

# Playing with IoT-Cloud Services with SmartX Labs & Playground

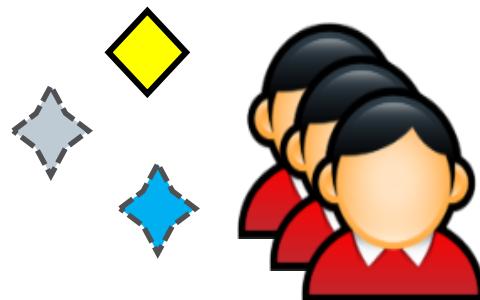
**K-ICT NET Challenge Camp 2016  
(Season 3)**

Dr. JongWon Kim

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

# IoT-Cloud Services for Software-Defined Economy

**Diversified Human-Defined Services**



**Cloud Platforms**

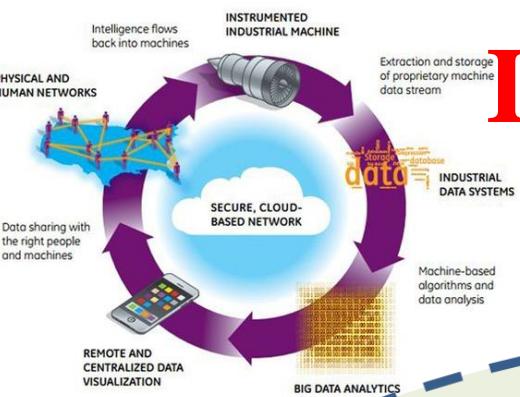
(SDN/NFV +  
BigData/FastData  
Intelligence + ...)



**IoT  
Platforms**  
Mobile SmartX Things

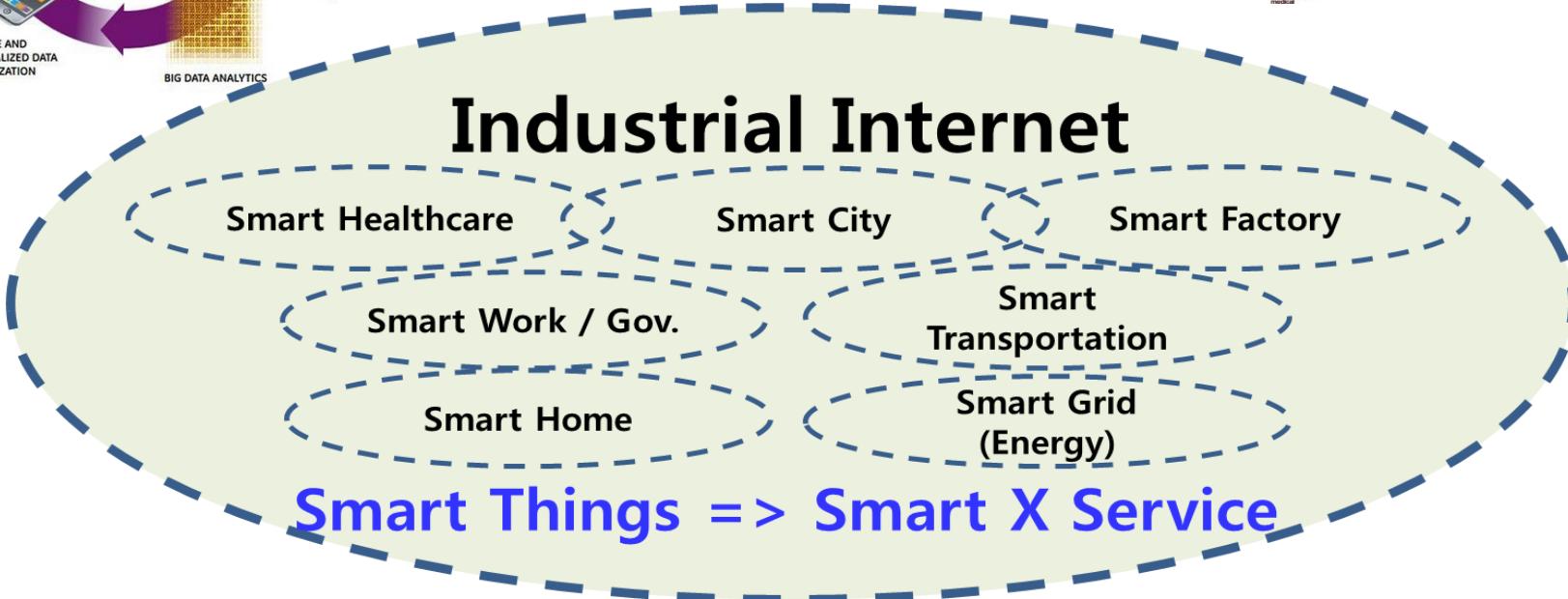


**Convergent Software-Defined  
Infrastructure**



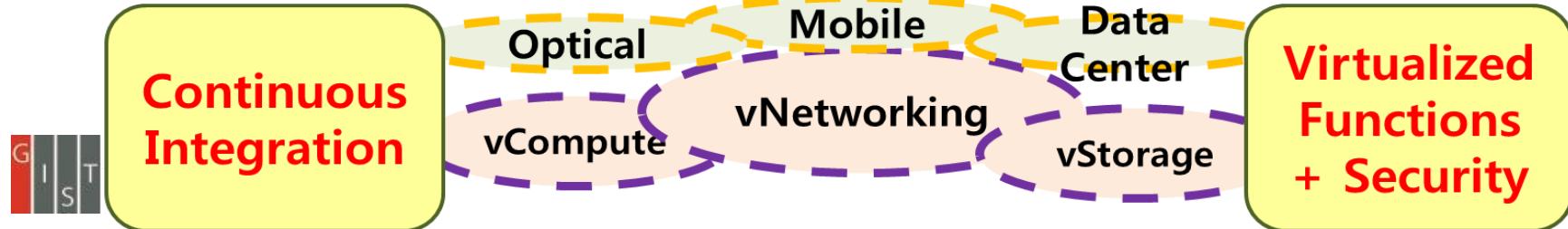
# Industrial Internet of Things (I<sup>2</sup>oT)

Industrial data analysis is revolutionizing various sectors, from healthcare and energy to manufacturing and logistics. By leveraging big data and advanced analytics, organizations can gain valuable insights into operational efficiency, customer behavior, and market trends. This shift is driven by increasing sensor data collection and the need for real-time decision-making. Key technologies like machine learning, blockchain, and AI are playing a crucial role in this transformation, promising to create more sustainable and competitive industries.

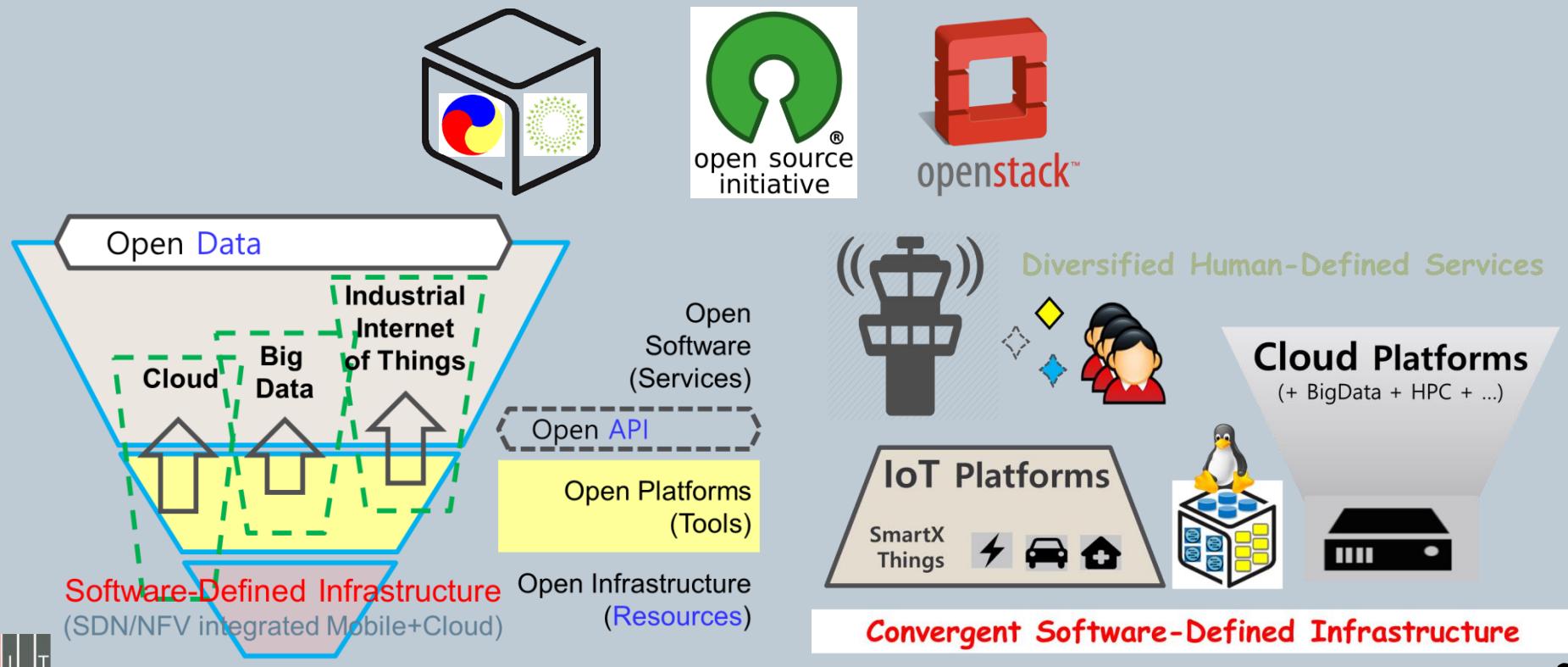


# Platform Challenges for Reliable, Safe, Agile, and Economic Services

# Open, Software-Defined, Virtualized **BIG** Cloud Machines

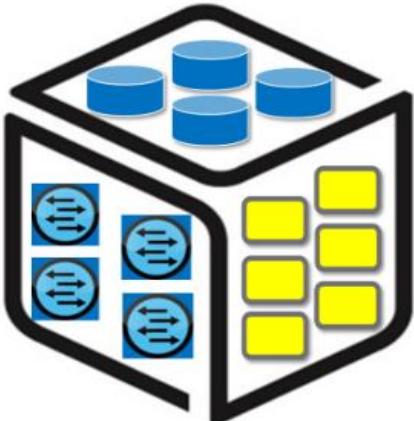


# IoT-Cloud Services over Hyper-convergent Software-Defined Infrastructure



# Realize SmartX Services with Open APIs enabled by SmartX Boxes

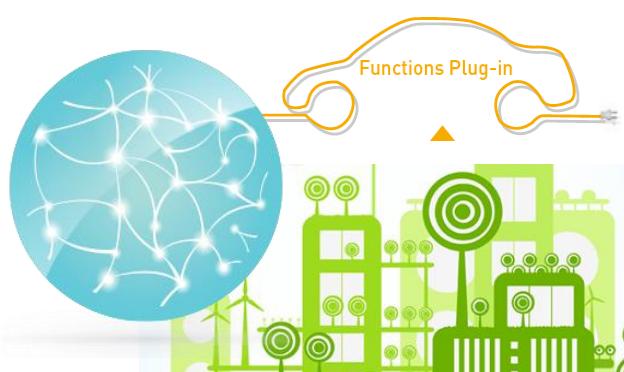
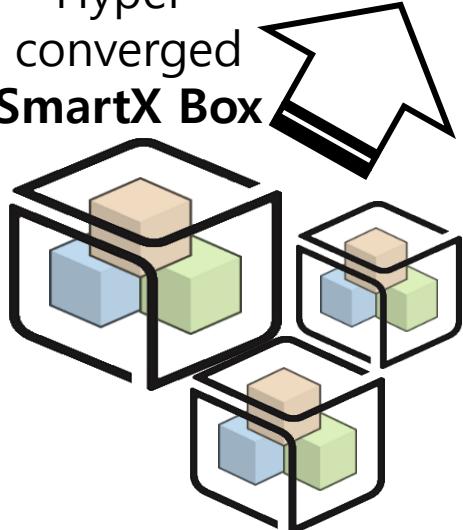
Prepare  
Programmable  
& Virtualized  
Resources with  
Hyper-  
converged  
**SmartX Box**



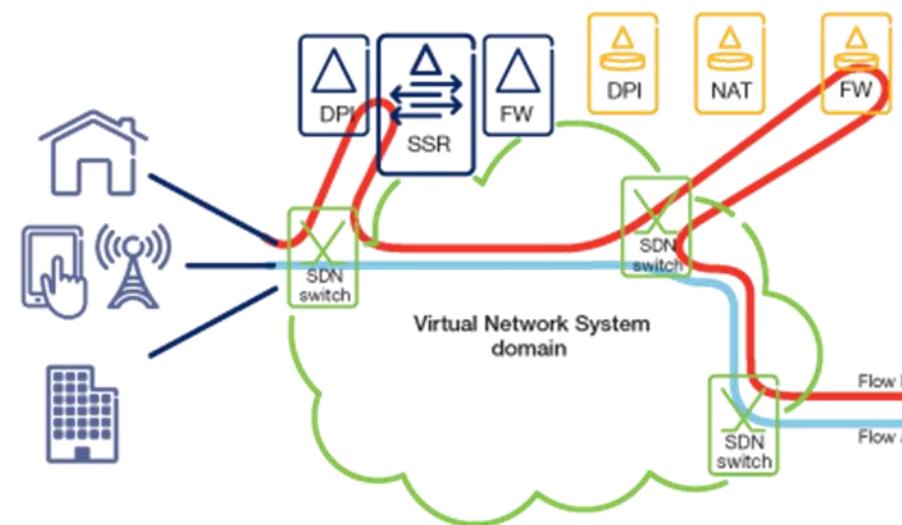
# Build Open APIs with Inter-connected Functions



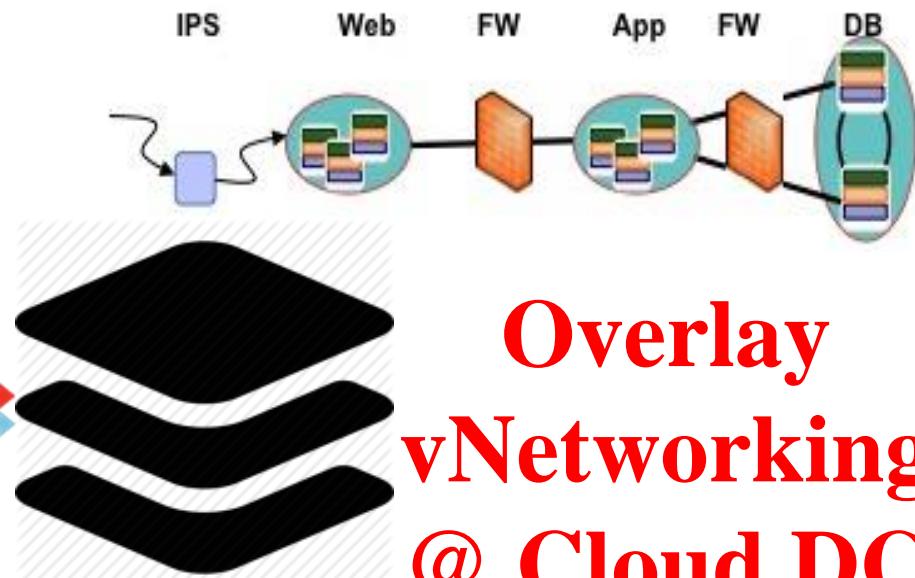
# Create Smart Services with **Smart Things,** **API Tools,** and **Open Data**



# End-to-end Inter-connections (via Flows) for Diverse IoT--Cloud Services



**Flow Steering @ Edge**

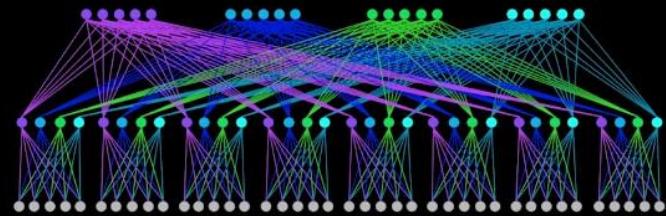


**Overlay  
vNetworking  
@ Cloud DC**



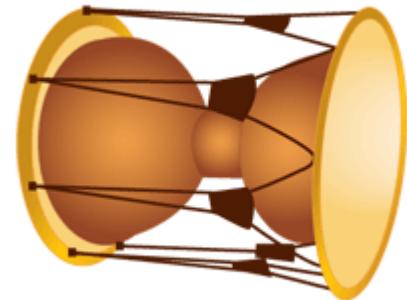
**Flow Tag/Steer/Map**

**The Fabric:** datacenter-wide performance

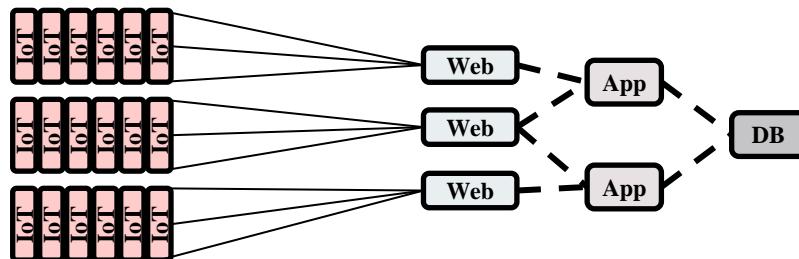


- highly scalable
- smaller units
- all 40G links
- IPv4 + IPv6
- 1 protocol: BGP
- software-driven

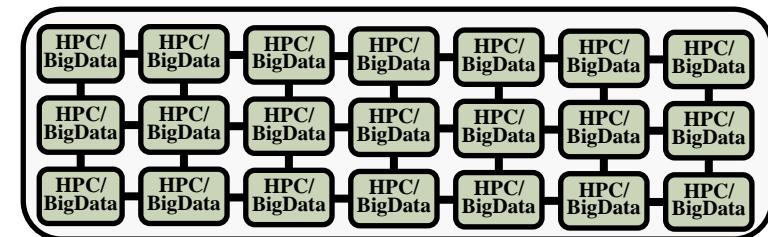
# Diversified Services built with Inter-Connected Functions



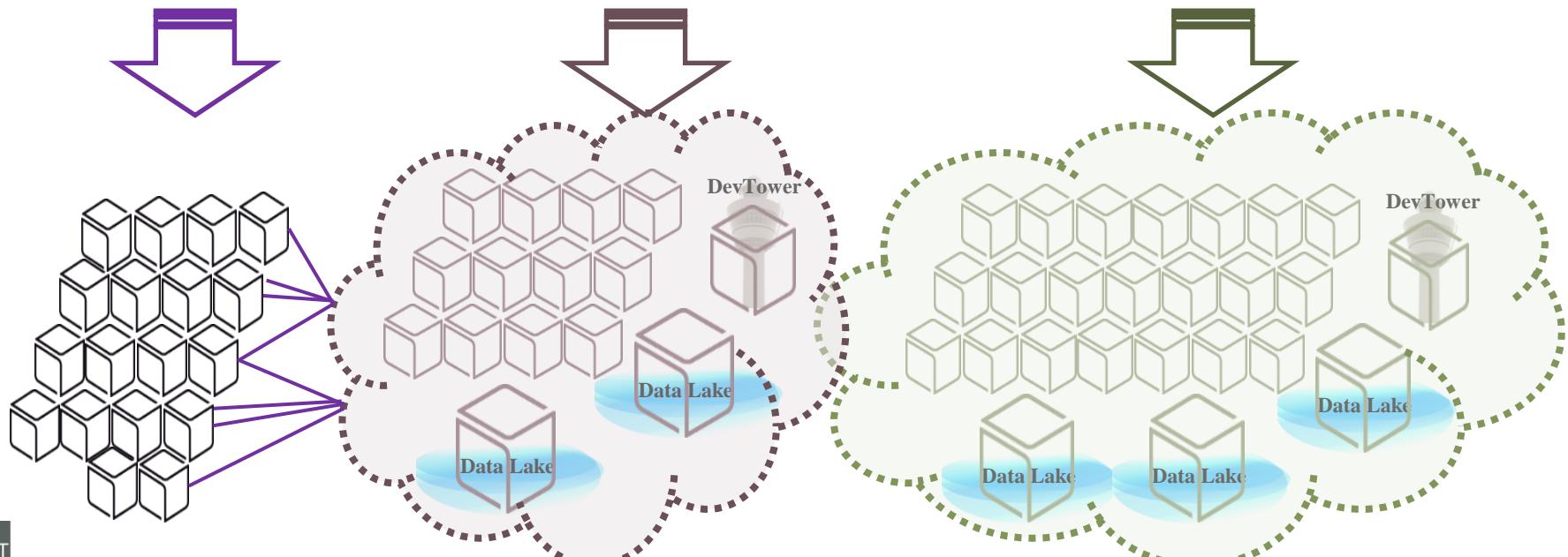
IoT-----Cloud



Web-App-DB 3-tier

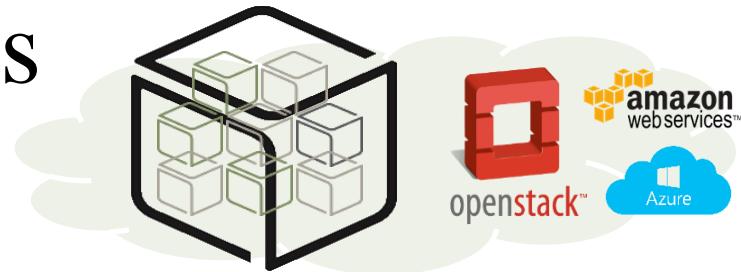


HPC/BigData Cluster

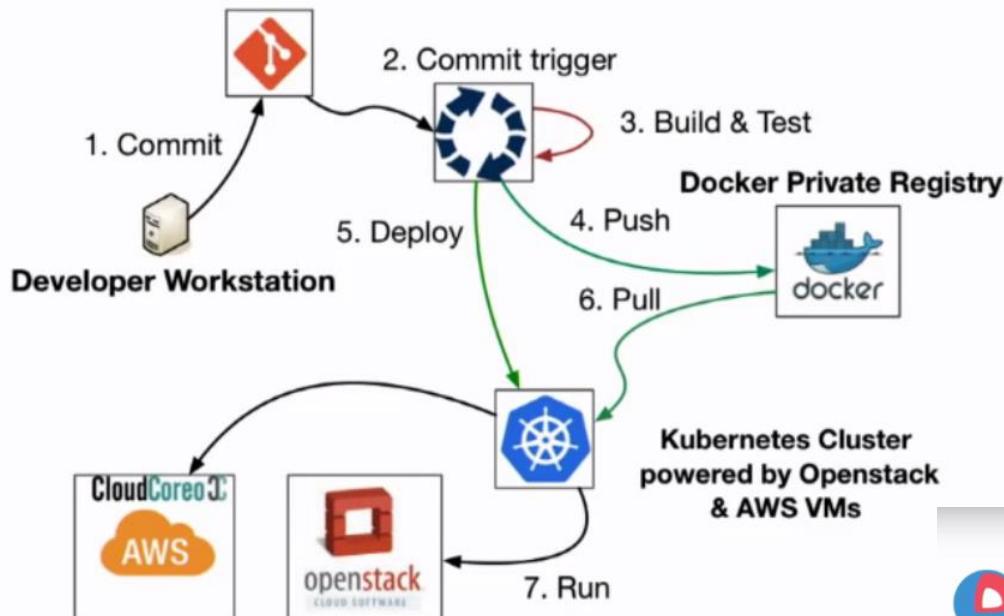


# Automated Deployment of Container-based Services over Hybrid Cloud

Composable/Software-Defined Infrastructure



## Microservice Pipeline



Kubernetes Cluster  
powered by Openstack & AWS VMs



Container-based Orchestration & Dynamic Resource Pooling

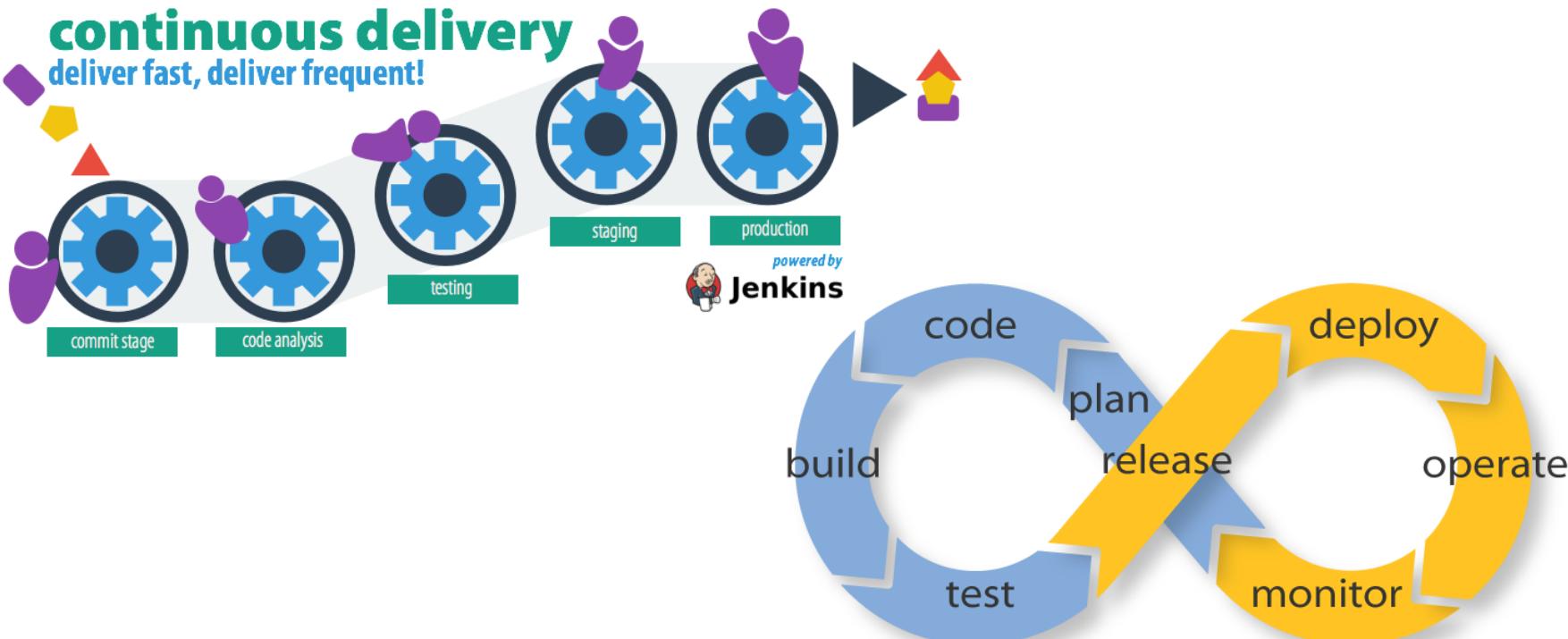
# DevOps Automation & Continuous Integration/Delivery



## 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.

# SmartX Software Framework

## SmartX Automation

Security & Federation

### Orchestration

Policy-driven  
Orchestration

Automated  
Scaling /  
Chaining

Flexible  
Control

Zero-touch Configuration

### Intelligence

BigData /  
FastData  
Intelligence

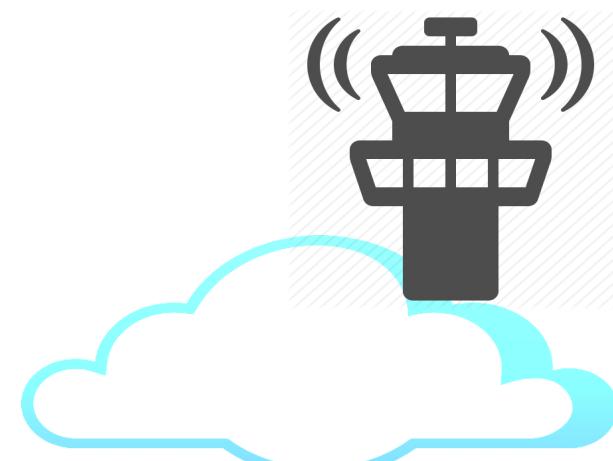
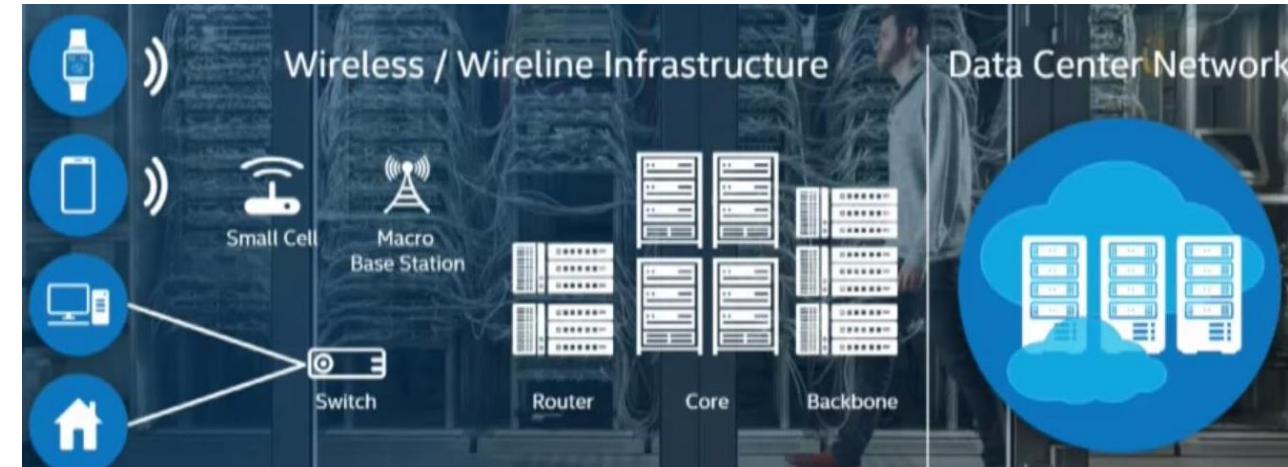
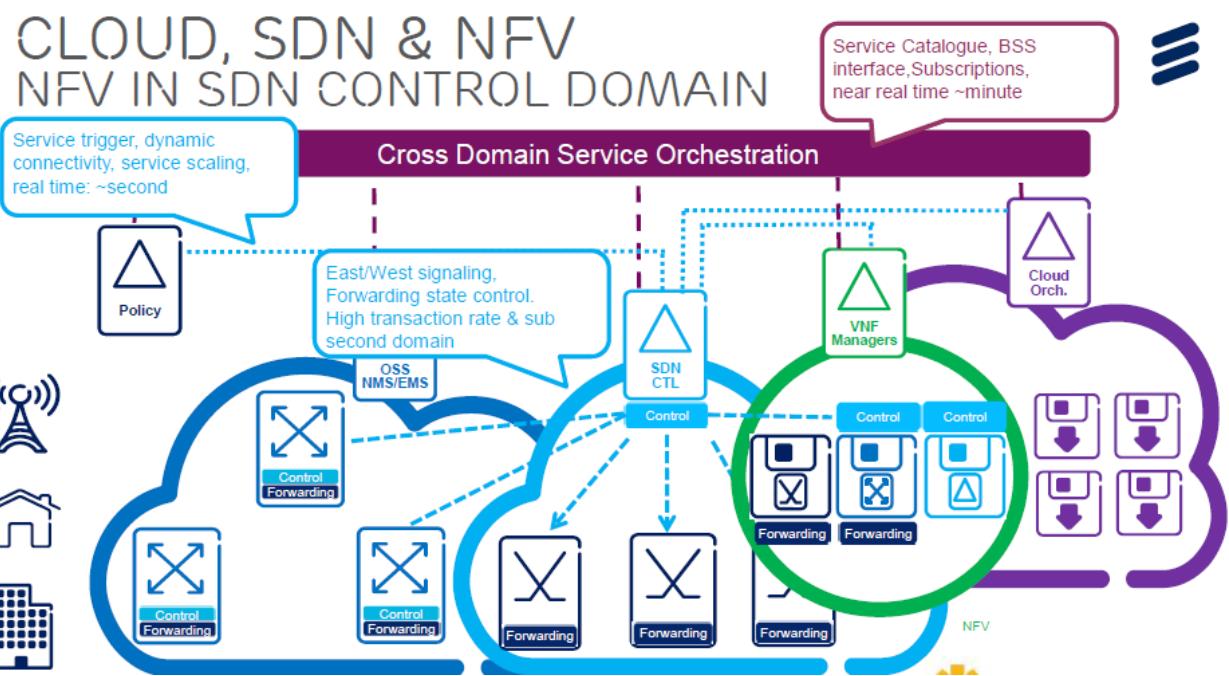
### Visibility

Multi-level  
Visibility

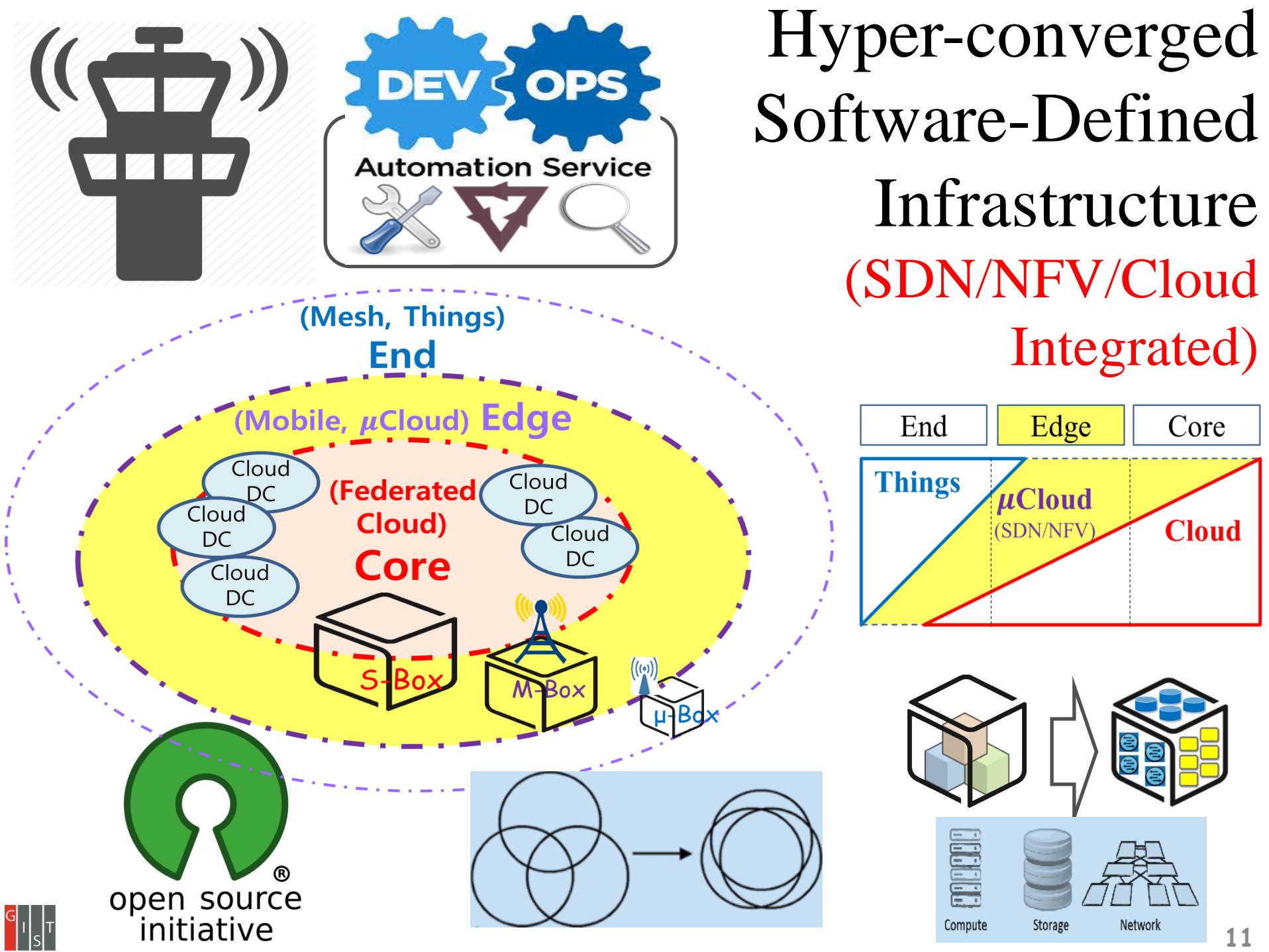
### Provisioning

Visualization

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

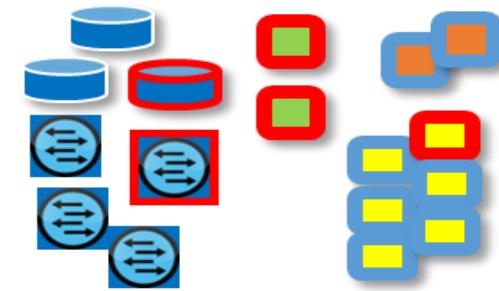


- **Amazon AWS / Microsoft Azure / Google Cloud Engine**
- **OpenStack (IBM, Oracle, RackSpace, HP, Cisco, AT&T, Verizon, NTT, ...)**
- **VMware Hybrid**

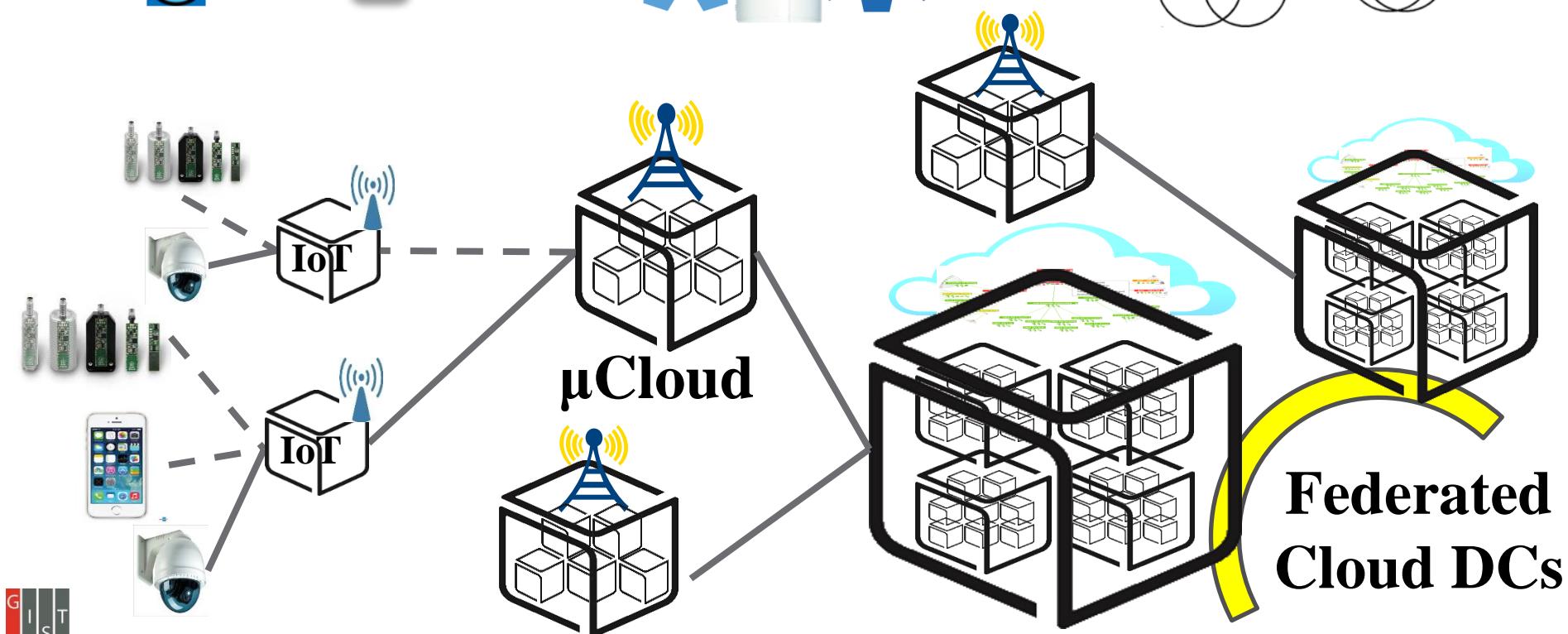
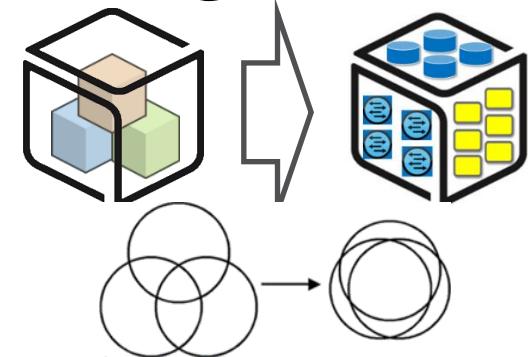


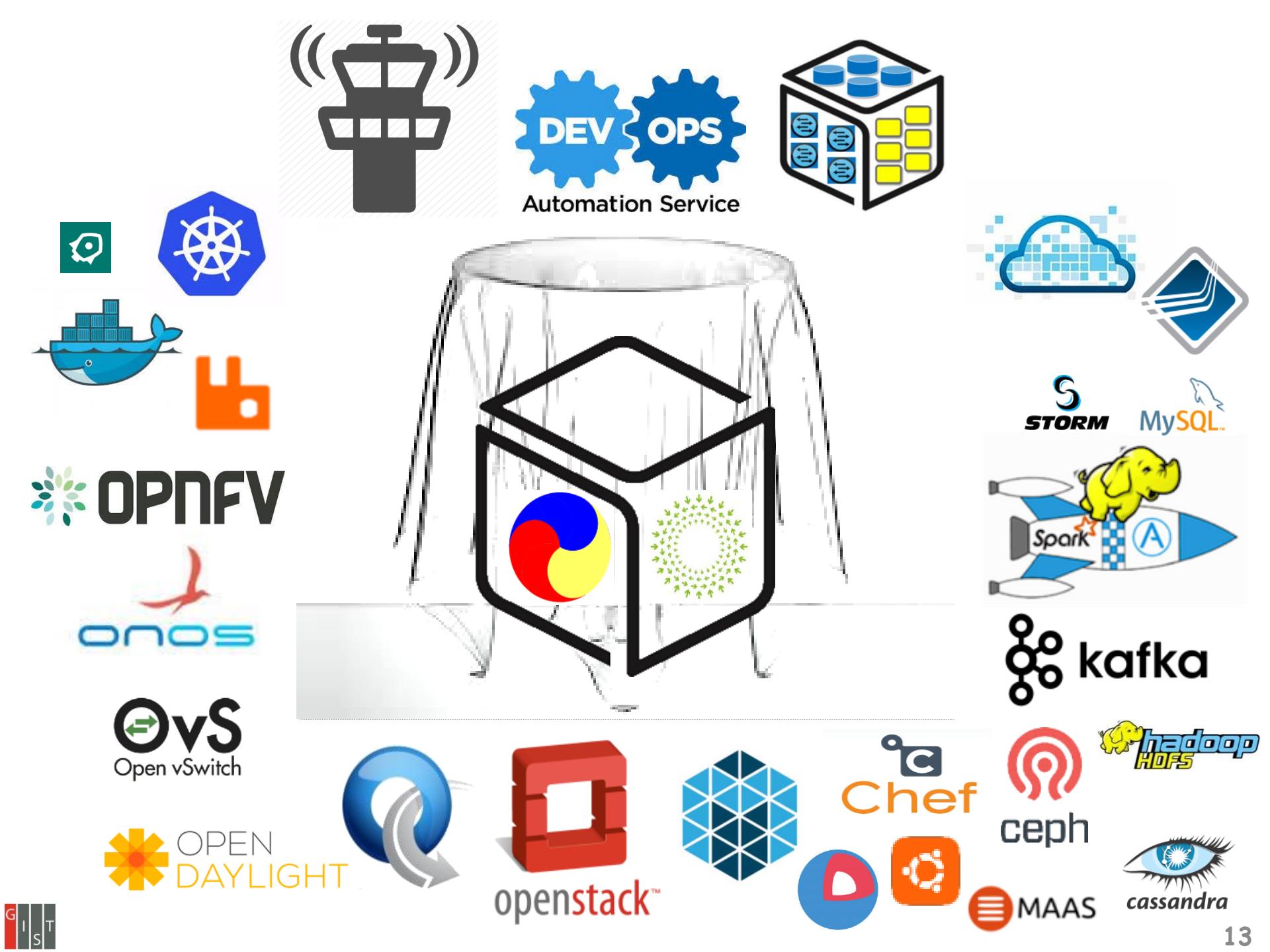
# Hyper-converged SDI for Diversified Services

## Diversified SaaS Applications



## Resources in Hyper-convergent Boxes

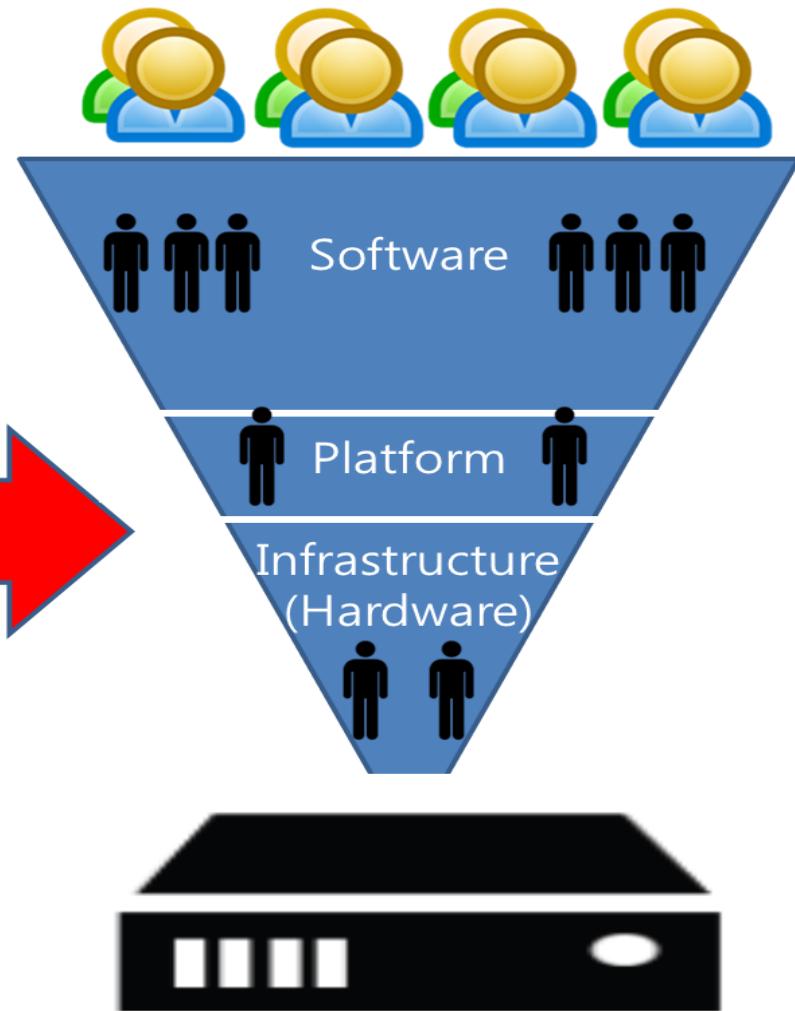
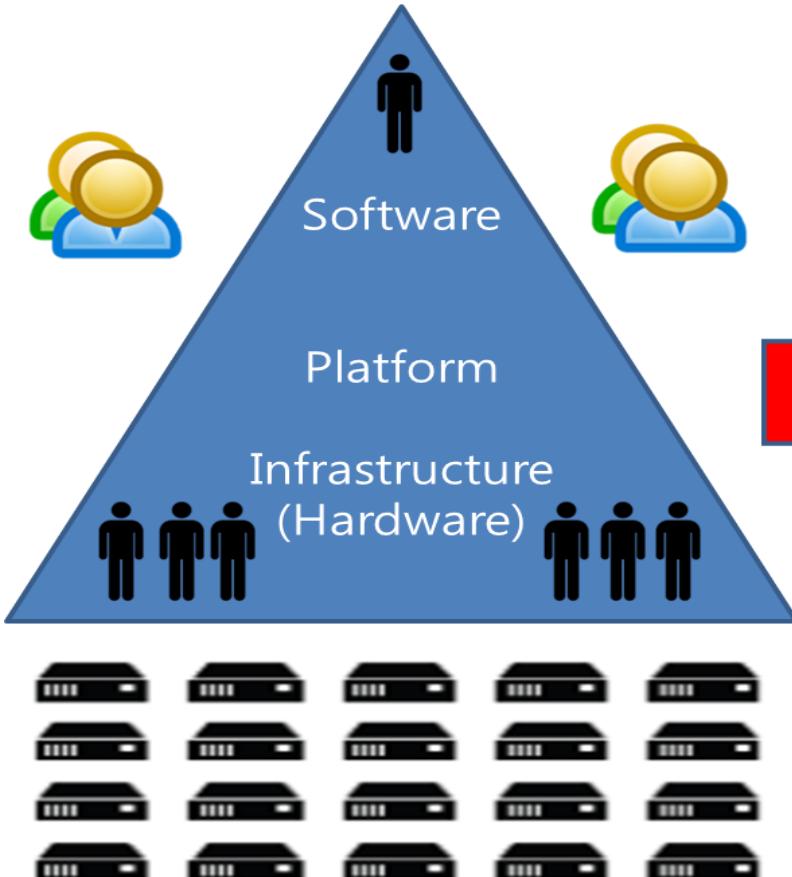




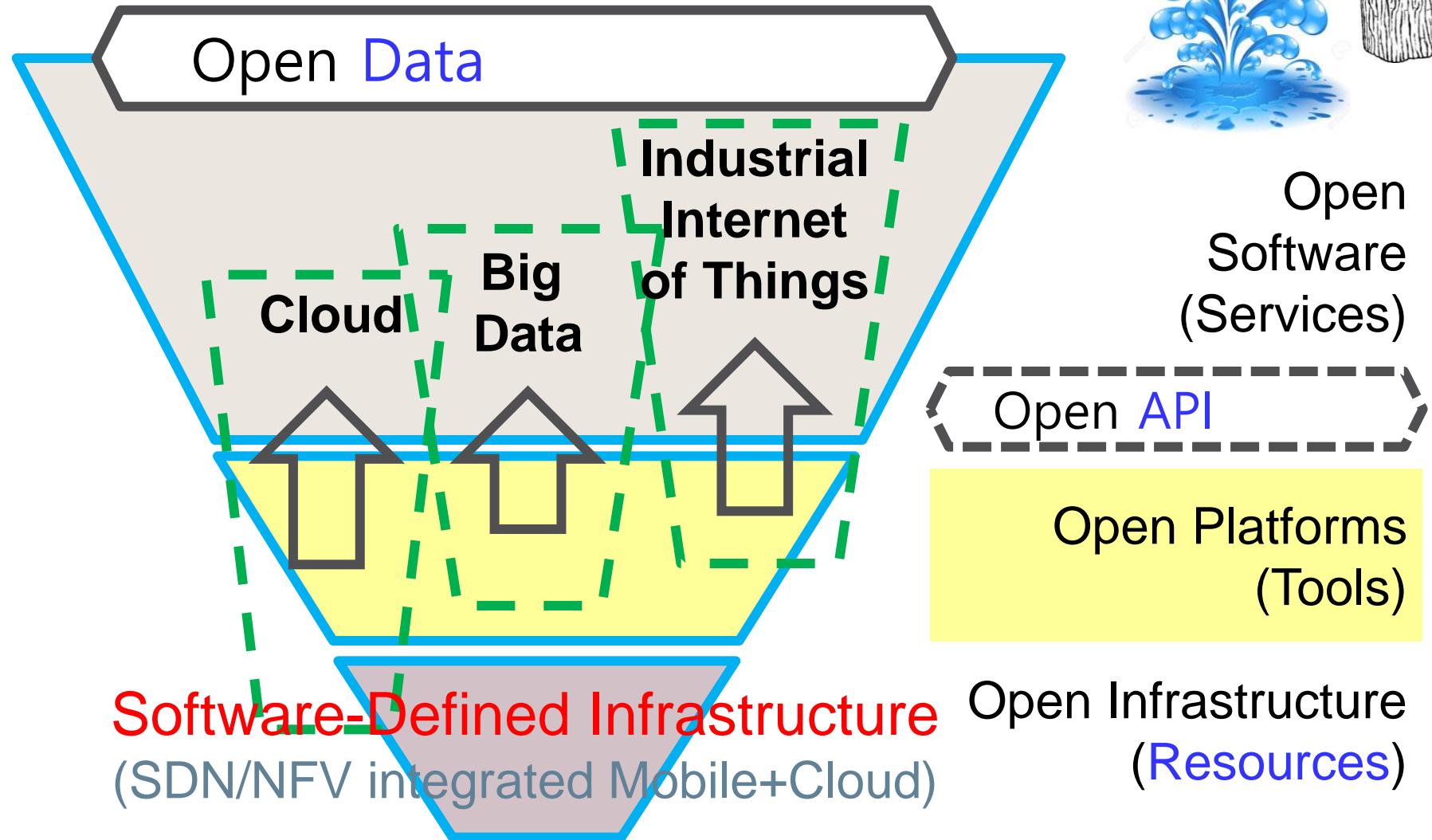
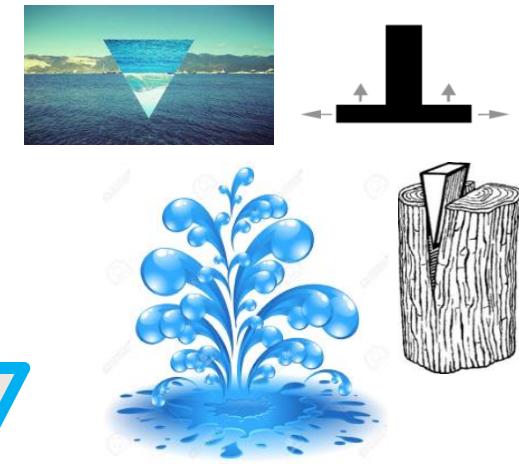
# Software-centric Vision for ICT Infrastructure

**Reset, Rebuild, Run!**

**Open  
Destruction**



# Human-Defined Services over Software-Defined Infrastructure

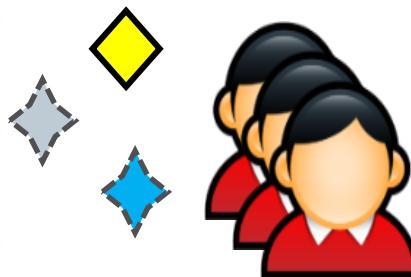


# IoT--Cloud Services over Convergent SDI

## (IoT – SDN/NFV/FastData – Cloud (BigData/HPC) )



Diversified Human-Defined Services

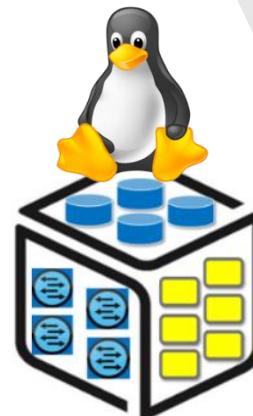


Cloud Platforms

(+ BigData + HPC + ...)

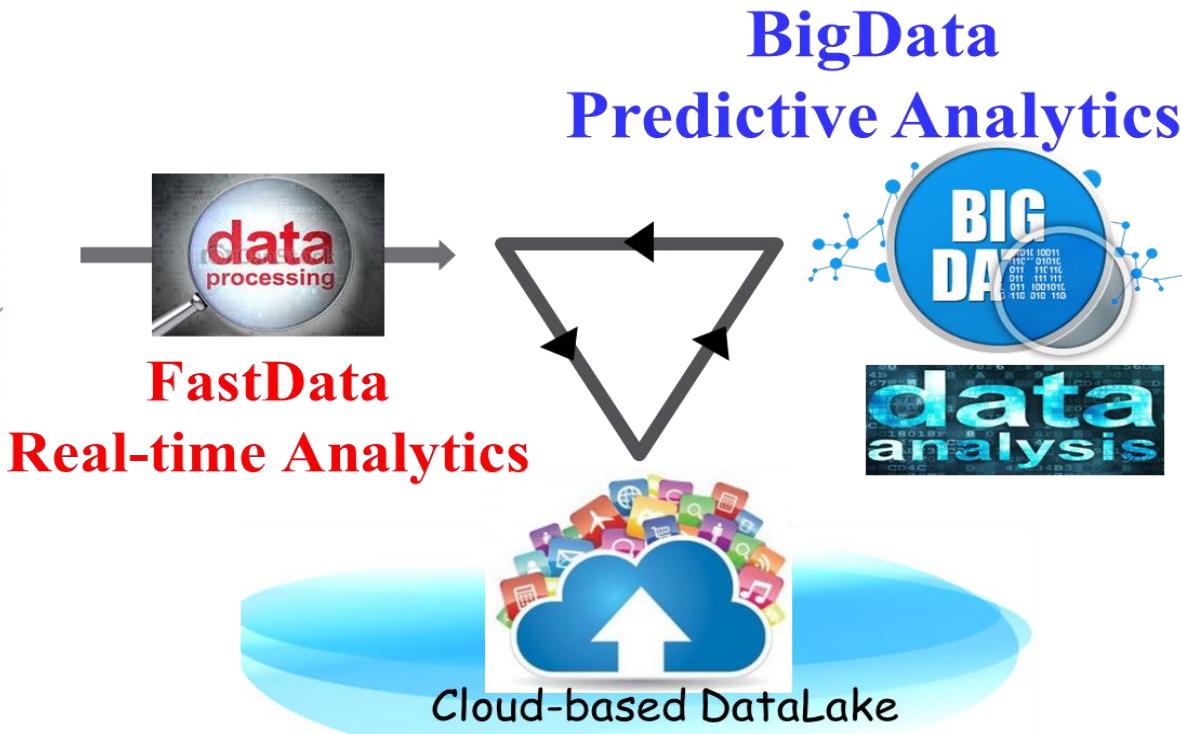
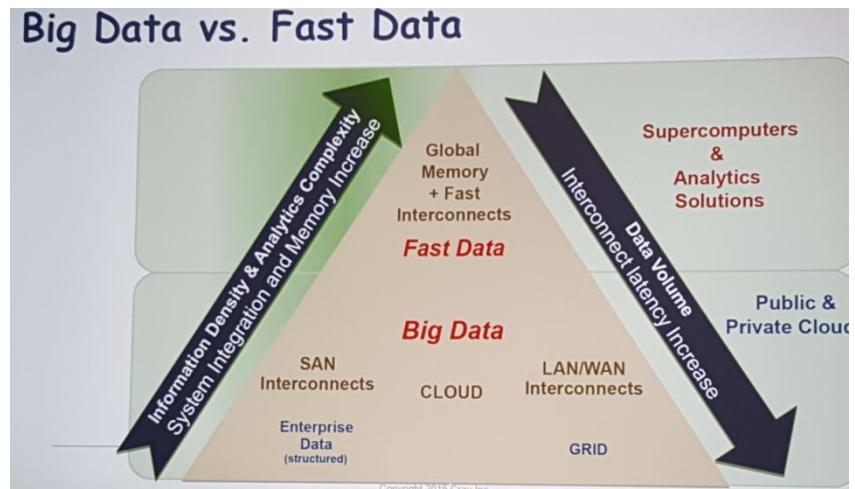
IoT Platforms

SmartX  
Things



Convergent Software-Defined Infrastructure

# SmartX IoT—Cloud Services with FastData/BigData Analytics



# AWS IoT (<https://aws.amazon.com/iot>)

Data on road conditions and performance transmitted



Alert cars that moisture levels are high



Alert to driver "Warning: Roads are slippery"

AWS IoT



Process data based on rules and interpret that moisture levels are high.  
Sends alert to nearby cars.



Engine performance data stored in S3 for future analysis



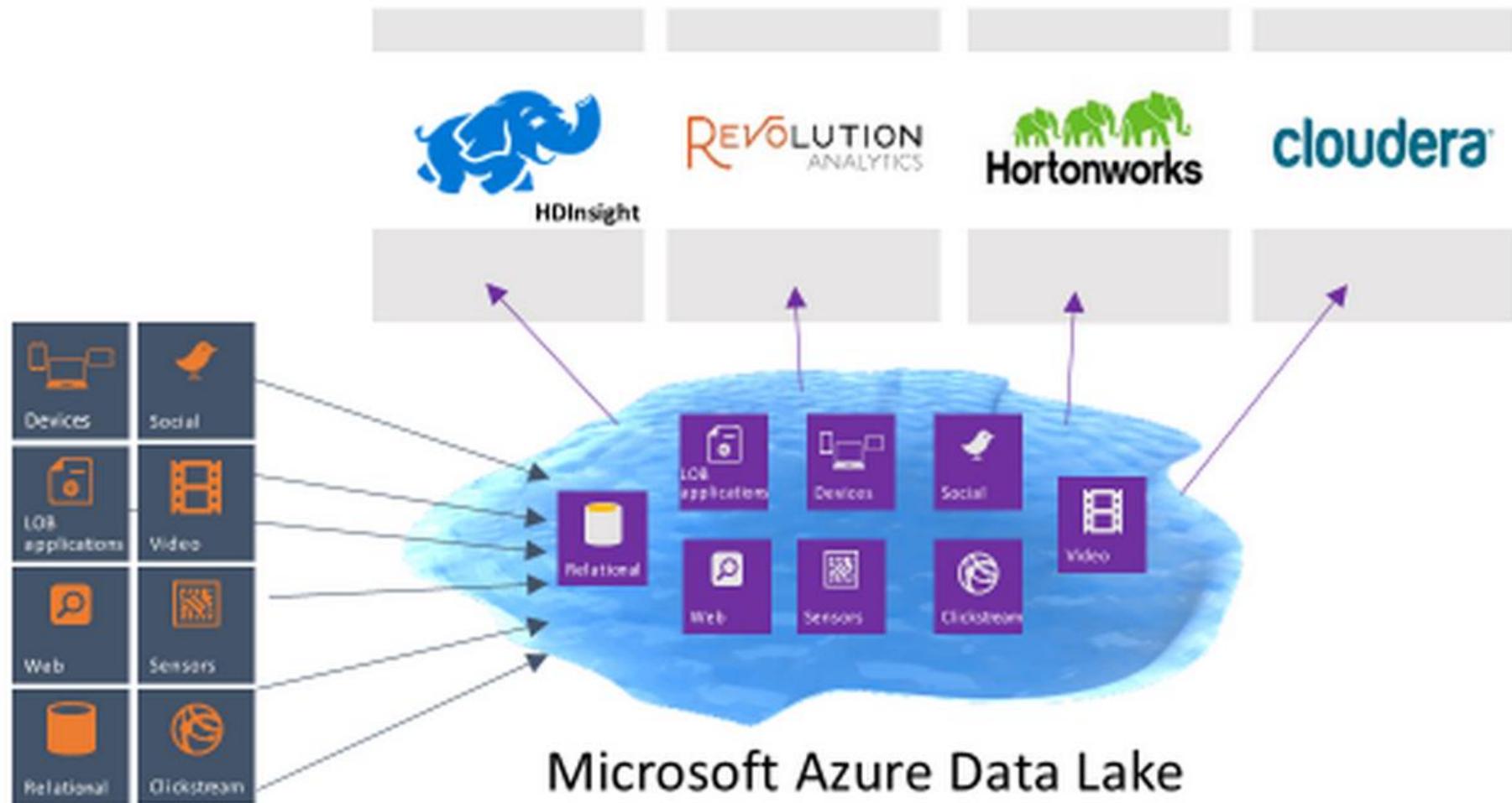
Visualize analytics with Amazon QuickSight



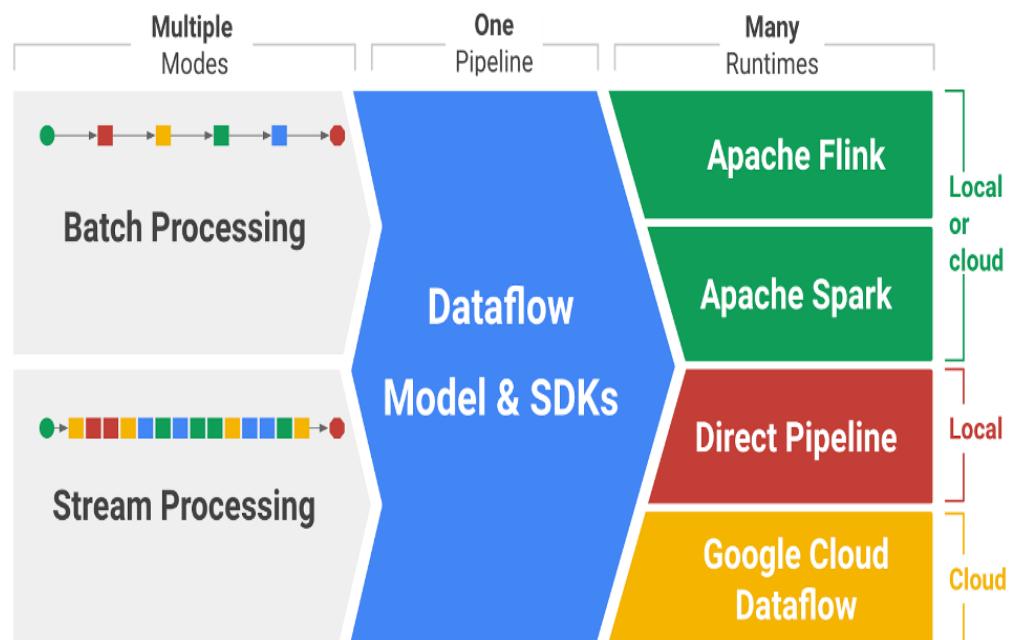
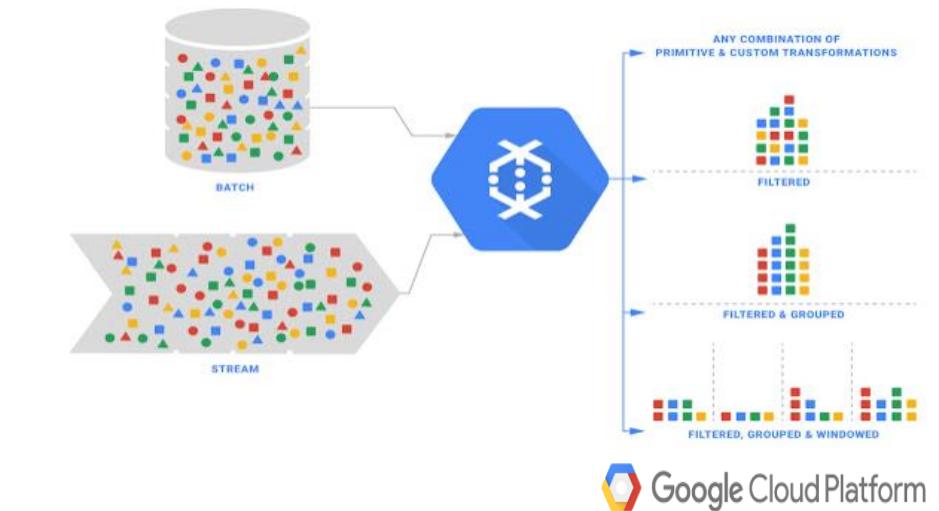
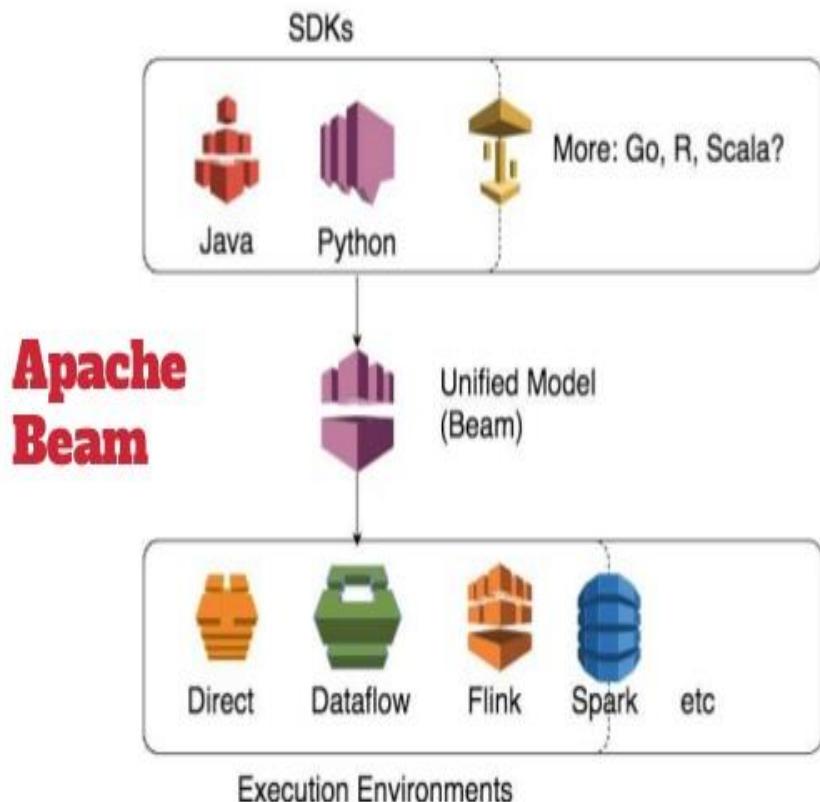
The engine performance data trains an Amazon Machine Learning model for predictions that get more accurate over time

- A complete software stack for managing devices and endpoints.
- Partnerships with limited number of hardware companies for software integration.
- Messaging stacks – queues, brokers, request routing, ...
- Comprehensive software backend for database, object management, notification and streaming.
- Cloud infrastructure for compute, storage and network.
- Analytics platforms with multiple analytics engines.

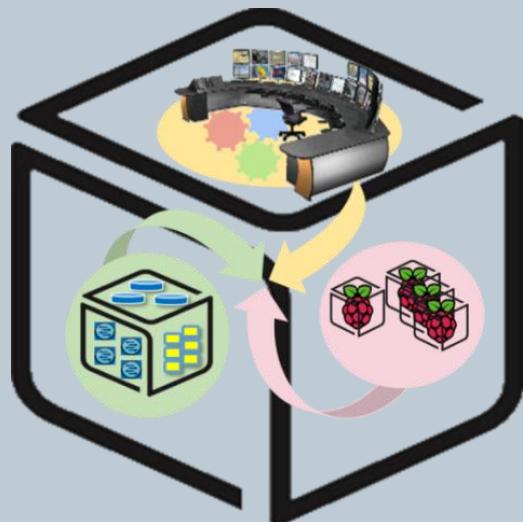
# Microsoft Azure Data Lake



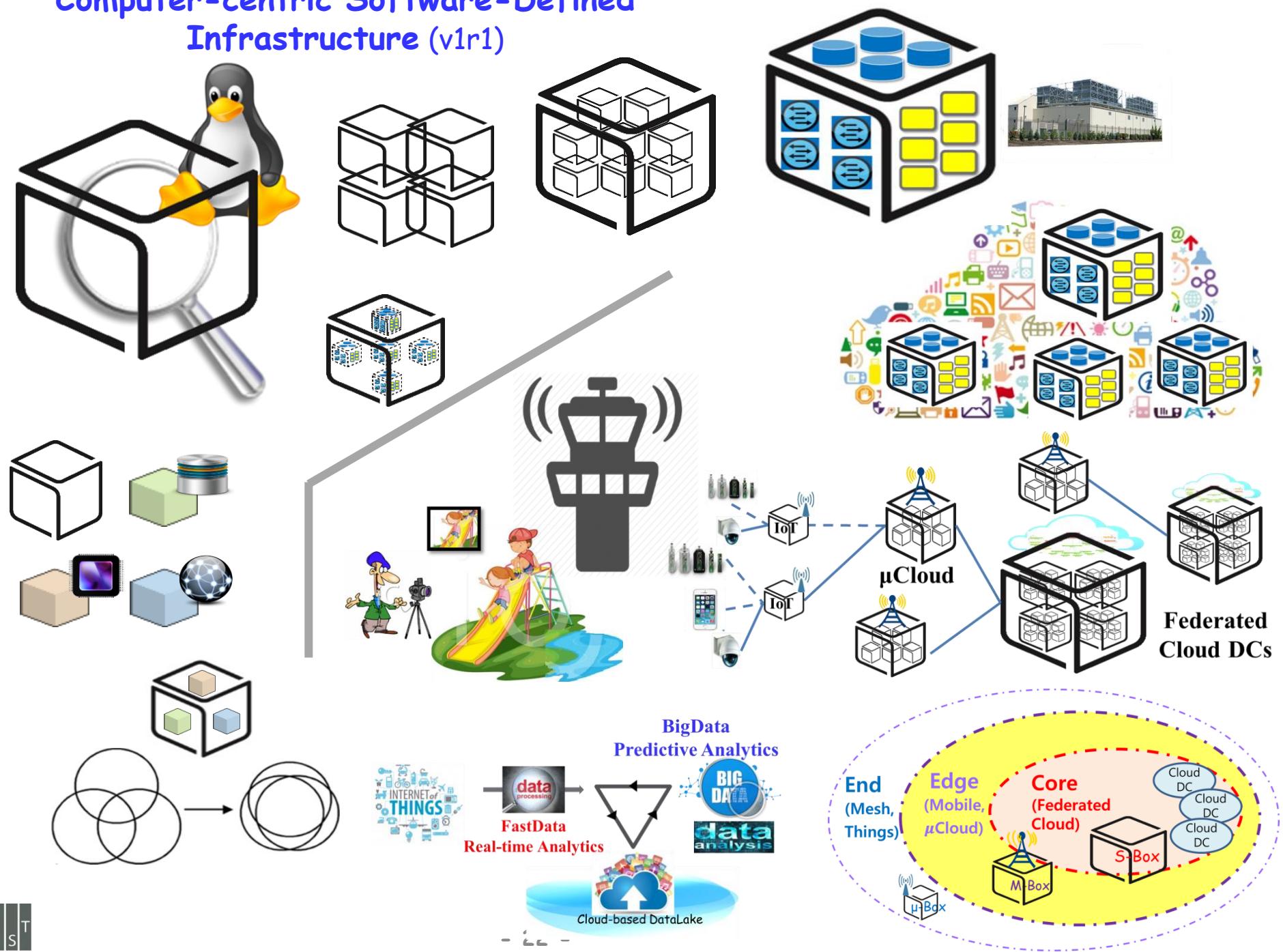
# Google DataFlow & Apache Beam



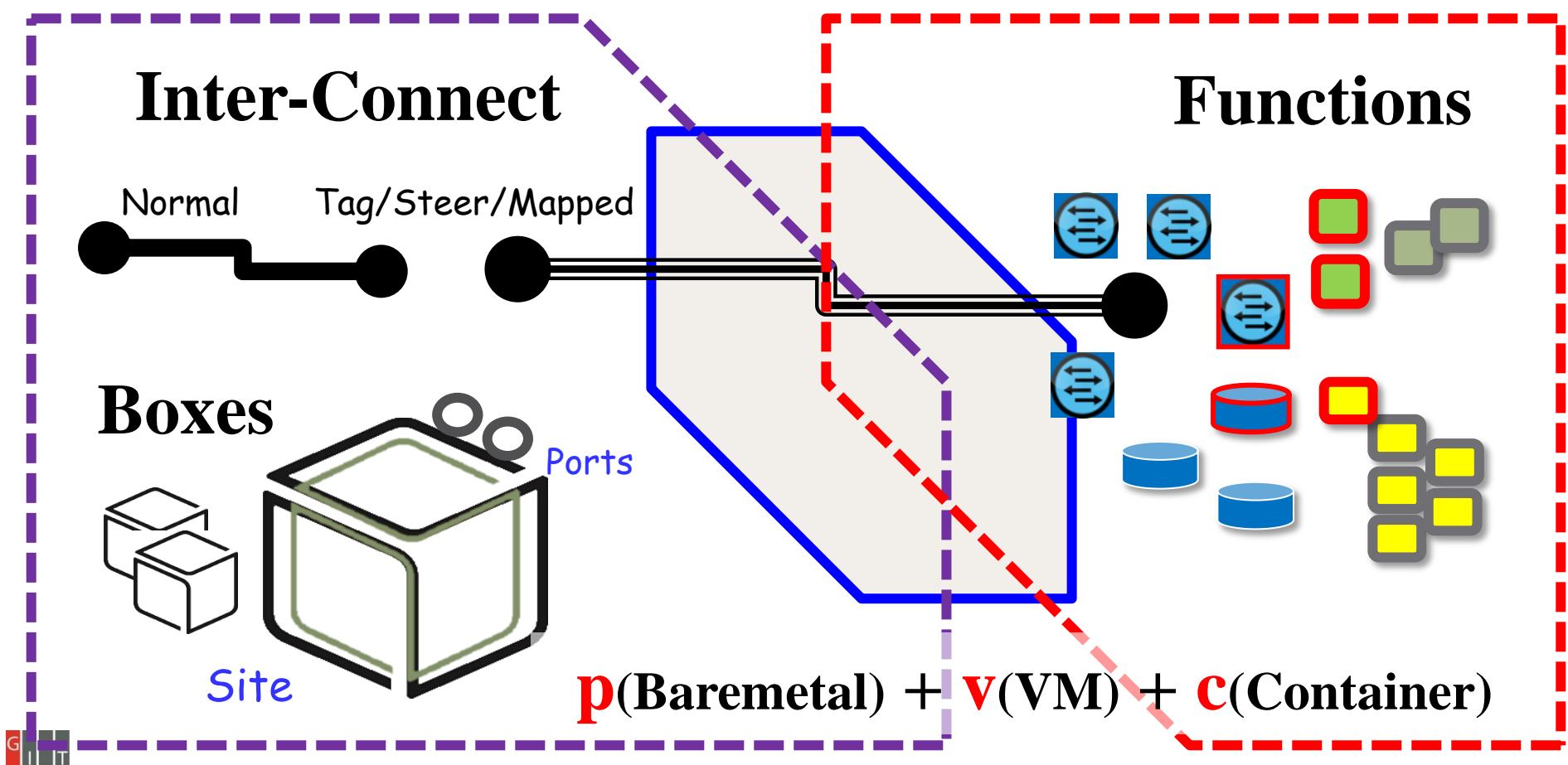
# IoT-Cloud Services with SmartX Labs & SmartX Playground



# Computer-centric Software-Defined Infrastructure (v1r1)



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

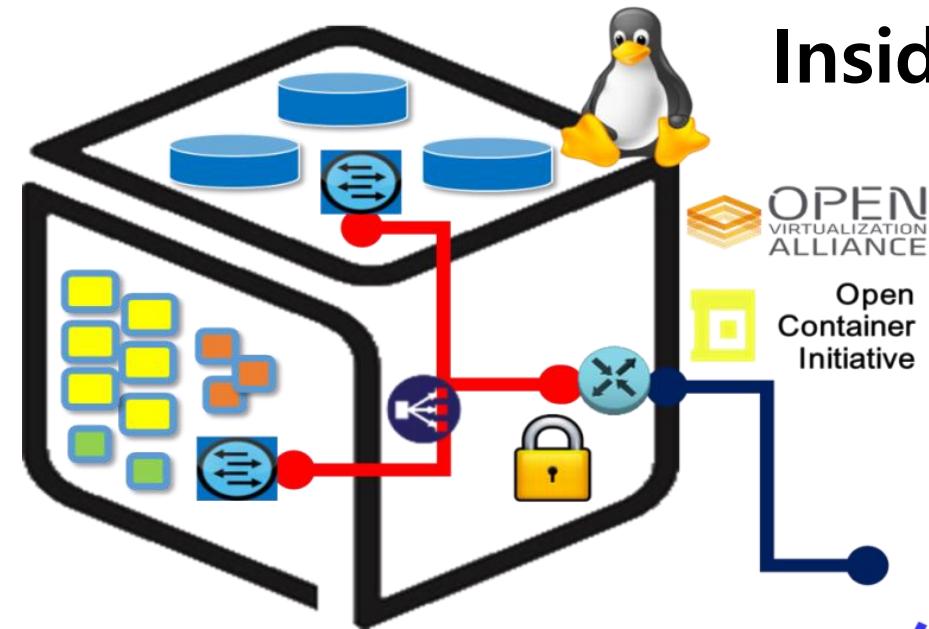


# SmartX Box: Inter-Connected

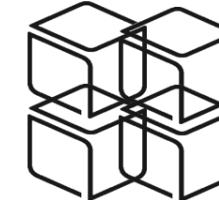
Functions inside/among Boxes/Sites



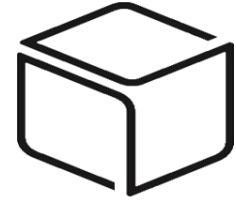
Inside a Box



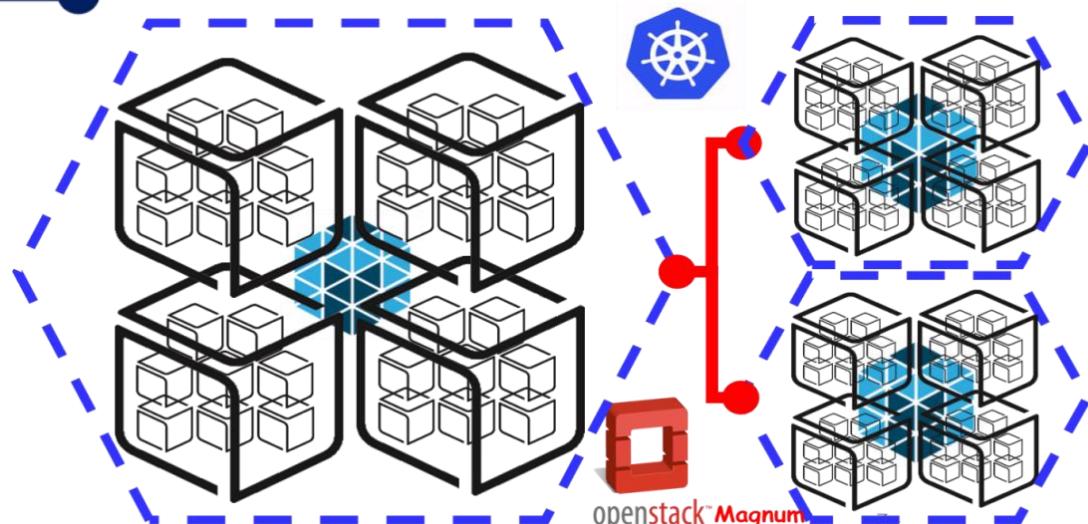
Scale Out



Scale Up



Across Clusters



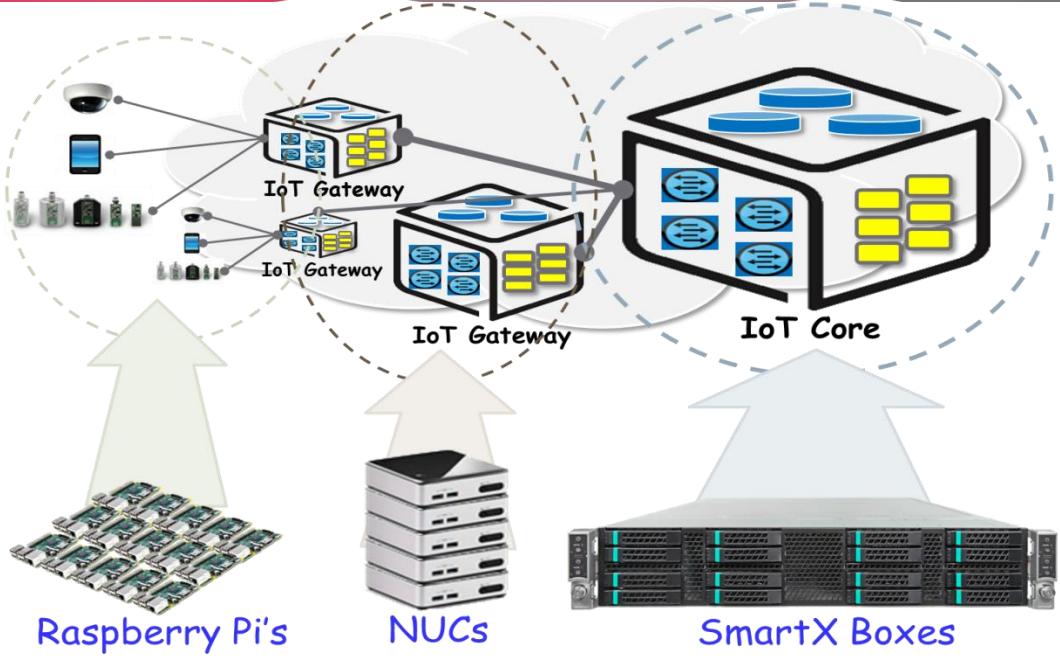
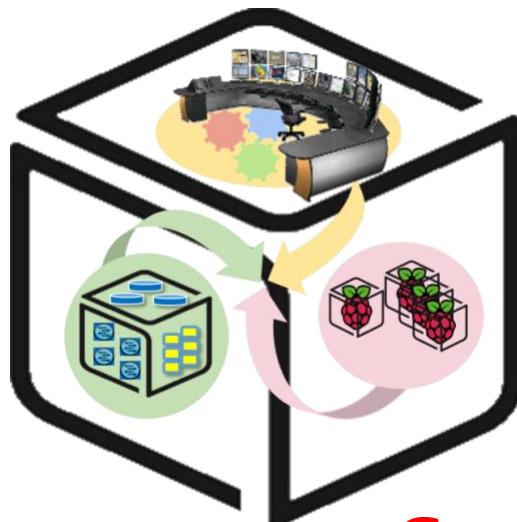
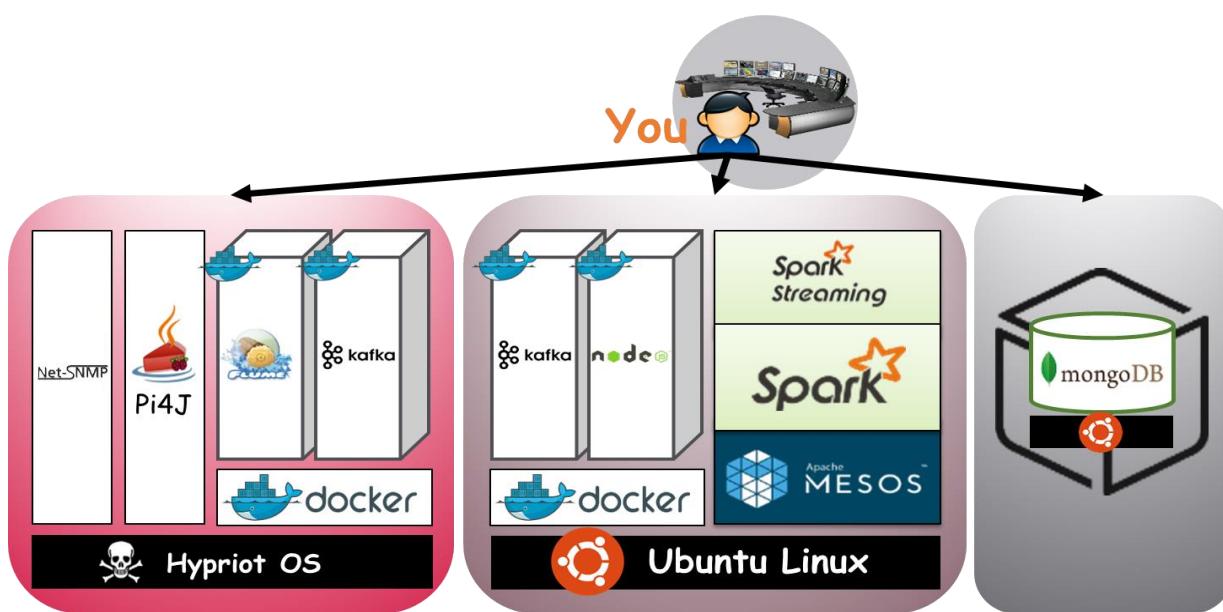
**p+v+c Challenge:**

**p(Baremetal)**

+ **v(VM)**

+ **c(Container)**

# SmartX Playground Expansion for IoT—Cloud (2015~)



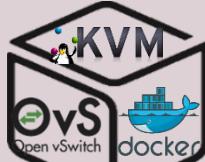
## SmartX & SmartX-mini IoT-Cloud

# SmartX Labs – Mini (<https://github.com/SmartX-Labs/Mini>)

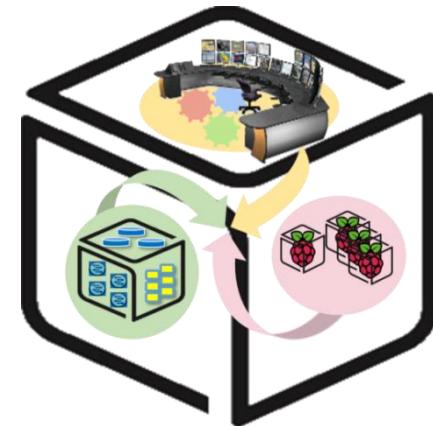
## SmartX Labs - Mini



Box



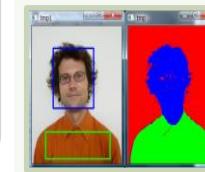
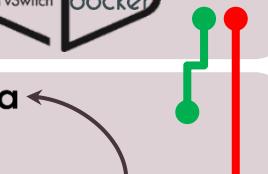
SmartX  
Services



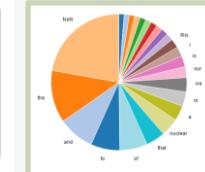
Tower



InterConnect



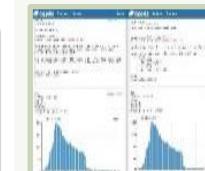
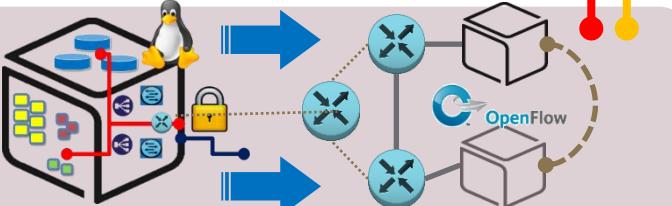
Functions



SDN

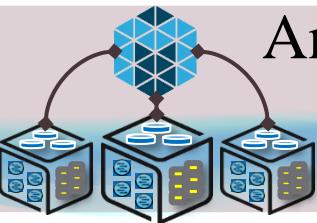


onos  
Open Network Operating System



Cluster

hadoop  
HDFS



Analytics

Apache Zeppelin  
Spark



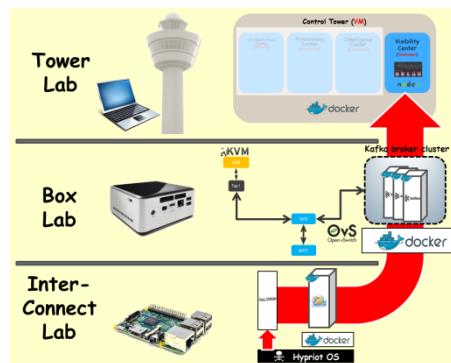
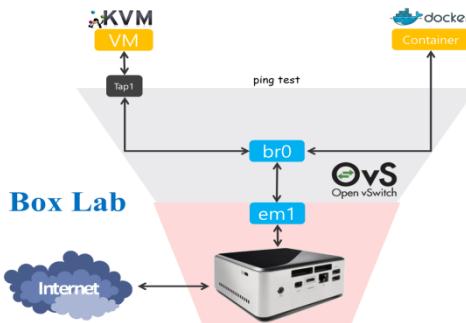
github  
SOCIAL CODING

# SmartX Labs – Mini: Current Labs

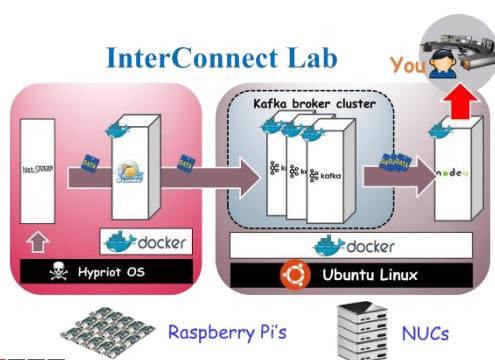
**Tower Lab**



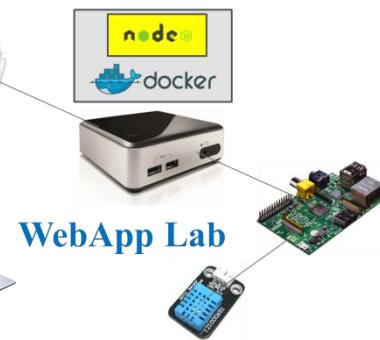
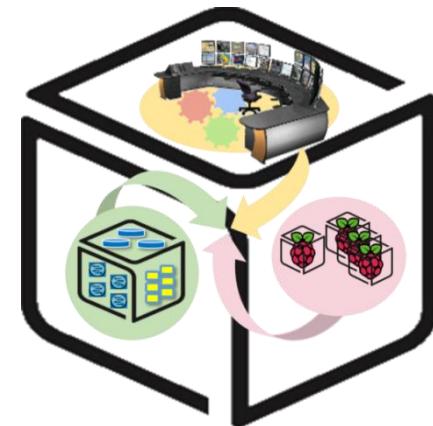
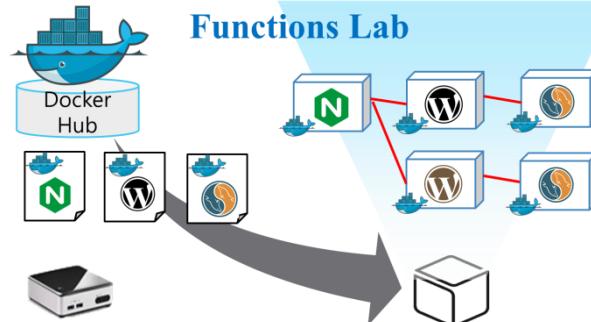
**Box Lab**



**InterConnect Lab**



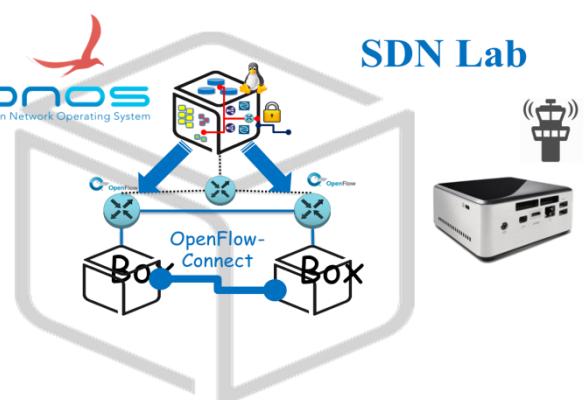
**Functions Lab**



**Cluster & Analytics Lab**



**SDN Lab**



# Testbed: Wild & Organized Playground

# DevOps

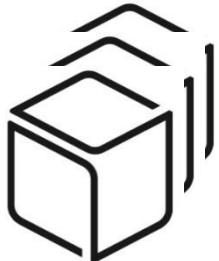
Play (Experiment)

- Configuration
- Control
- Visibility



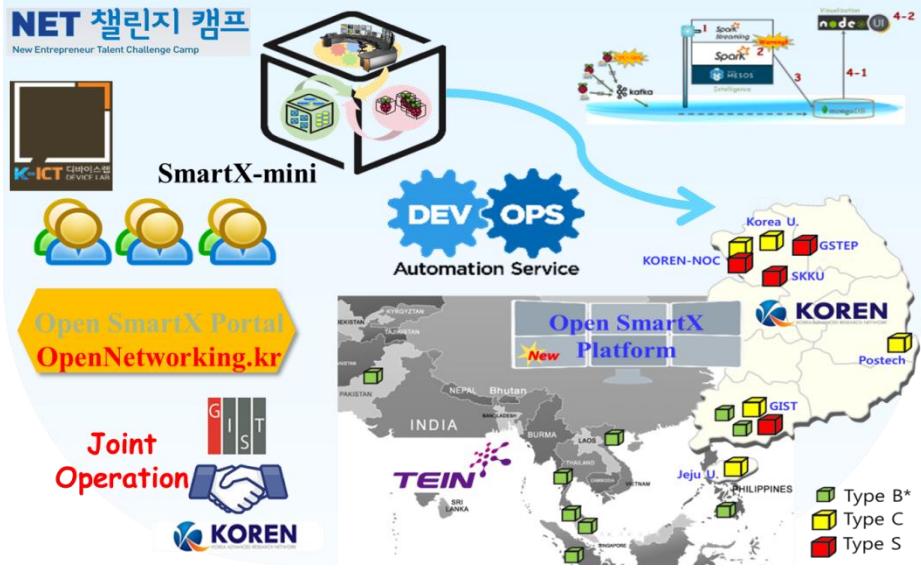
Provide Playground with Resources

(Provider)

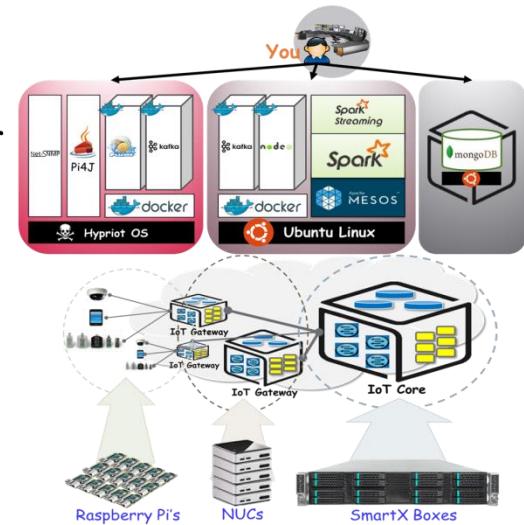


(Power Users)

# SmartX Playgrounds & Open SmartX Platform

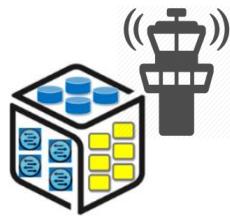
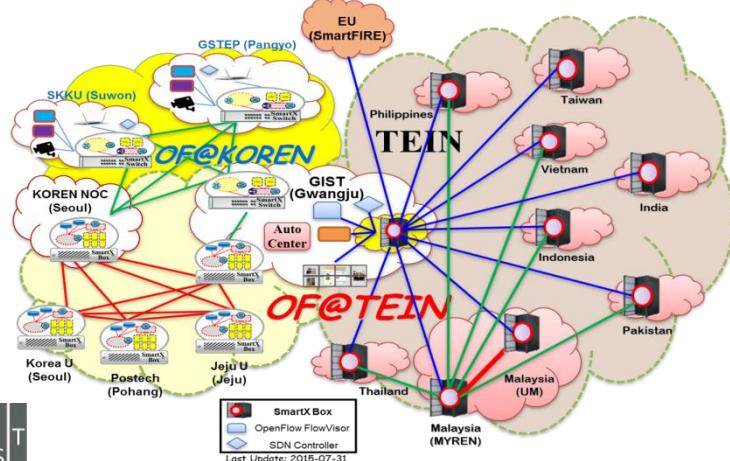


# SmartX Playground Expansion for IoT—Cloud (2015~)

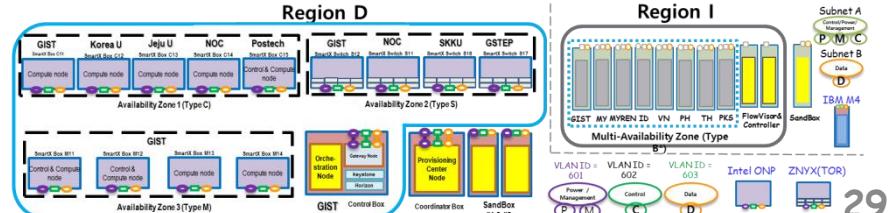
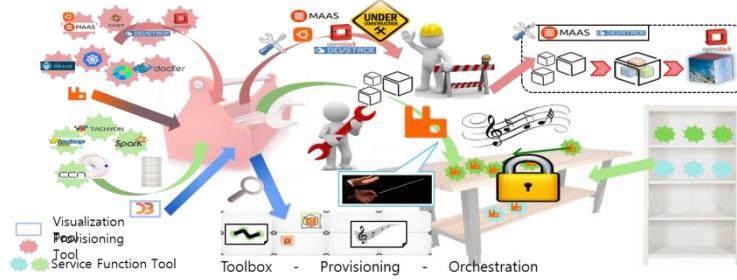


## SmartX & SmartX-mini IoT-Cloud

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



SmartX Playground & Operation Tower (2012~2015)



# Building Playgrounds for Convergent SDI

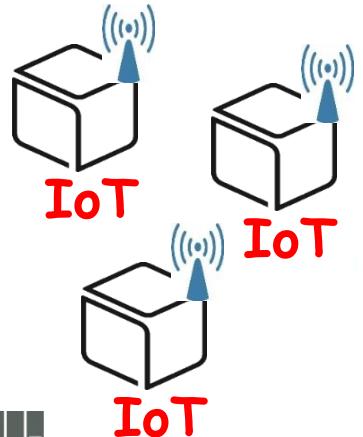


**K-ONE**

**openwincon**

Single controller for all wired & wireless networks

**OF@KOREN & OF@TEIN**  
**SmartX Playgrounds**



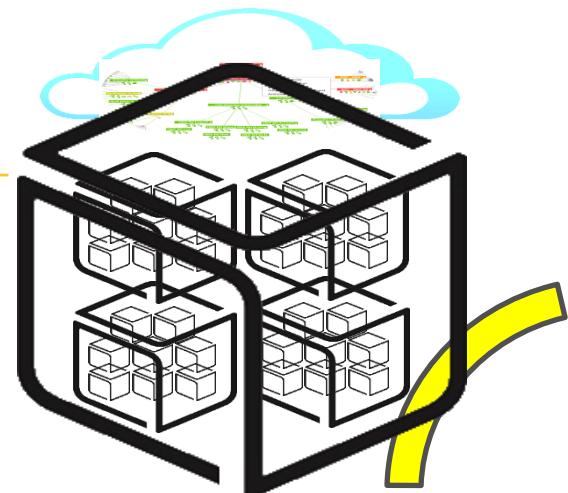
**OPNFV**



**μCloud  
(SDN/NFV/  
FastData)**

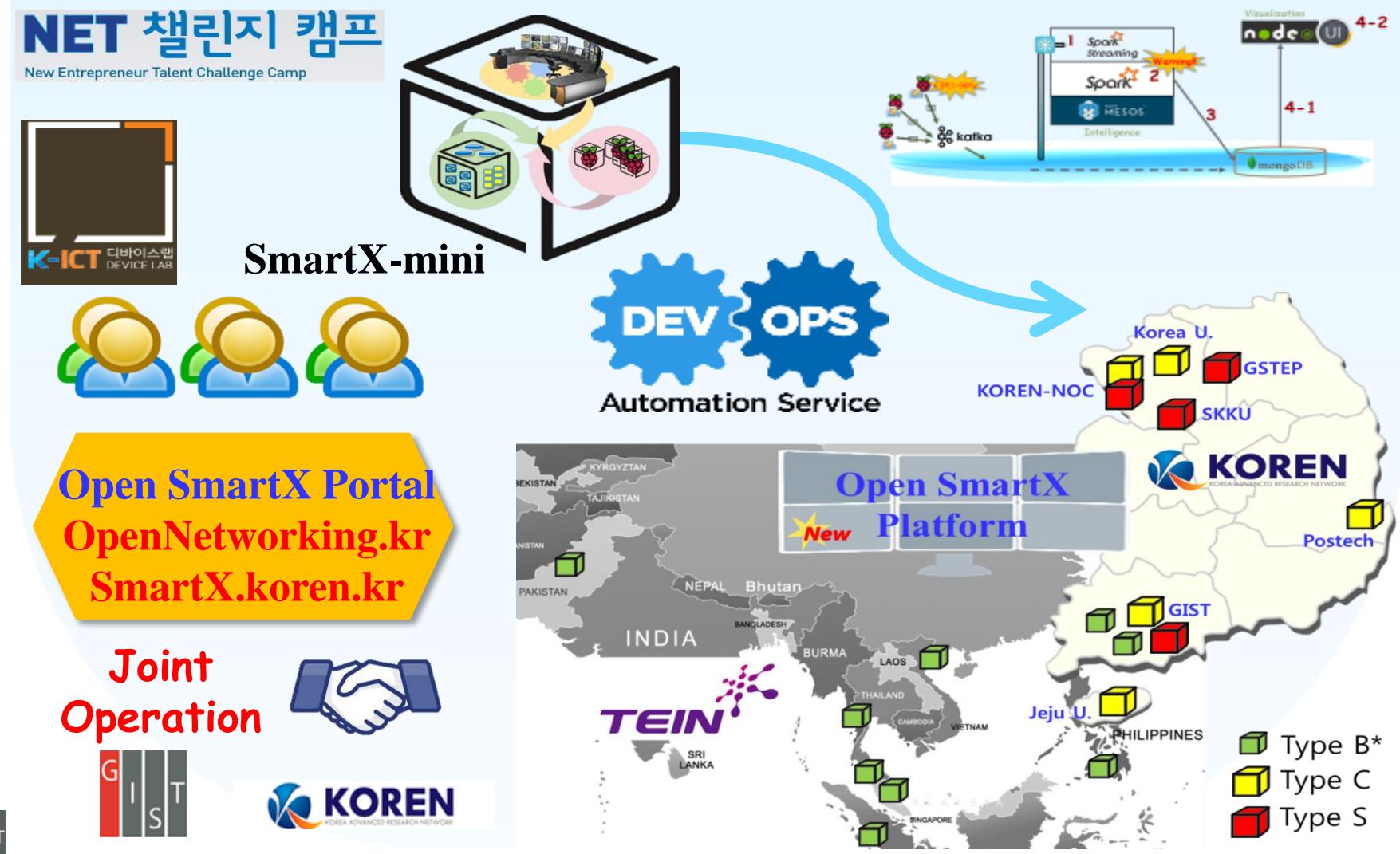
**OPEN  
DAYLIGHT**

**openstack™**

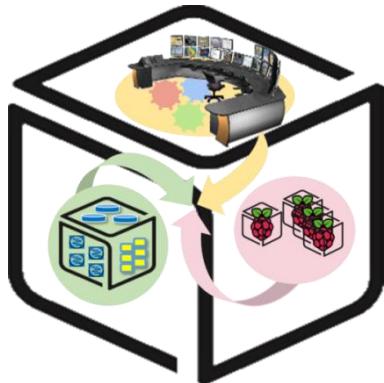


**Federated Cloud DCs  
(BigData/HPC)**

# Open SmartX Platform over SmartX Playground (2015~)



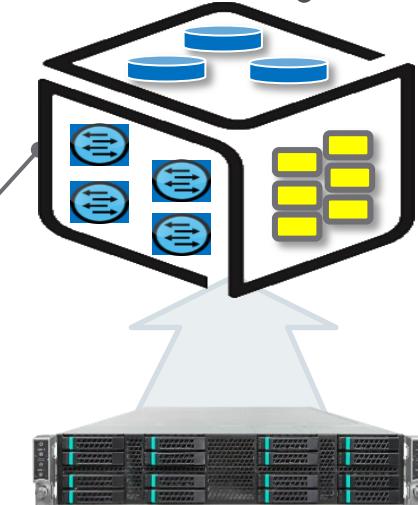
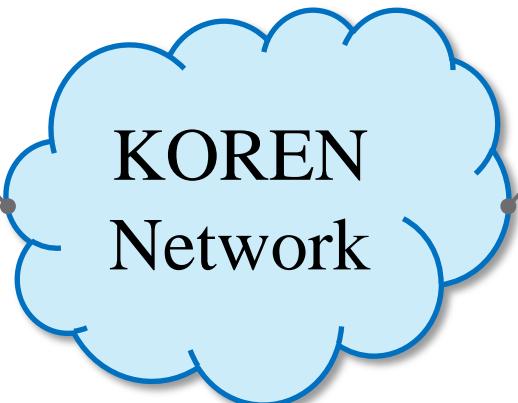
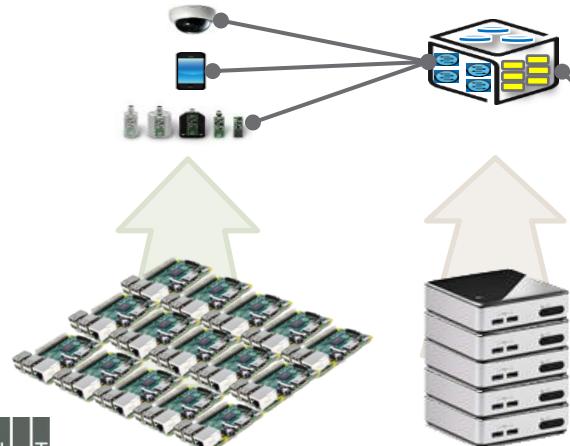
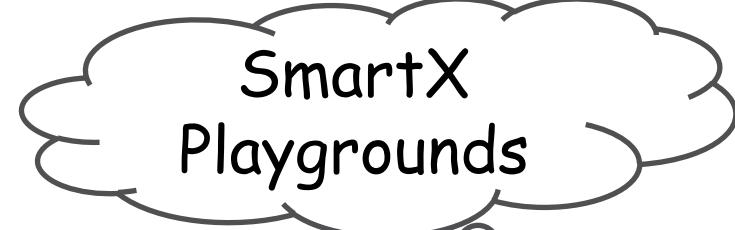
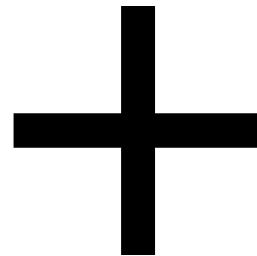
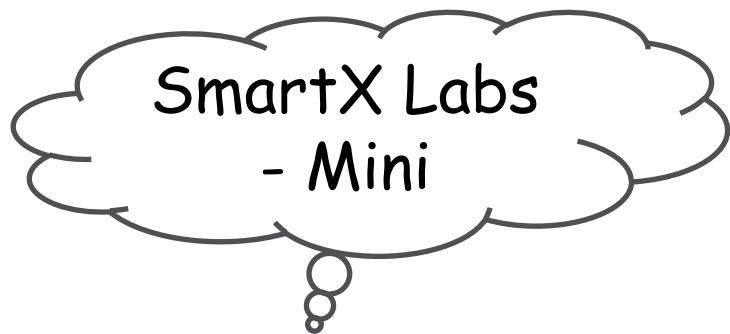
# Connecting SmartX Labs & Playgrounds

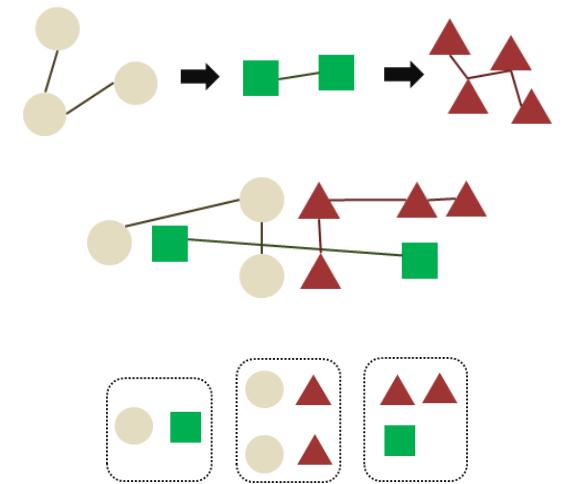
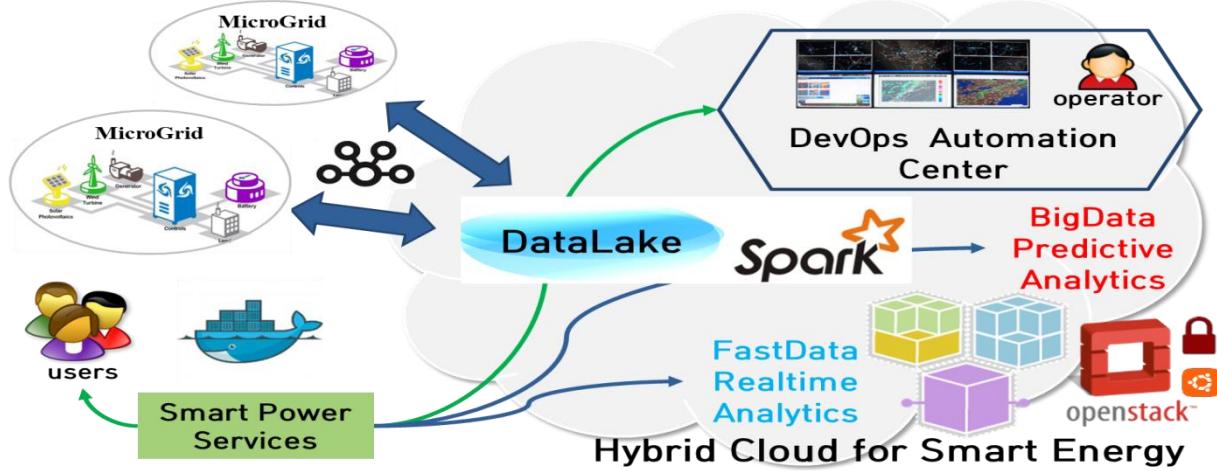


OF@TEIN Playground



OF@KOREN Playground





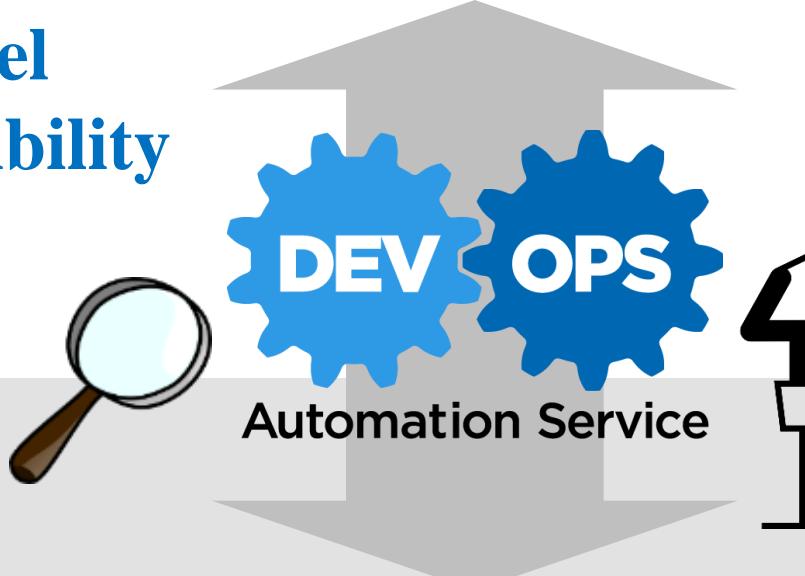
# DevOps-based Automation of IoT-Cloud Services

## Multi-level Ops/App Visibility

Services

Flows

Resources



## Workflow-based Orchestration

Workflow

Container Lifecycle

Resource Scheduling

Infrastructure/Platform with Hyper-converged Boxes



Gwangju Institute of  
Science & Technology



*Thank you!*

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# Open Networking KOREA

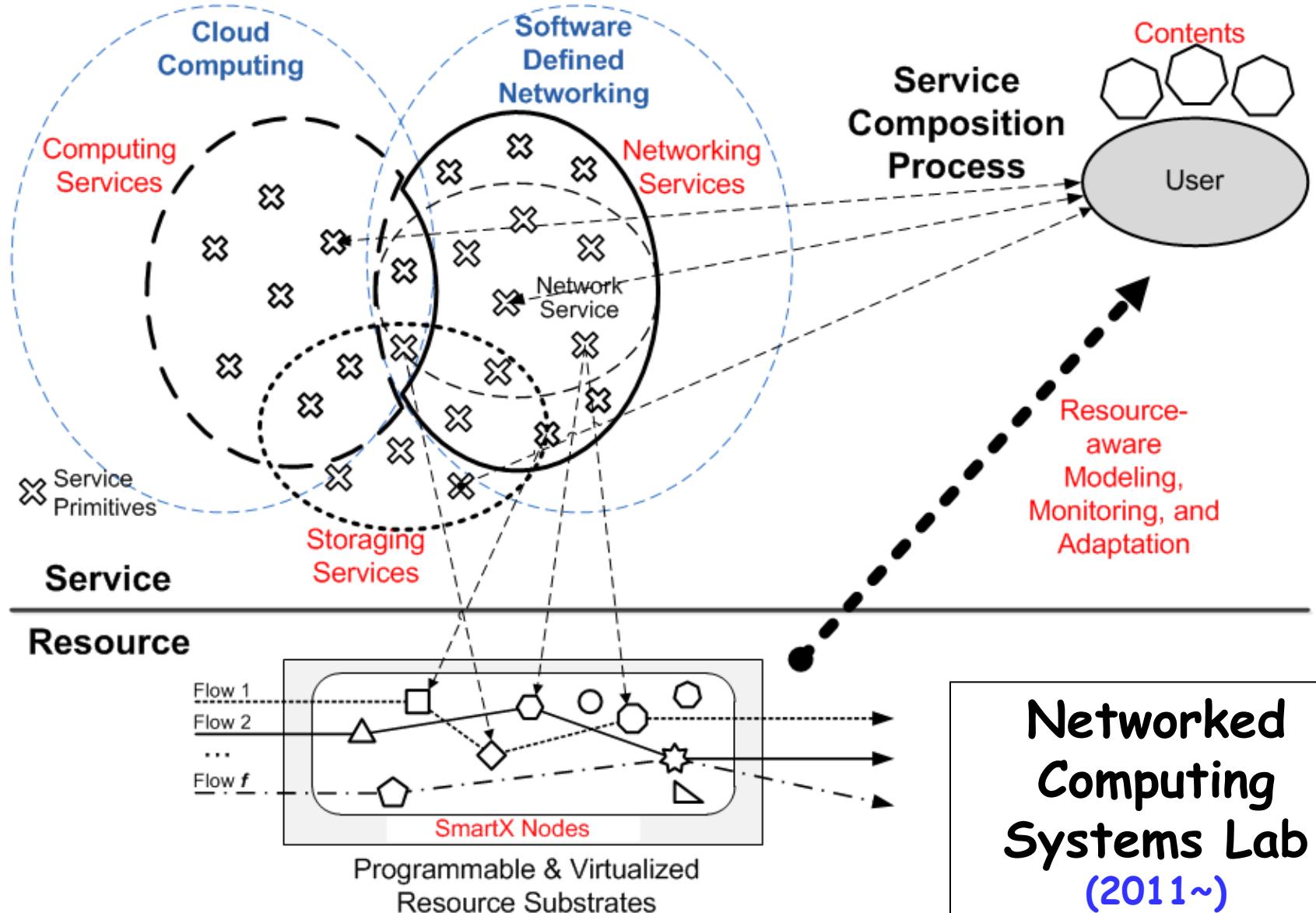


**openwincon**

Single controller for all wired & wireless networks

<http://opennetworking.kr>

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



**Networked  
Computing  
Systems Lab  
(2011~)**