Super Comp. → HPC

BigData ← Cloud Comp.



**Numerically-intensive with Math Models**  
(Modeling & Simulation with Mathematical Equations)

**Data-Intensive with Data Models**  
(Data-driven Analysis for Knowledge and Insights)

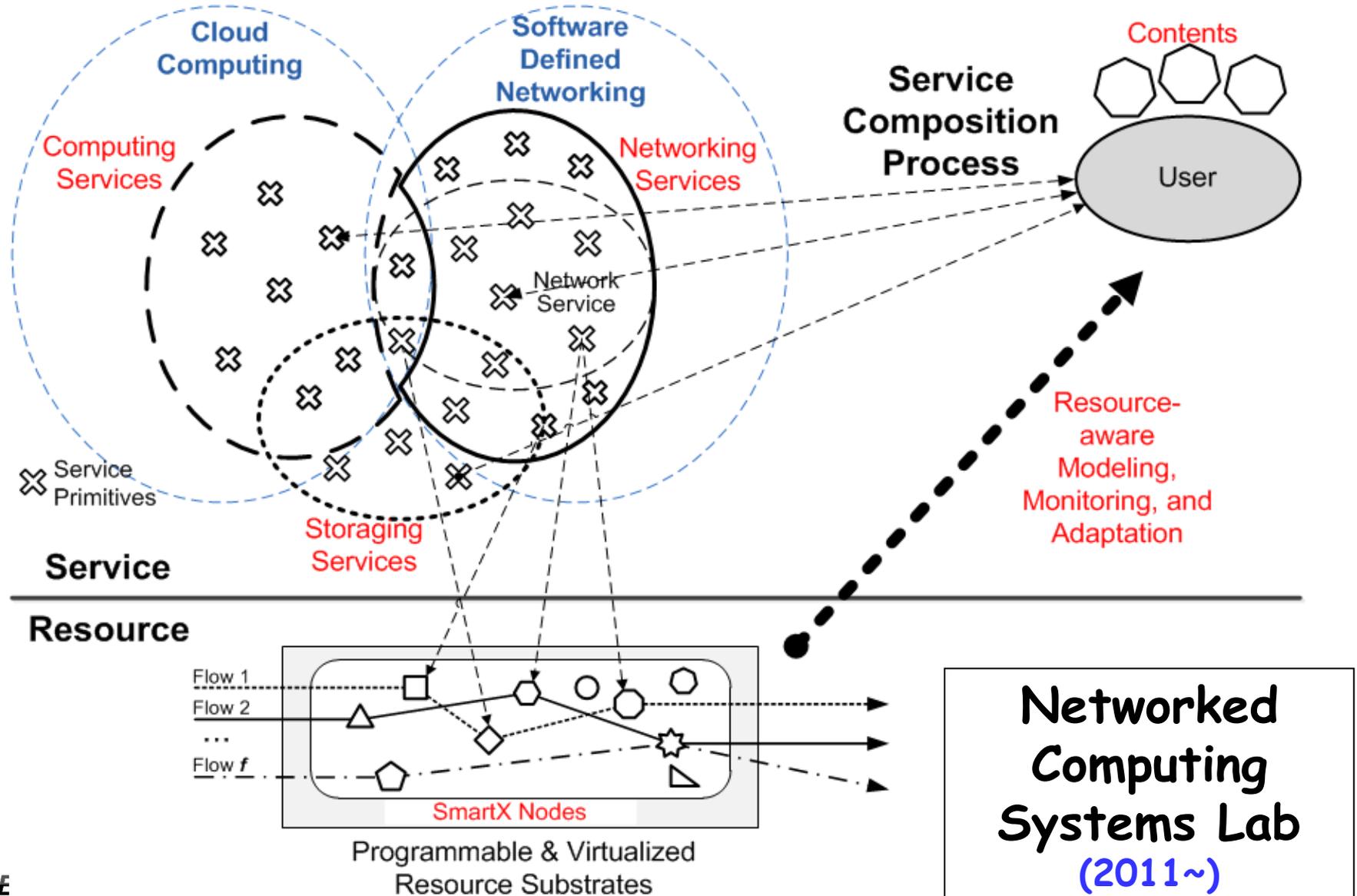
Compute Data

Store Data

Analyze Data

Inter-Connect (Move) Data

# Balanced Service Composition based on Programmable (and Virtualized) Resources





Gwangju Institute of  
Science & Technology



*Thank you!*

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