

Preparing SmartX IoT-Cloud Services leveraged with Cloud-based Analytics

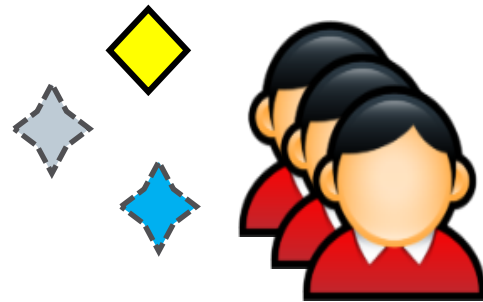
Tutorial Talk @ KNOM Conference 2016

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

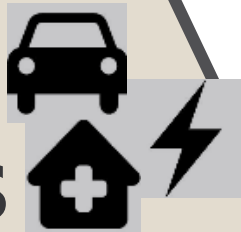


Cloud Platforms

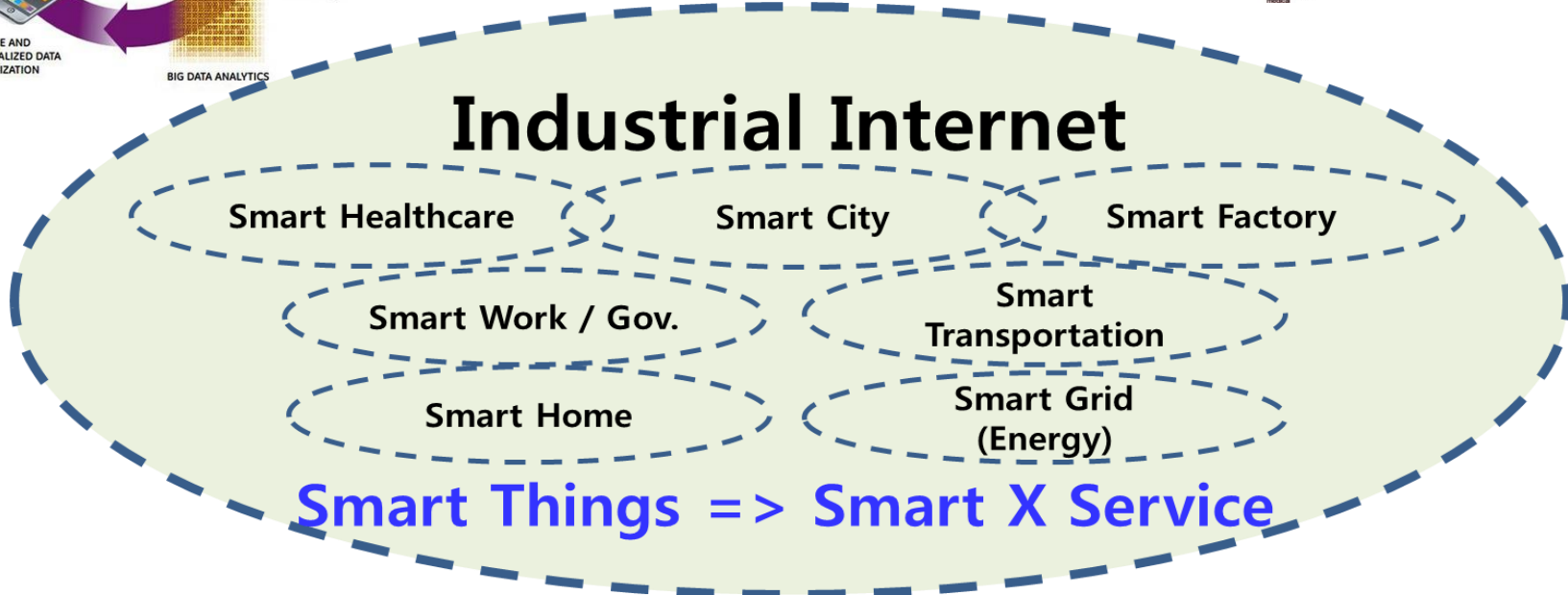
(SDN/NFV +
BigData/FastData
Intelligence + ...)



**IoT
Platforms**
Mobile SmartX Things



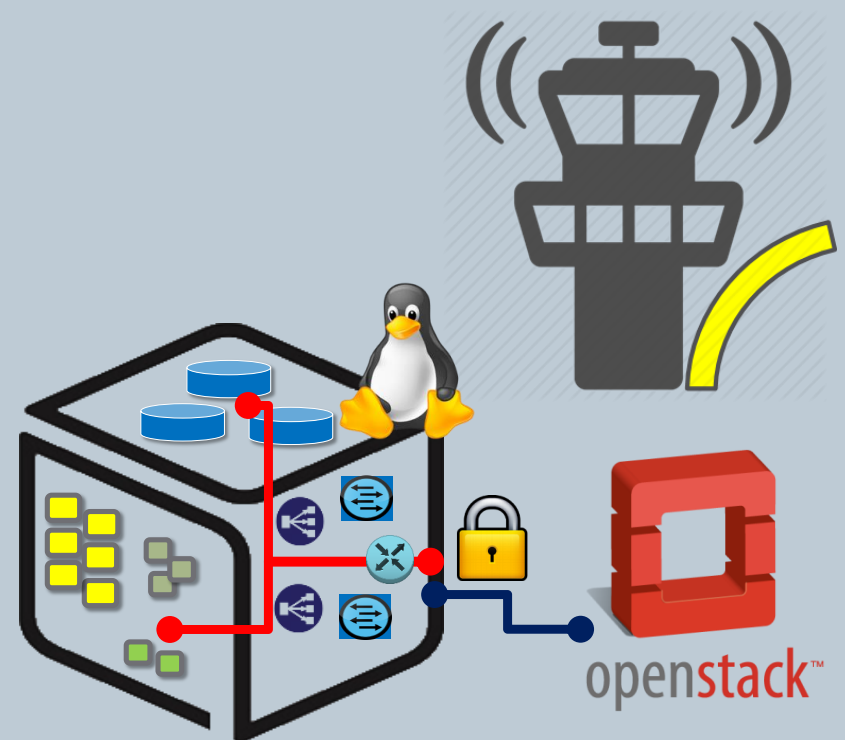
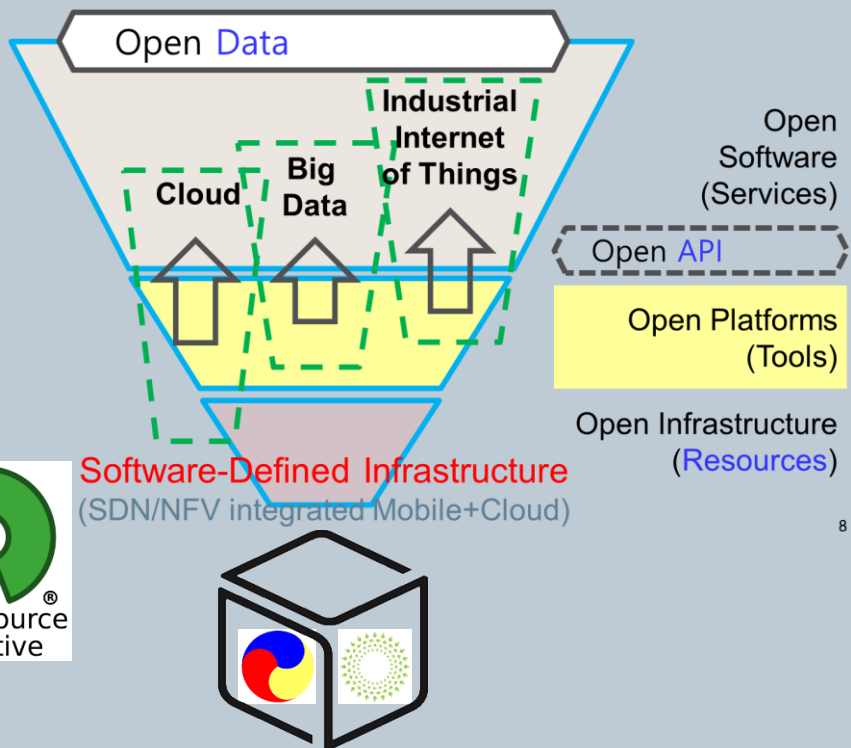
**Convergent Software-Defined
Infrastructure**



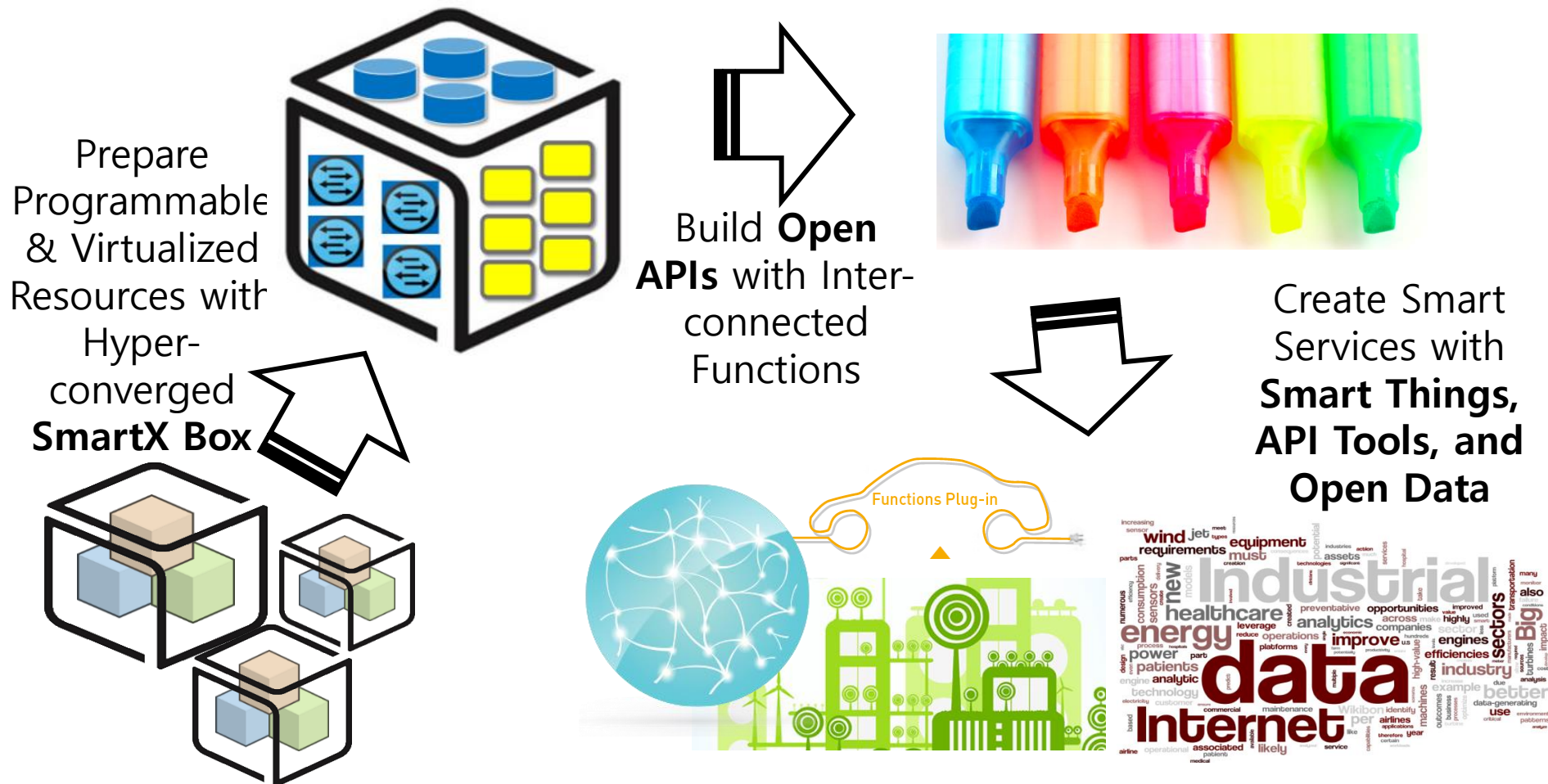
Open, Software-Defined, Virtualized **BIG Cloud** Machines



Enabling Services over Hyper-convergent Software- Defined Infrastructure



Realize SmartX Services with Open APIs enabled by SmartX Boxes



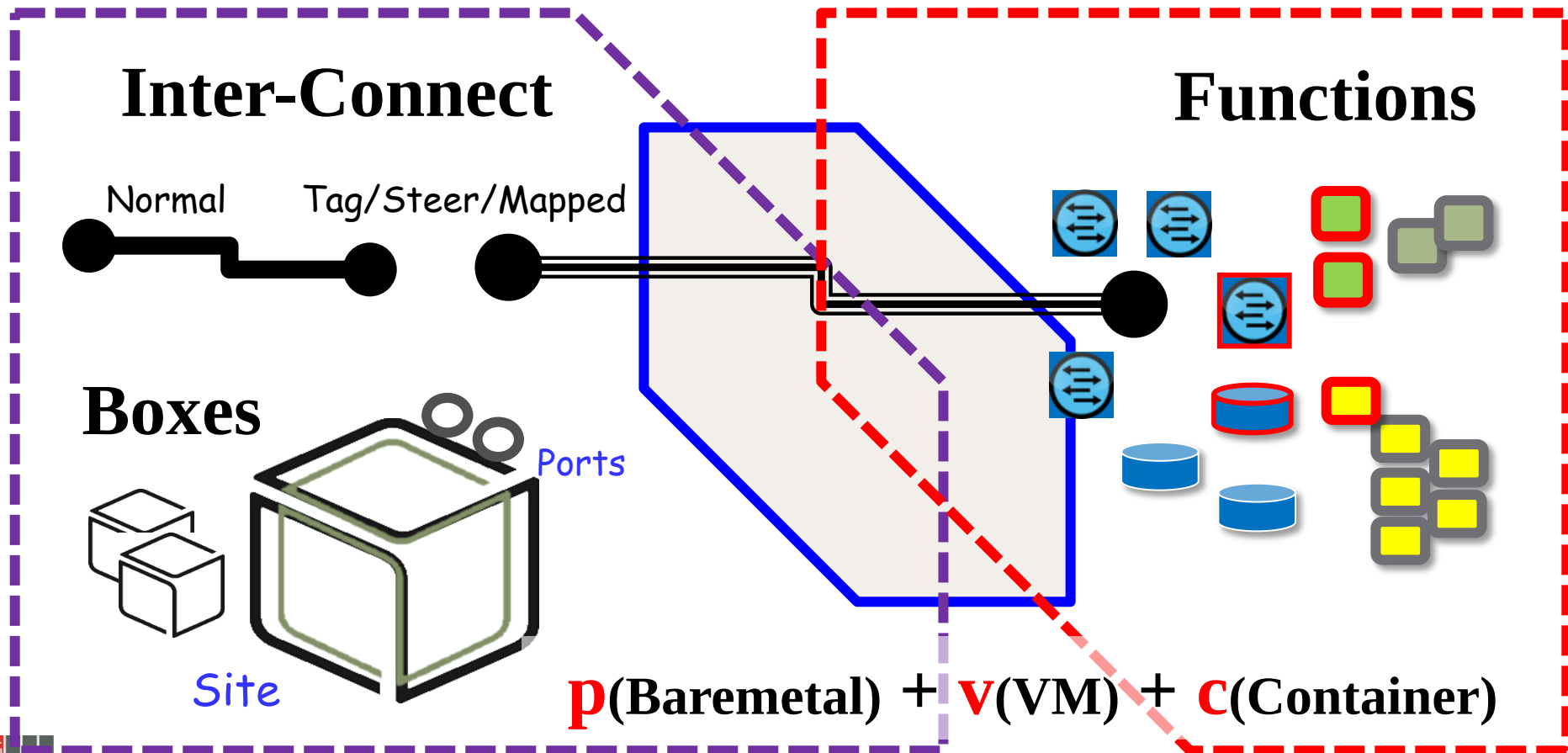
Inter-Connected Functions (Microservices) inside SmartX Boxes/Sites

 **Provisioning**

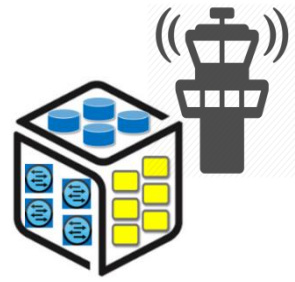
 **Orchestrate**

 **Visibility**

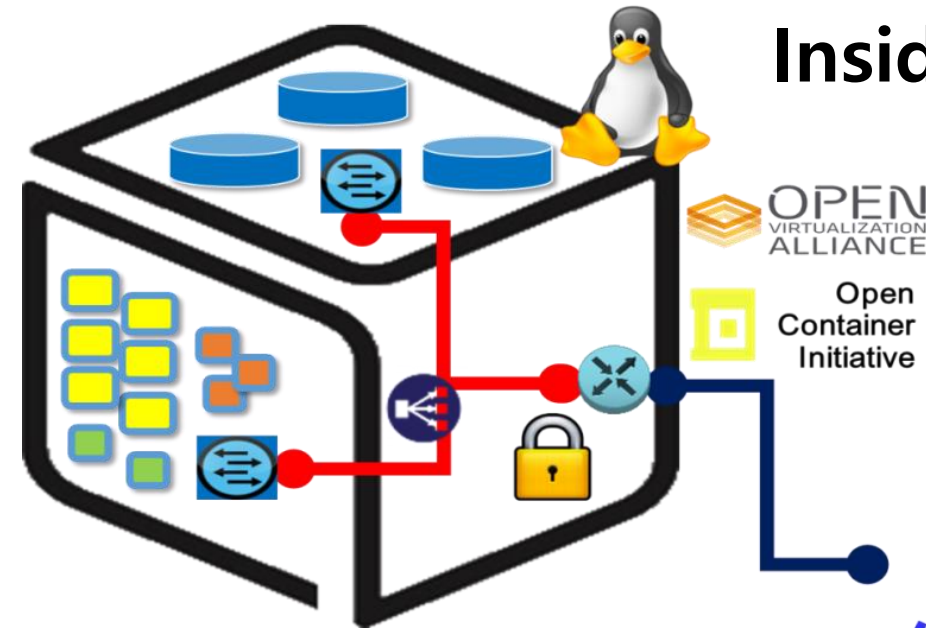
 **SaaS**
OverCloud
UnderCloud



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

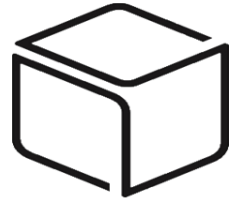
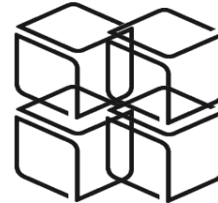


Inside a Box

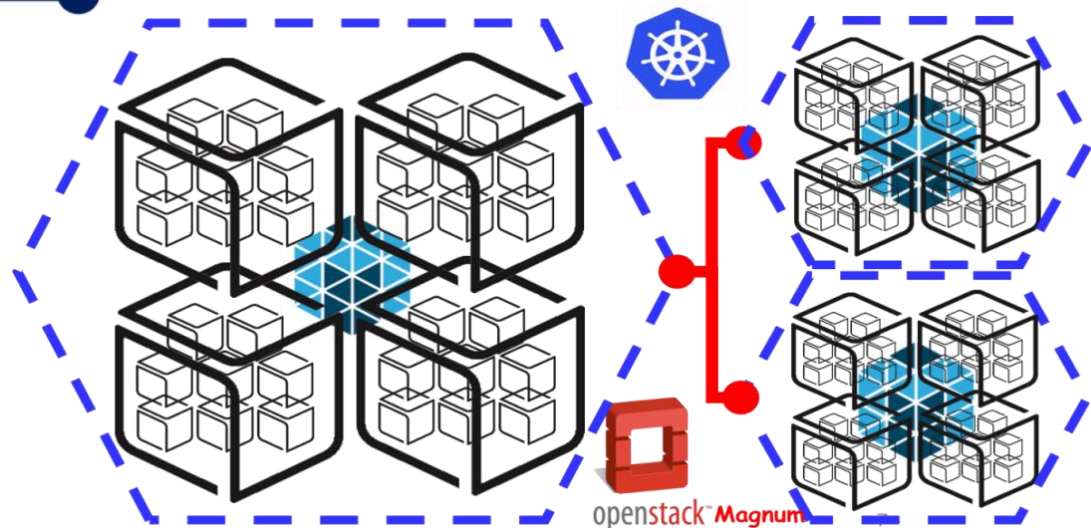


Scale Out

Scale Up



Across Clusters



p+v+c Challenge:

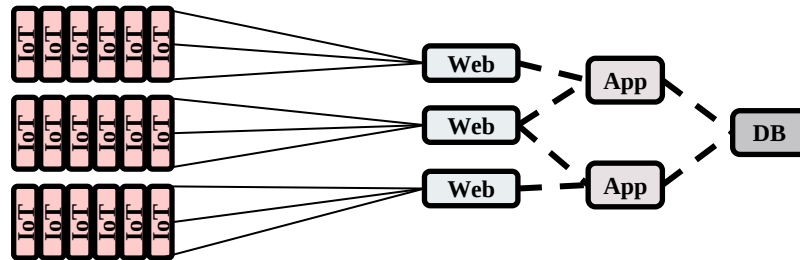
p(Baremetal)

+ **v**(VM)

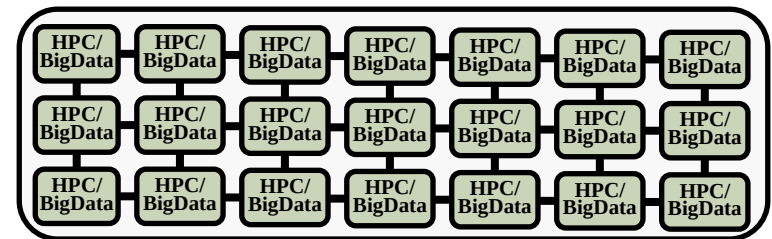
+ **c**(Container)

Diversified Services built with Inter-Connected Functions

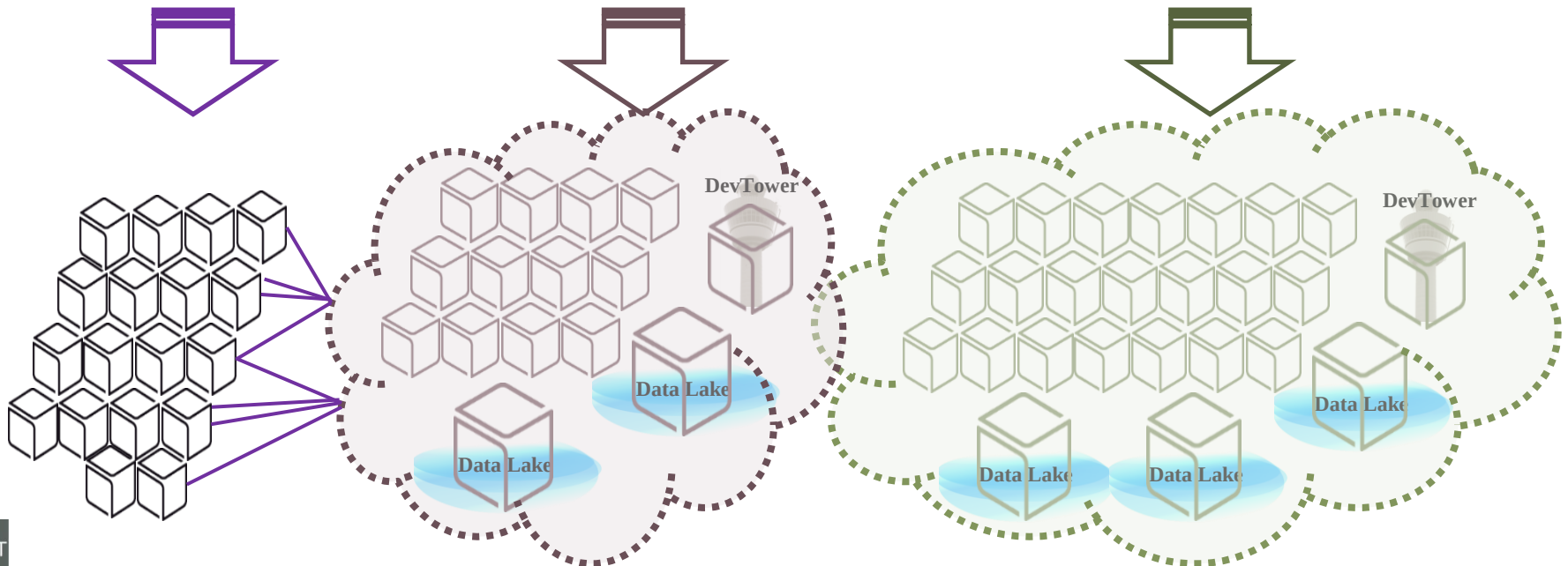
IoT-----Cloud



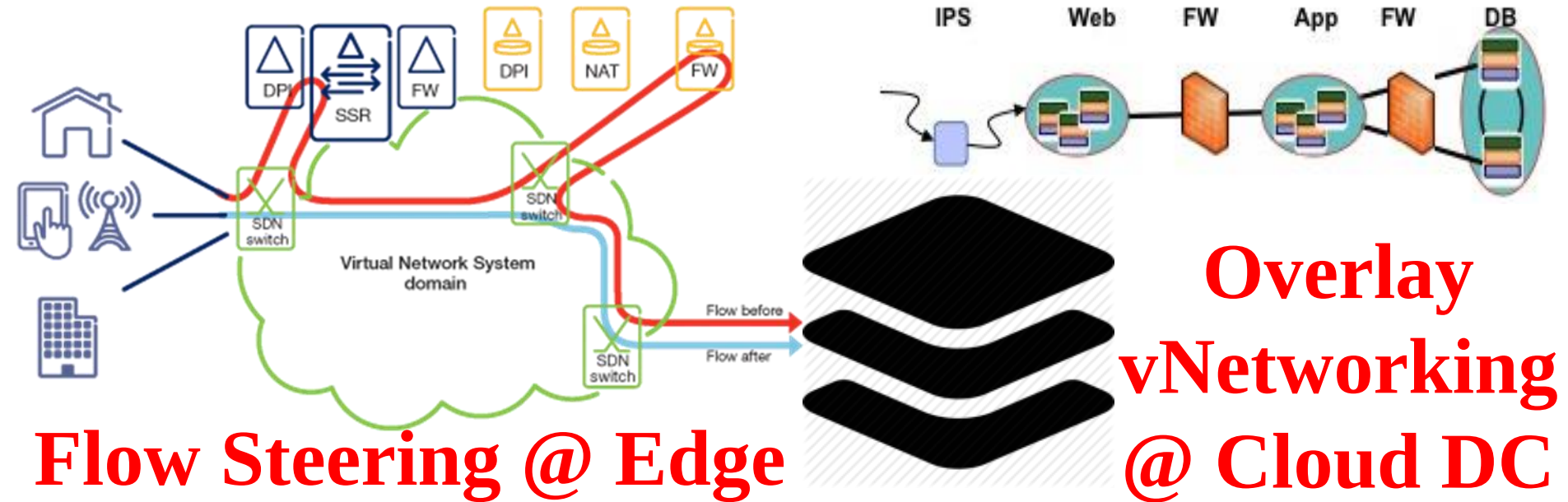
Web-App-DB 3-tier



HPC/BigData Cluster

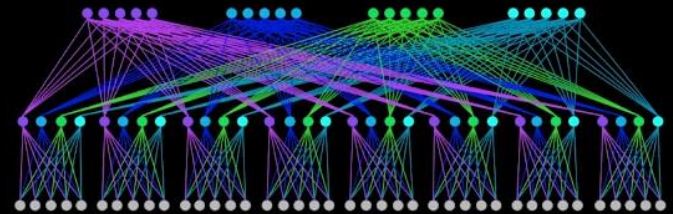


End-to-end Inter-connections (via Flows) for Diverse IoT--Cloud Services



Flow Tag/Steer/Map

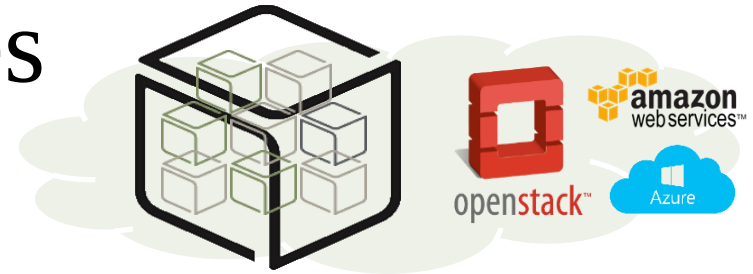
The Fabric: datacenter-wide performance



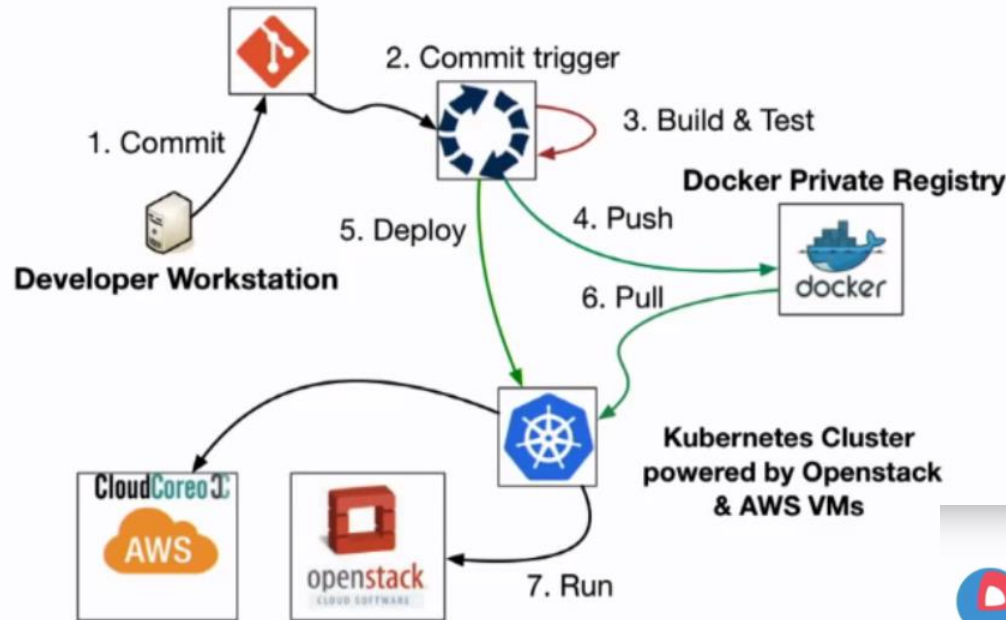
- highly scalable
- all 40G links
- 1 protocol: BGP
- smaller units
- IPv4 + IPv6
- software-driven

Automated Deployment of Container-based Services over Hybrid Cloud

Composable/Software-Defined Infrastructure



Microservice Pipeline



Container-based Orchestration
& Dynamic Resource Pooling



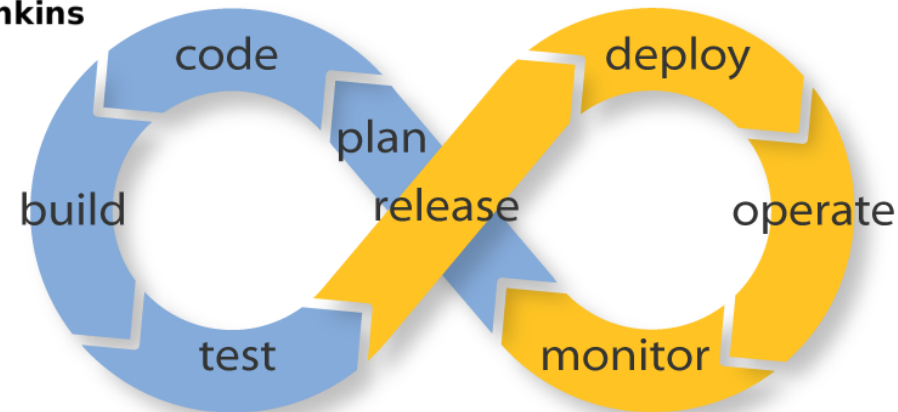
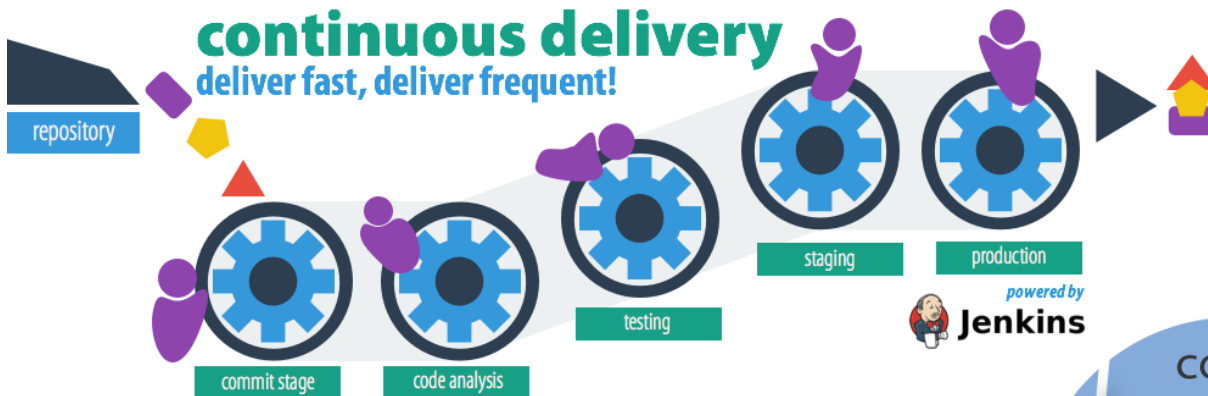
DevOps Automation & Continuous Integration/Delivery



DevOps (Development & Operation, 개발운영병행체제)

Building Software-based Automation over Overall Lifecycle:

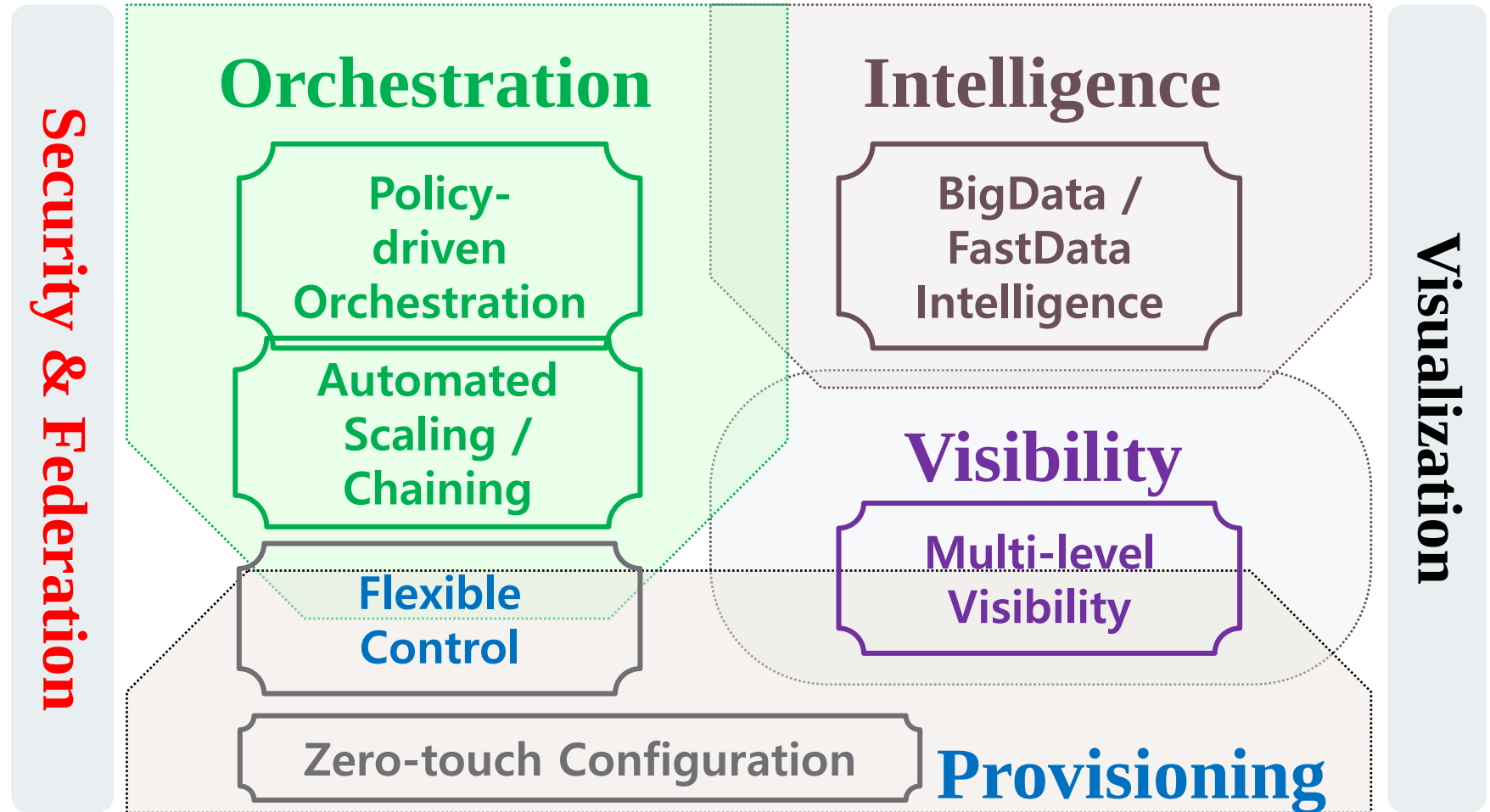
Development (Plan, Code, Build) → Test (QA & Staging) → Production (Deployment, Operation, Evaluation)



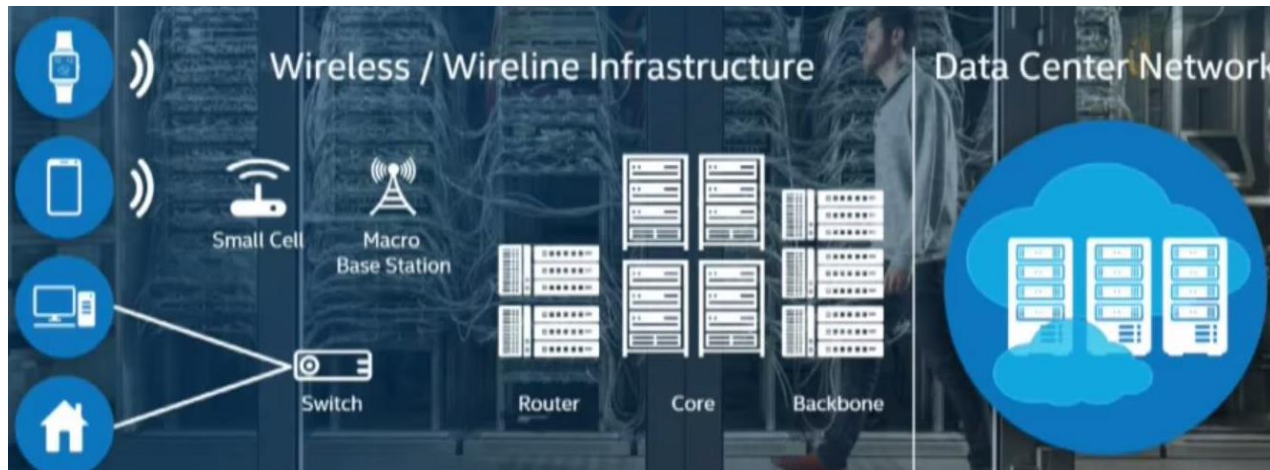
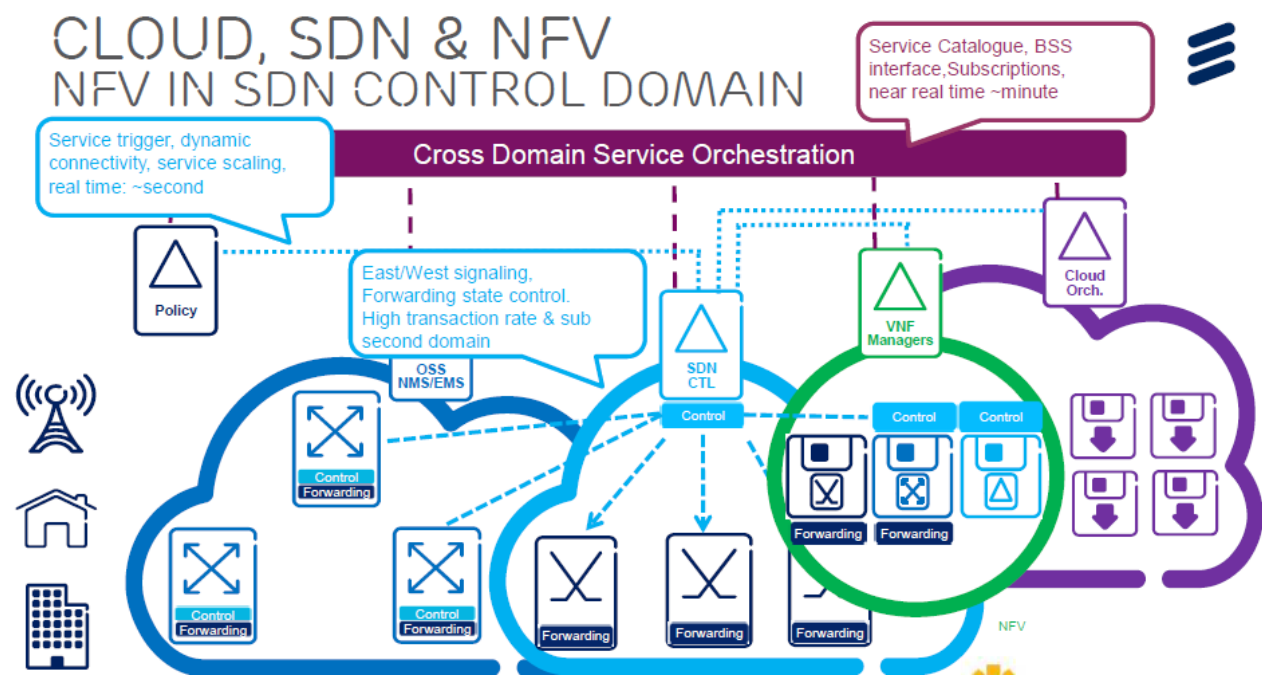
Endless Possibilities: DevOps can create an infinite loop of release and feedback for all your code and deployment targets.

SmartX Software Framework

SmartX Automation



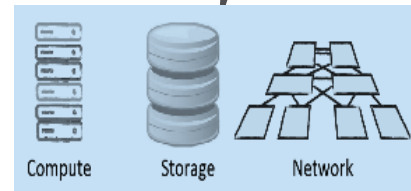
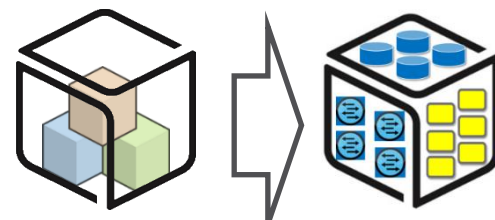
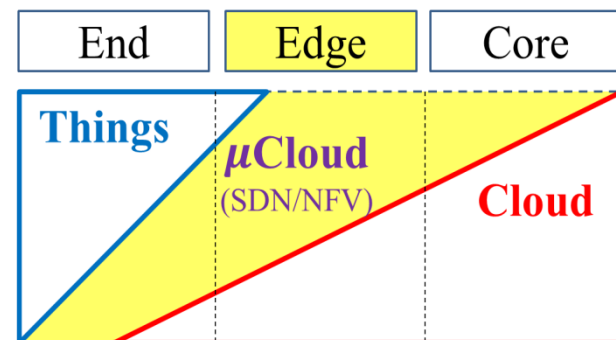
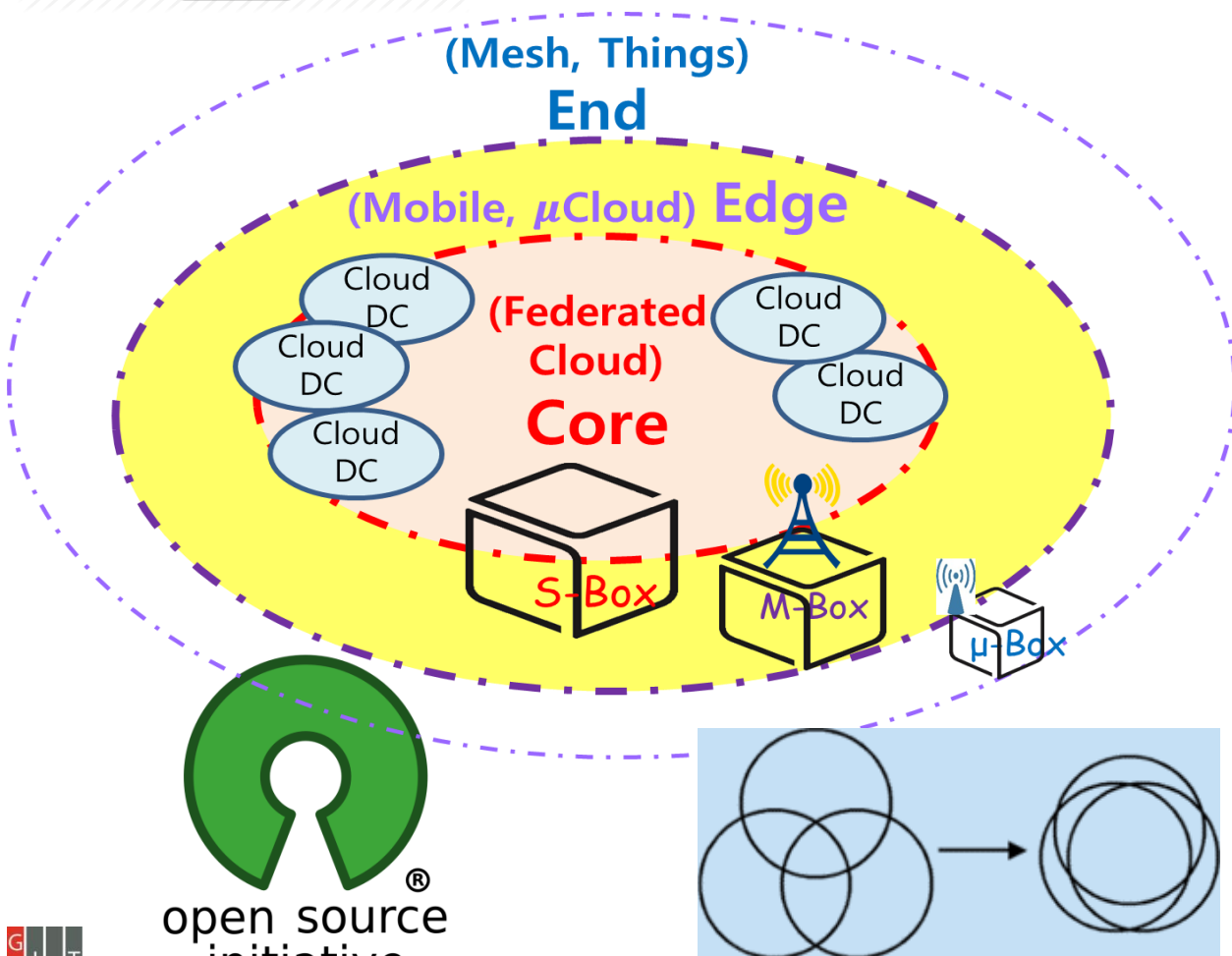
Converged Software- Defined Infrastructure (SDN/NFV/Cloud Integrated)



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

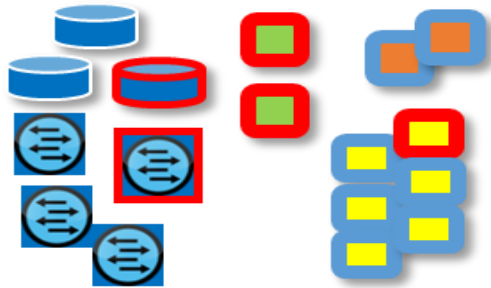


Hyper-converged Software-Defined Infrastructure (SDN/NFV/Cloud Integrated)

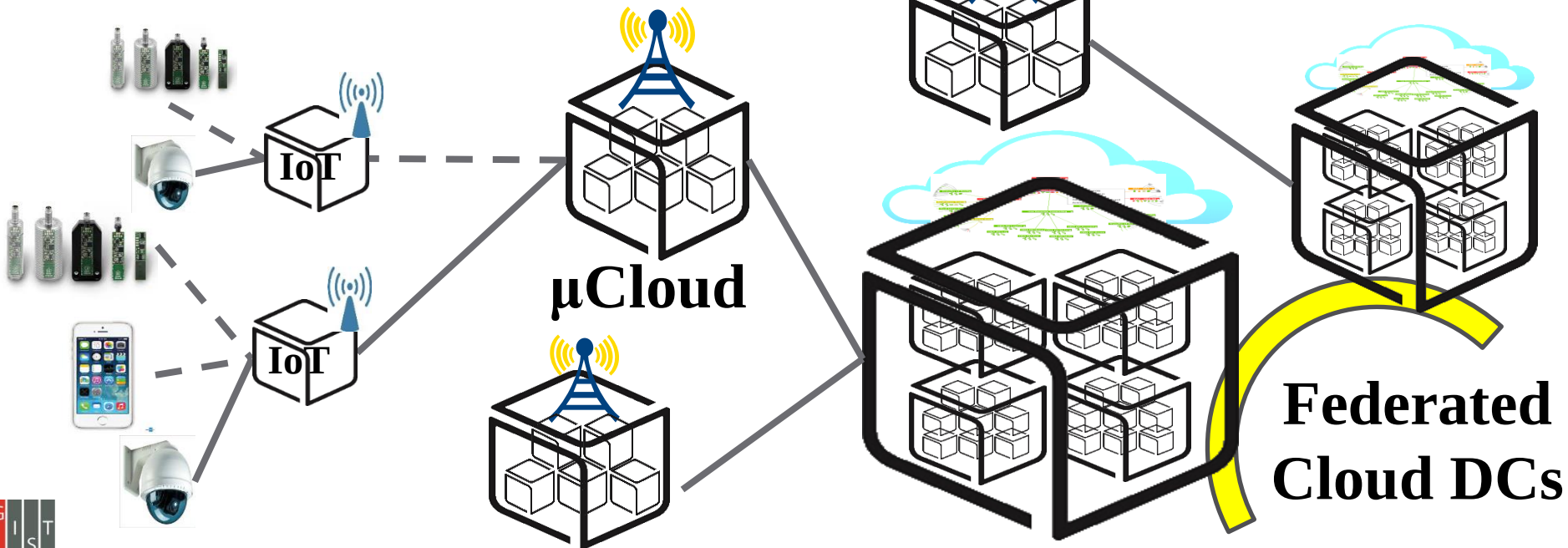
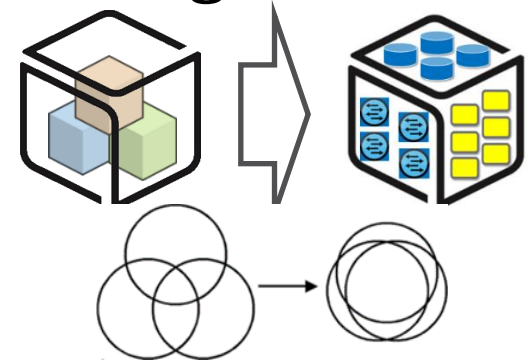


Hyper-converged SDI for Diversified Services

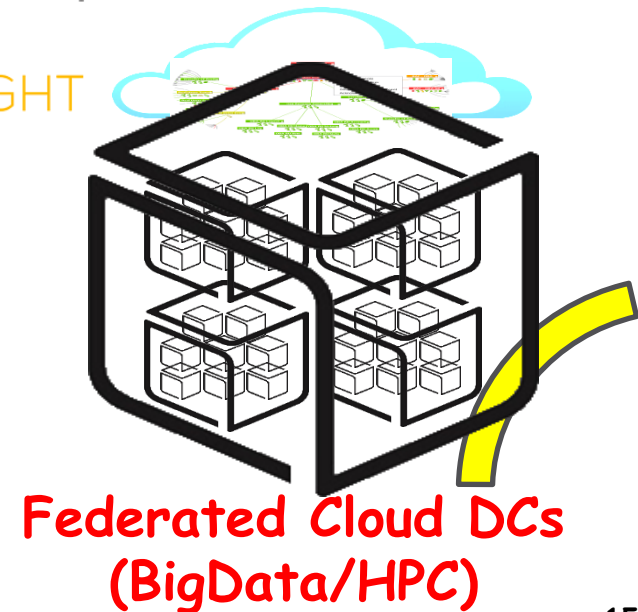
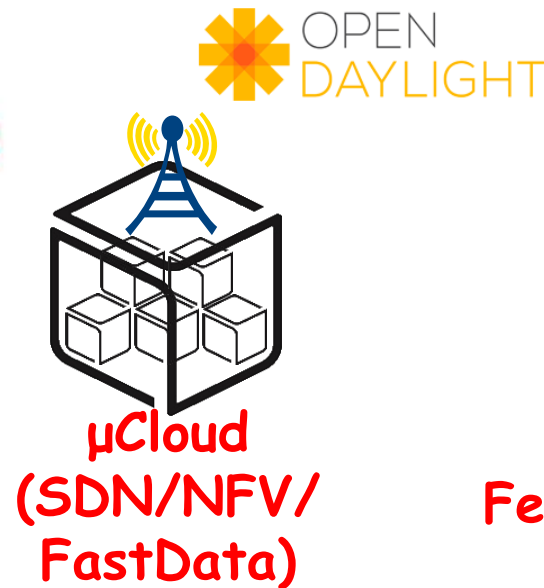
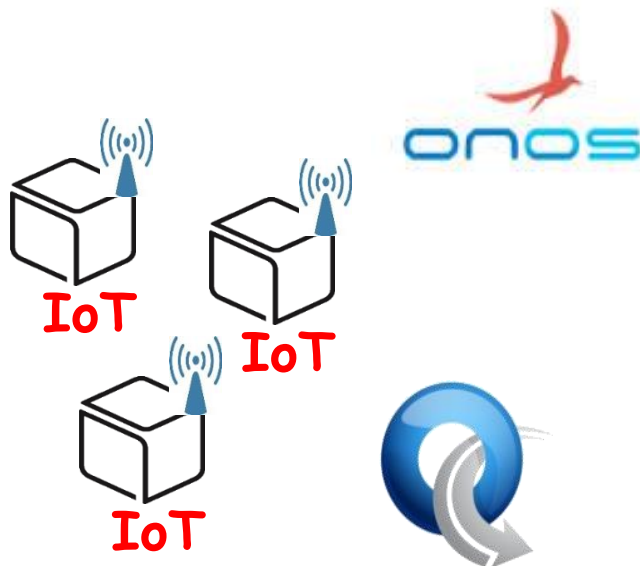
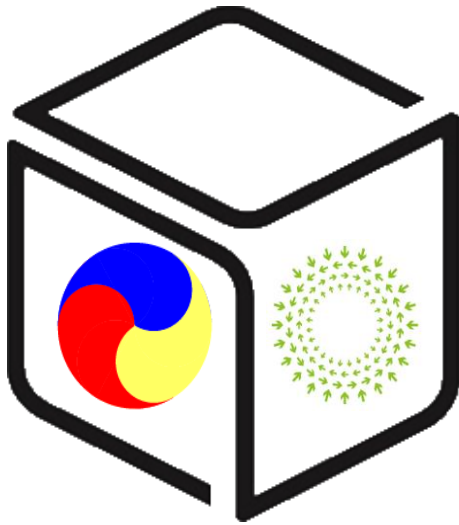
Diversified **SaaS** Applications



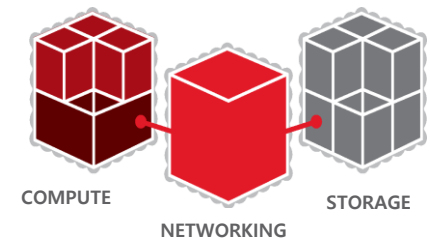
Resources in Hyper-convergent Boxes



Converged SDI & Open-Source Software

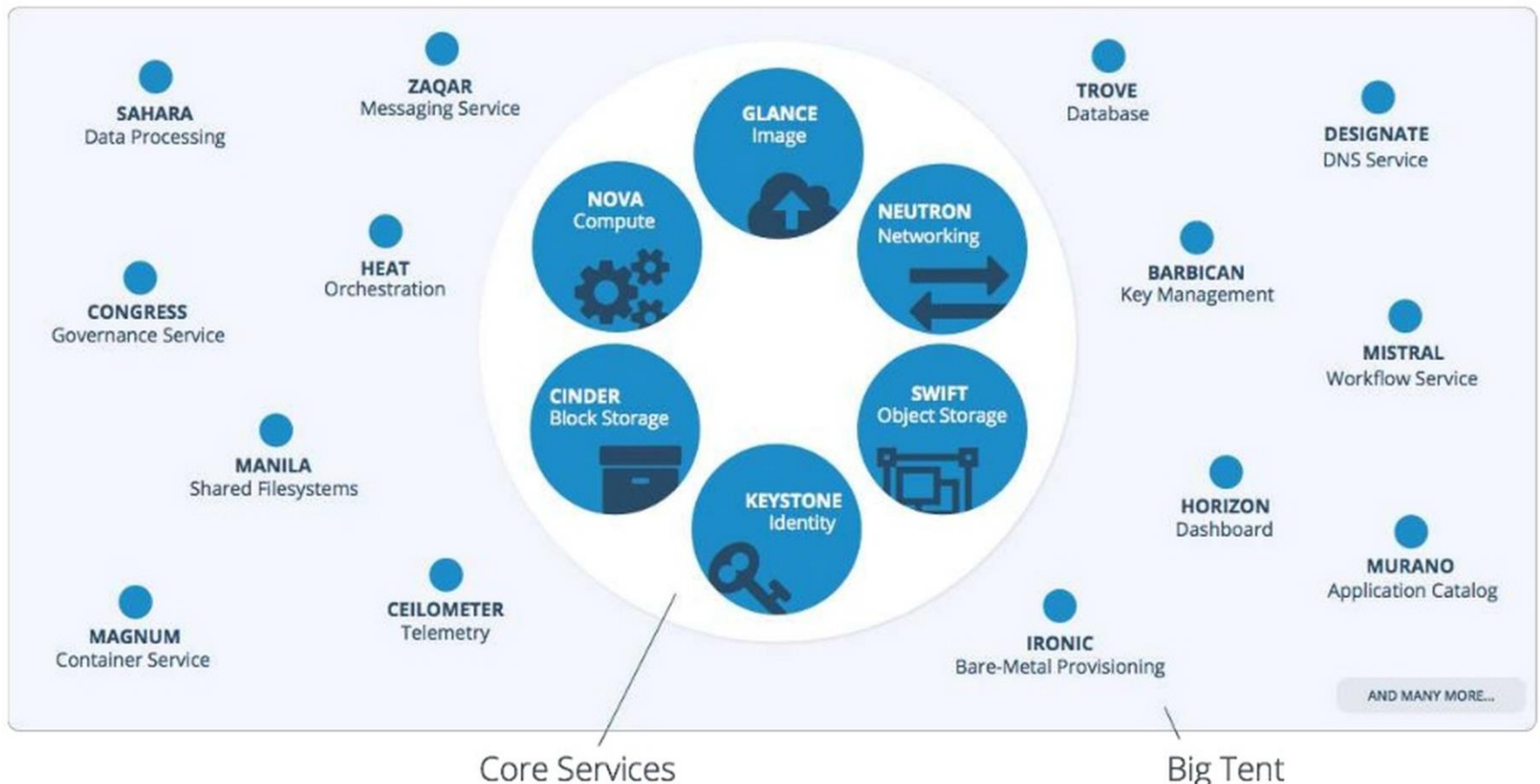


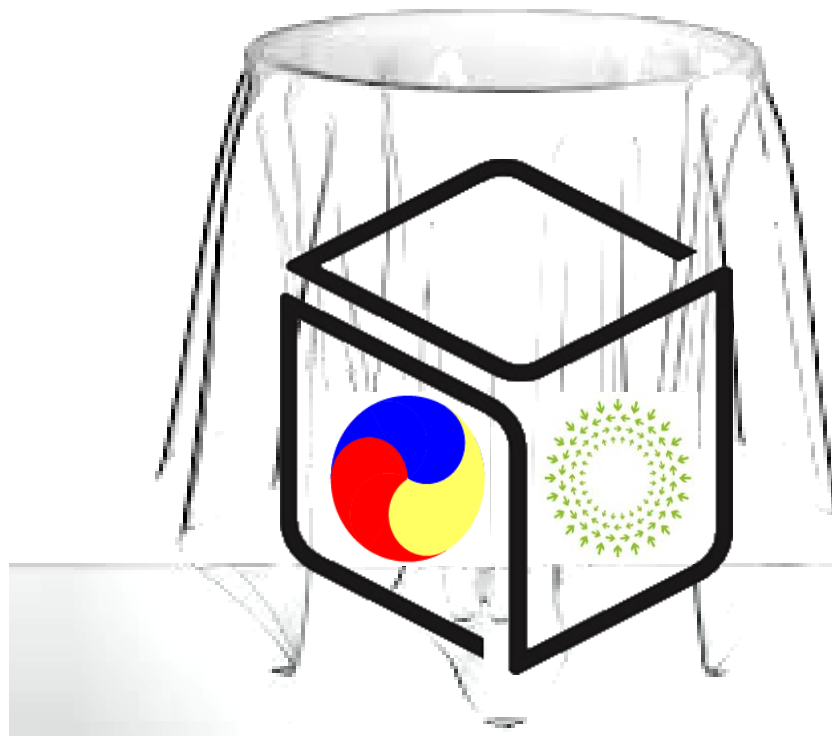
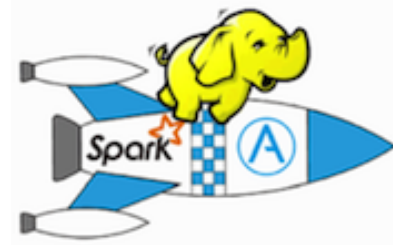
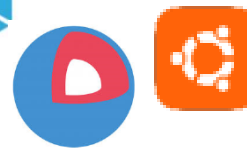
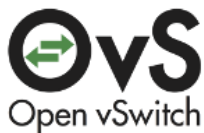
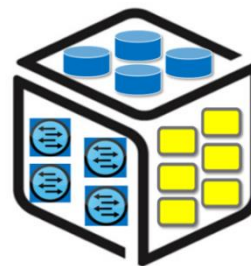
Open-Source Cloud OS: OpenStack



Containers, Bare Metal, NFV, Multisite/Federation, ...

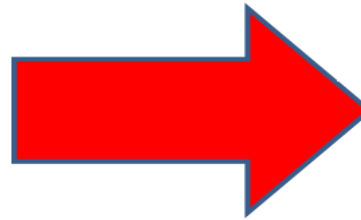
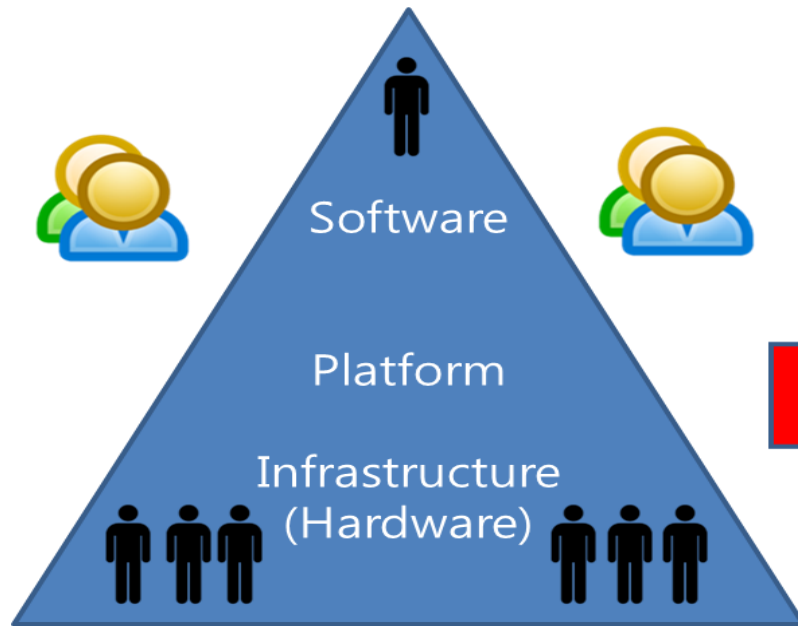
The “big tent” and “core services”



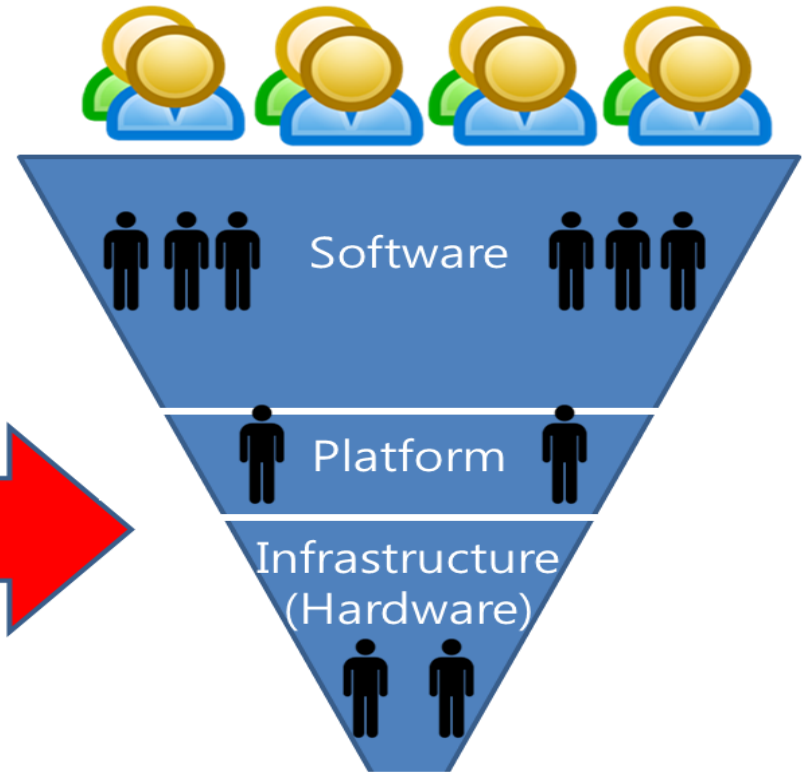


Software-centric Vision for ICT Infrastructure

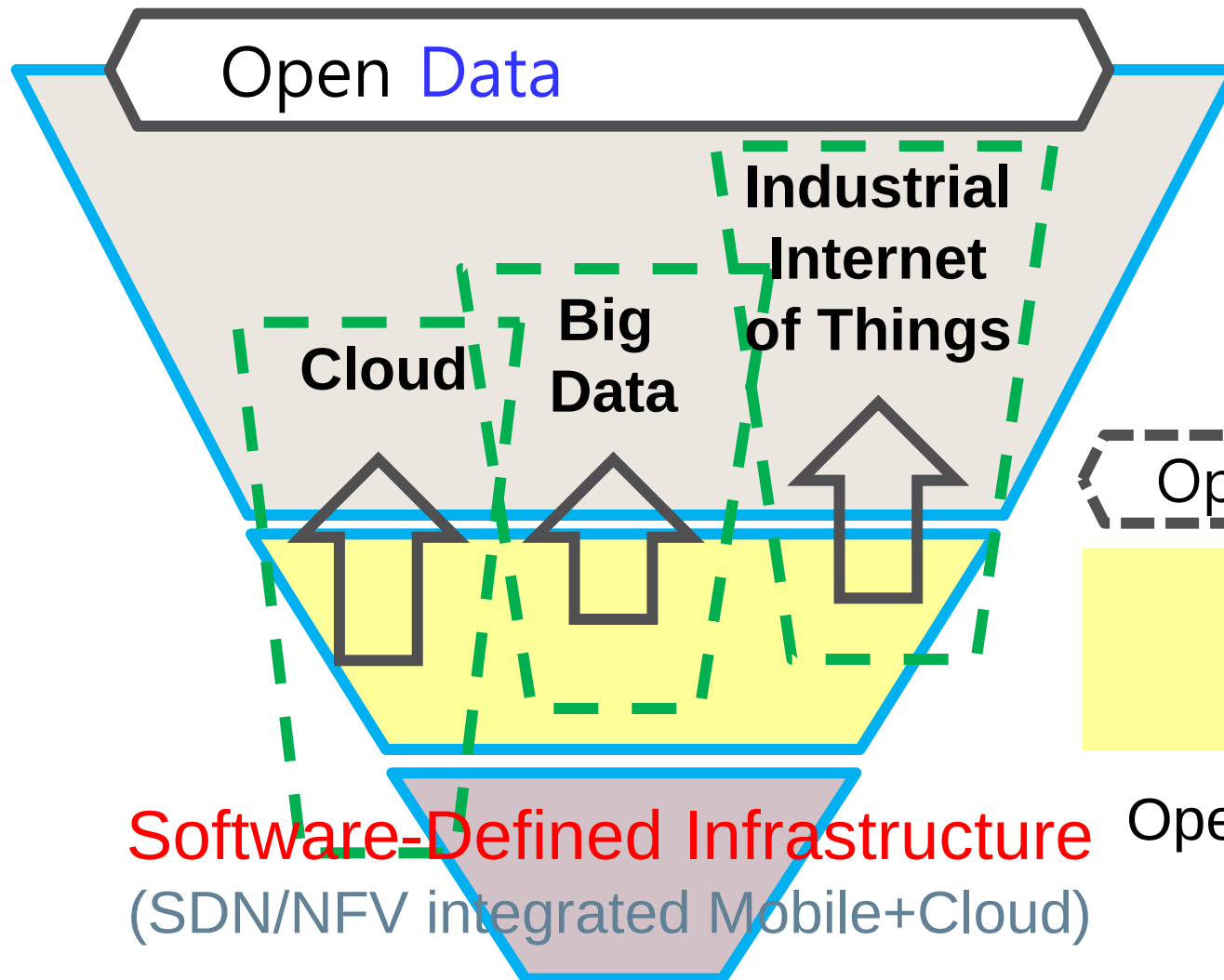
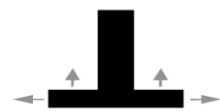
Reset, Rebuild, Run!



**Open
Destruction**



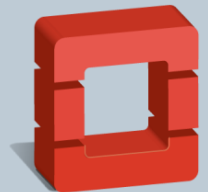
Human-Defined Services over Software-Defined Infrastructure



Open Software (Services)

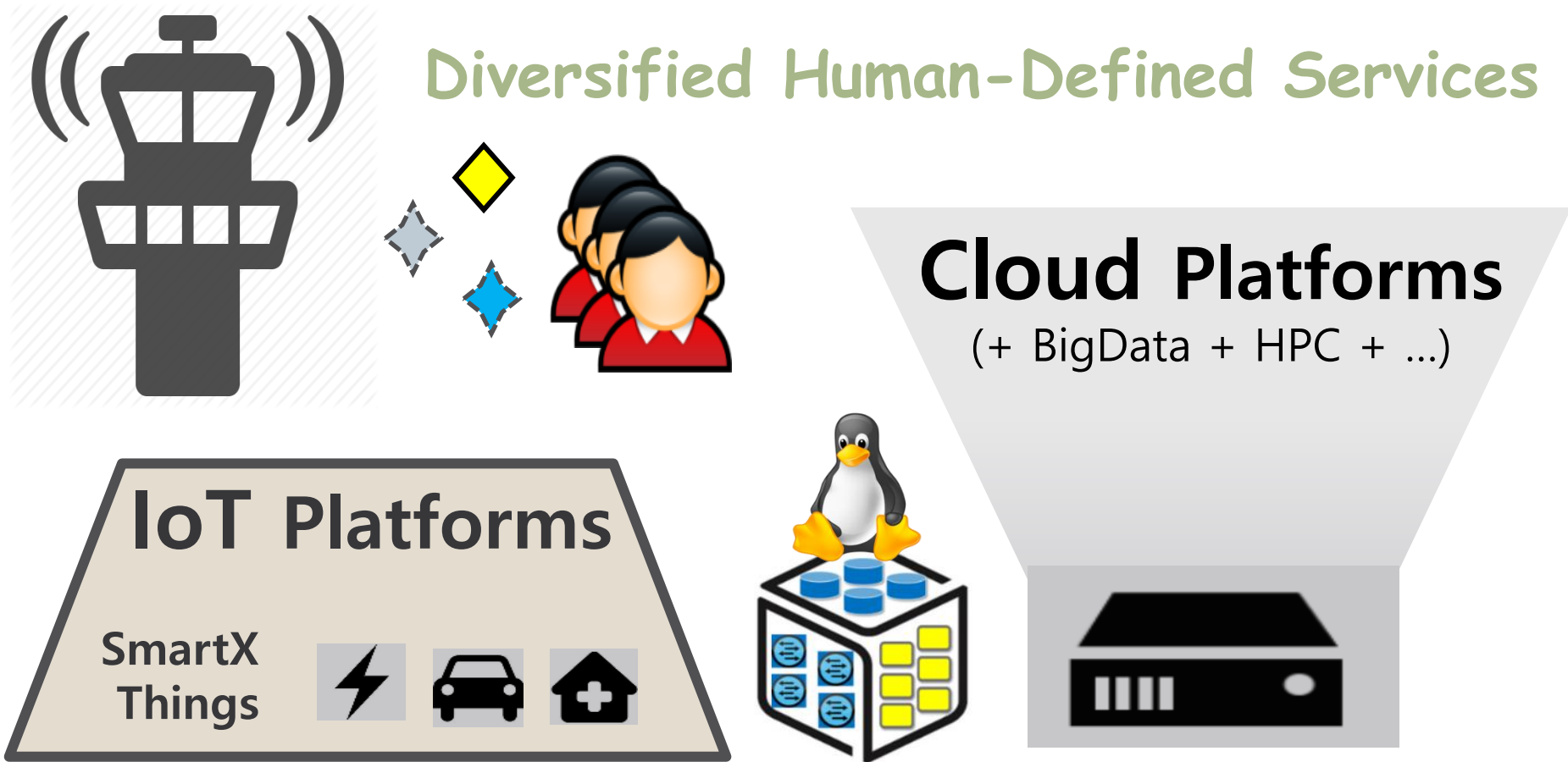
Open Infrastructure (Resources)

SmartX IoT-Cloud Services (with Cloud-based Analytics) over SmartX Playground



openstack™

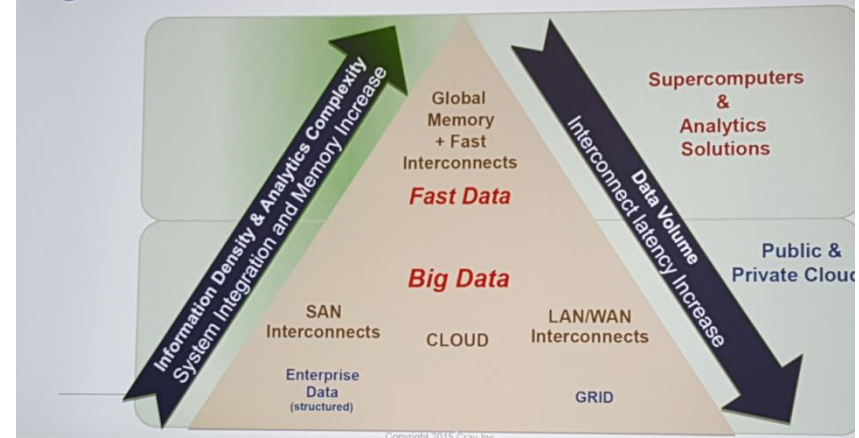
IoT--Cloud Services over Convergent SDI (IoT — SDN/NFV/FastData — Cloud (BigData/HPC))



Convergent Software-Defined Infrastructure

SmartX IoT—Cloud Services with FastData/BigData Analytics

Big Data vs. Fast Data

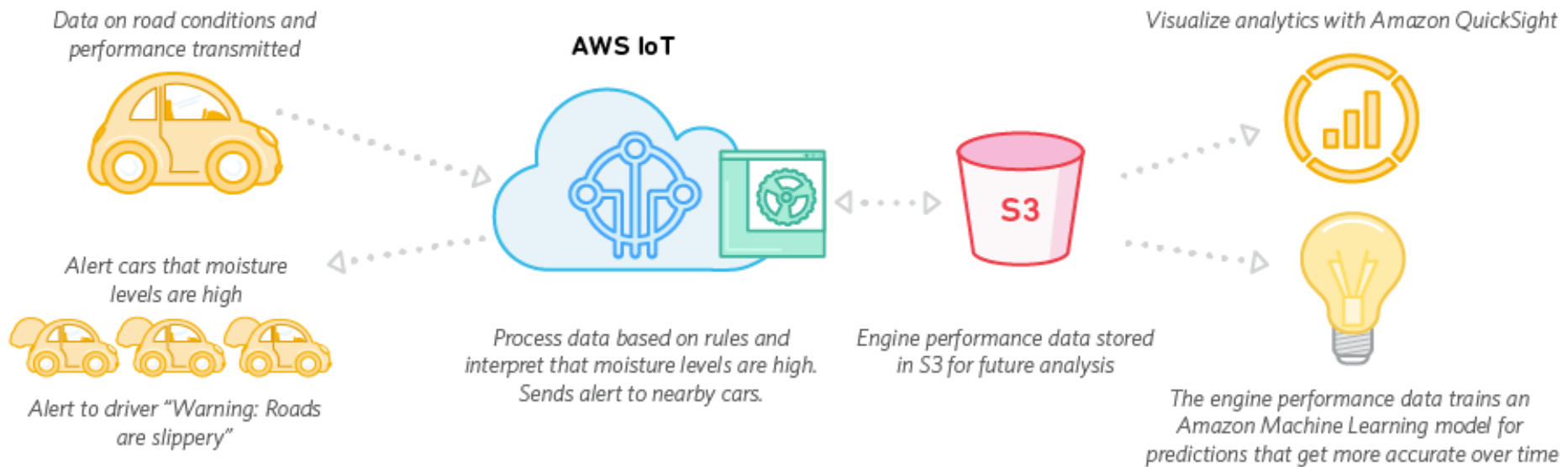


BigData Predictive Analytics



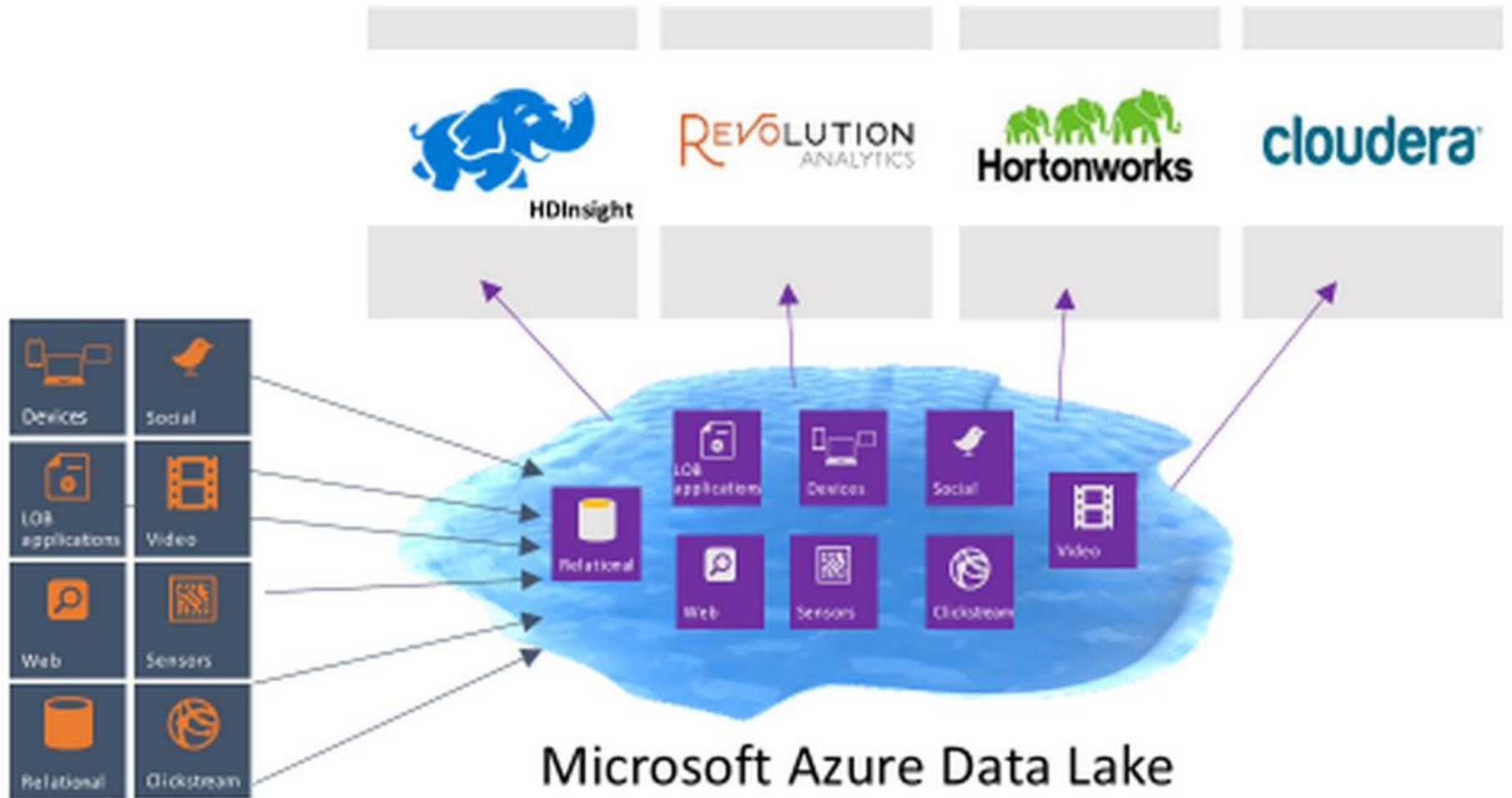
Cloud-based DataLake

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

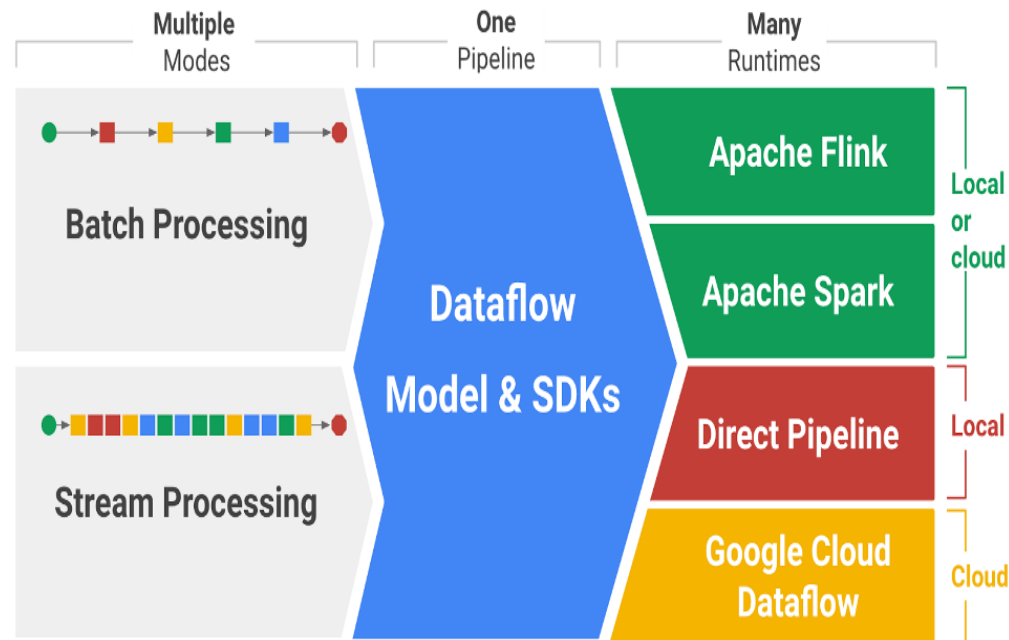
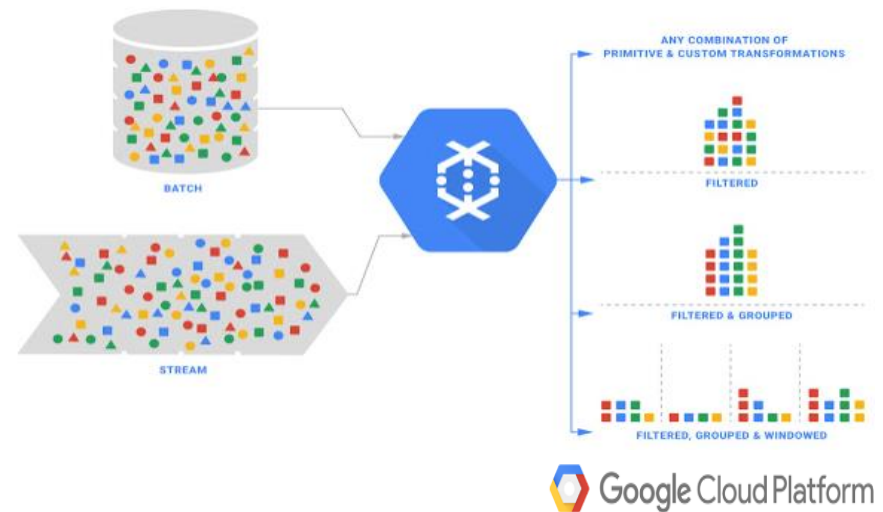
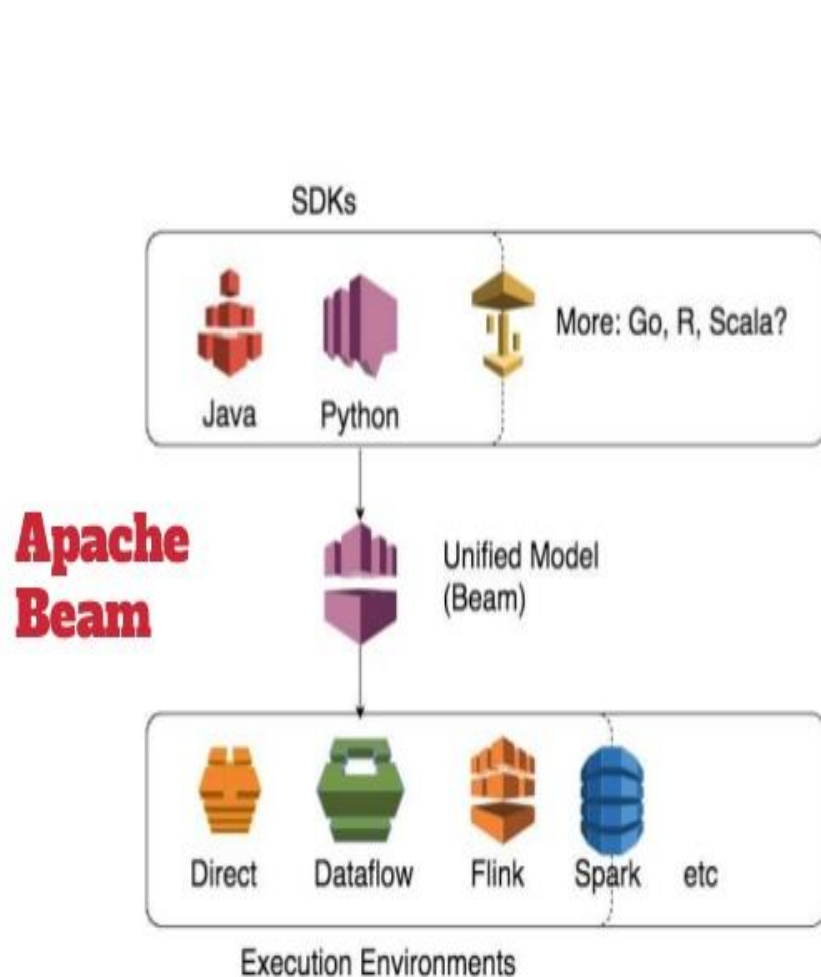


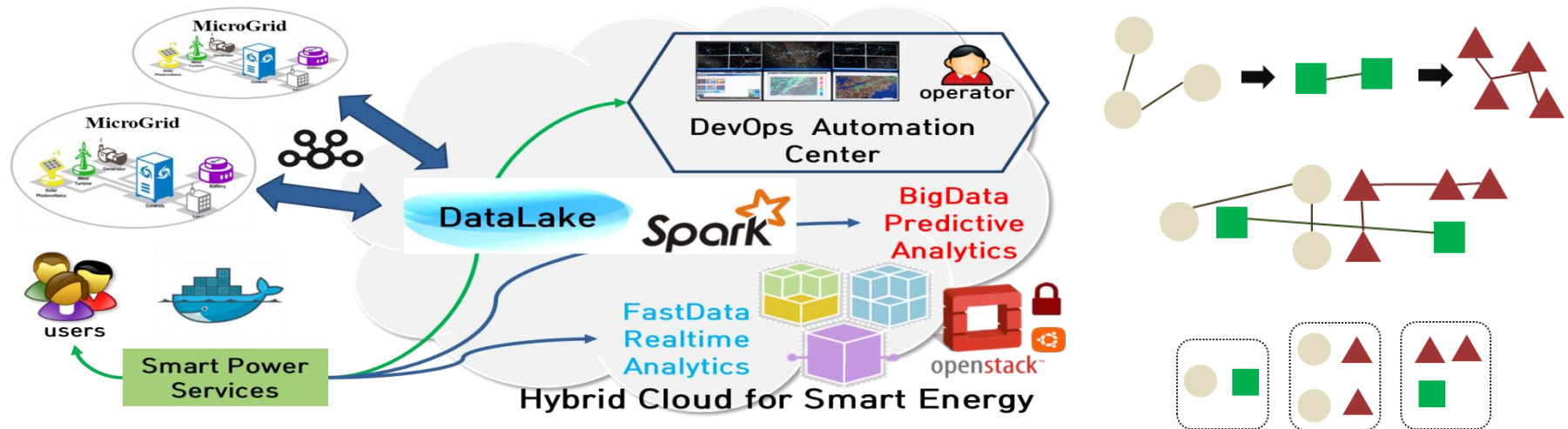
- A complete software stack for managing devices and endpoints.
- Partnerships with limited number of hardware companies for software integration.
- Messaging stacks – queues, brokers, request routing, ...
- Comprehensive software backend for database, object management, notification and streaming.
-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

Microsoft Azure Data Lake



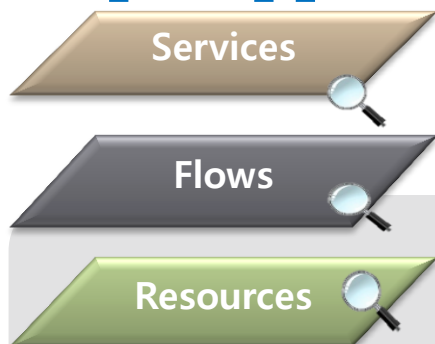
Google DataFlow & Apache Beam





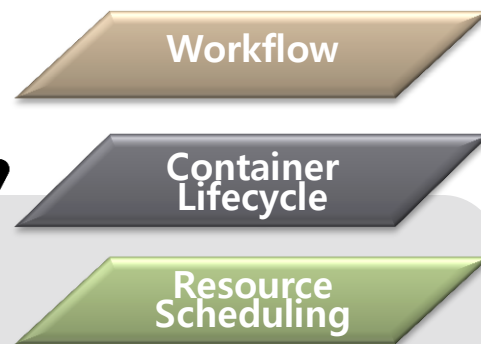
DevOps-based Automation of IoT-Cloud Services

Multi-level Ops/App Visibility



Automation Service

Workflow-based Orchestration

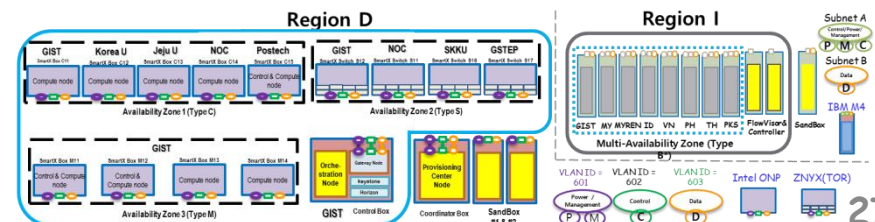
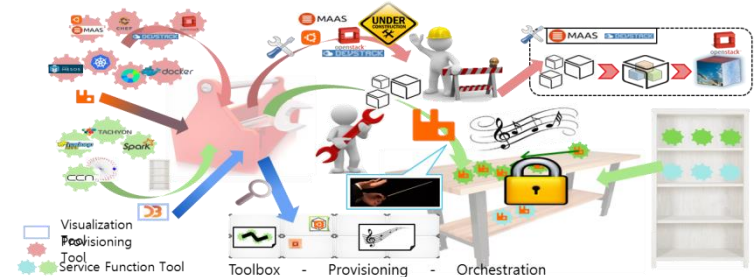


Infrastructure/Platform with Hyper-converged Boxes



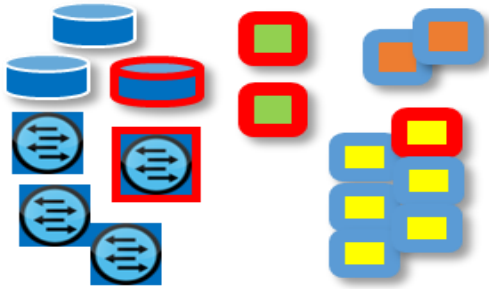
The diagram illustrates two interconnected network architectures:

- OF@KOREN (Left Side):** A cloud-based network centered around the "GIST (Gwangju)" node. It includes nodes for SKKU (Suwon), KOREN NOC (Seoul), Korea U (Seoul), Postech (Pohang), and Jeju U (Jeju). The network is managed by an "Auto Center".
- TEIN (Right Side):** A larger cloud-based network centered around the "Philippines" node. It includes nodes for Taiwan, Vietnam, India, Indonesia, Pakistan, Malaysia (MYREN), Thailand, and Malaysia (UM).
- Interconnection:** The "Auto Center" acts as a bridge between the two networks, facilitating communication between the GIST (Gwangju) node and the Philippines node.
- Legend:**
 - SmartX Box (Red circle with black dot)
 - OpenFlow FlowVisor (Blue circle with white dot)
 - SDN Controller (Blue square with white dot)
- Date:** Last Update: 2015-07-31

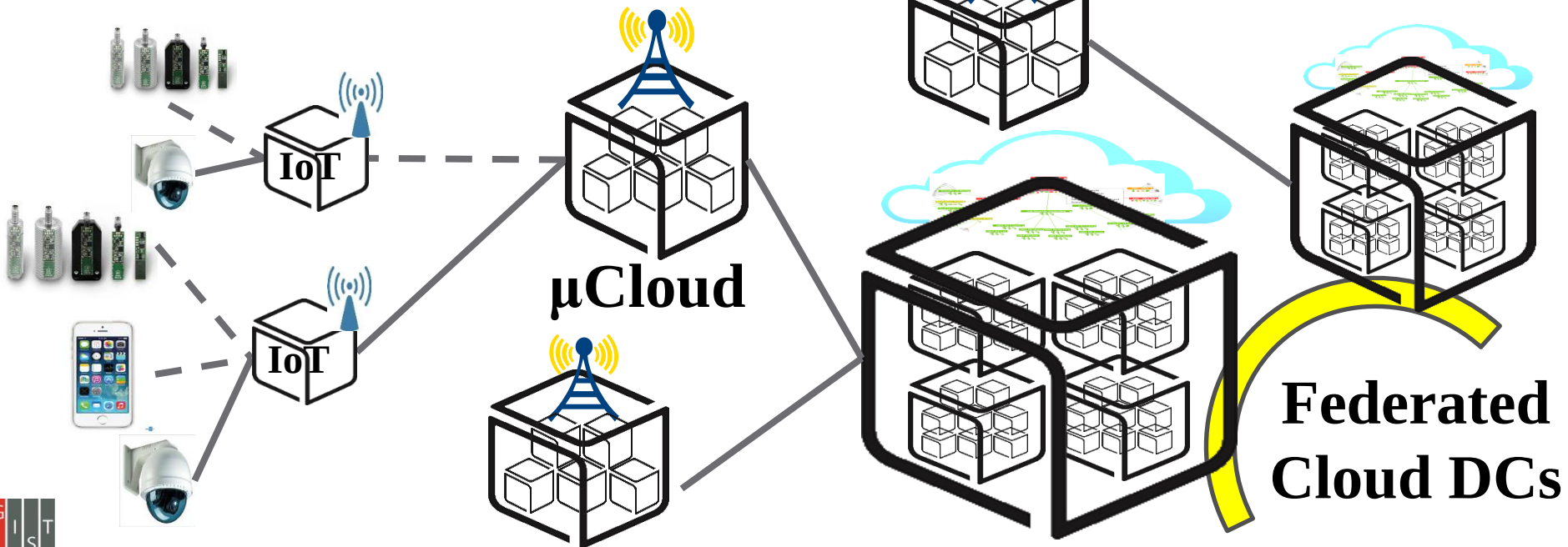
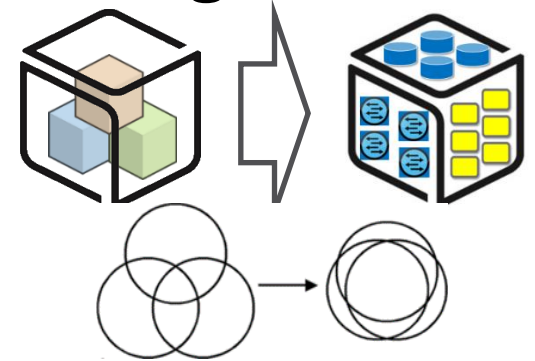


Hyper-convergent SDI for Diversified Services

Diversified **SaaS** Applications



Resources in Hyper-convergent Boxes

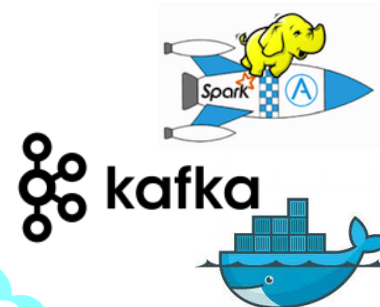
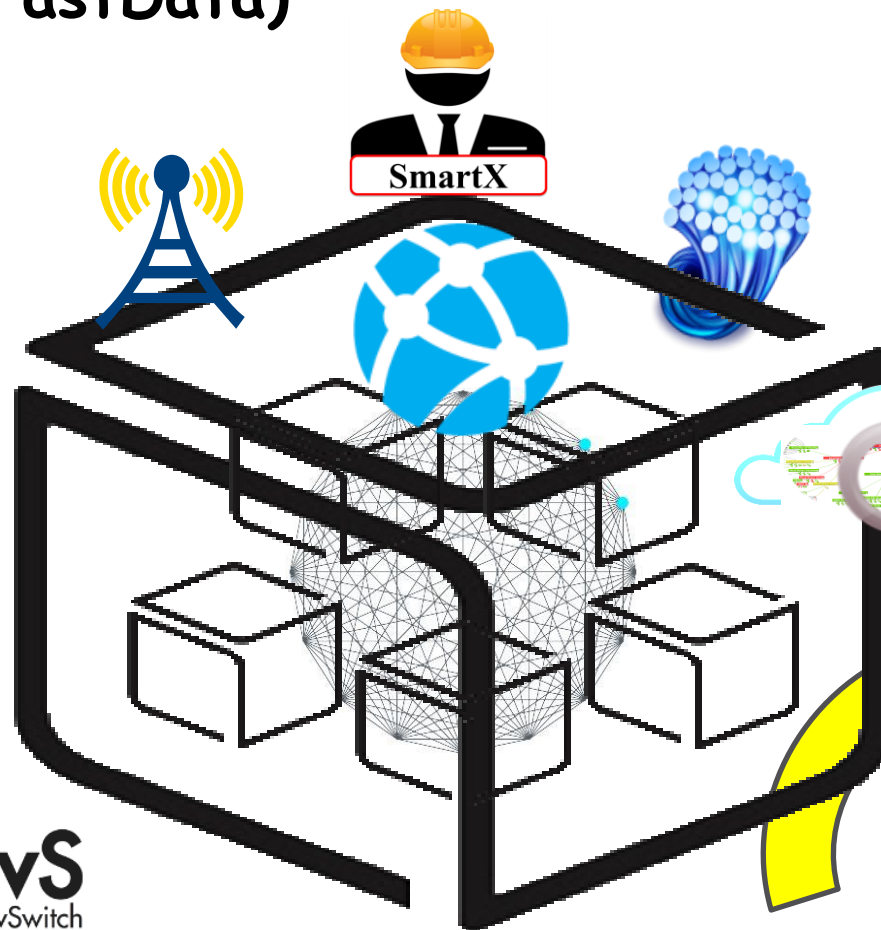


K-Cluster Concept Design (2016. 01 - v0.1)

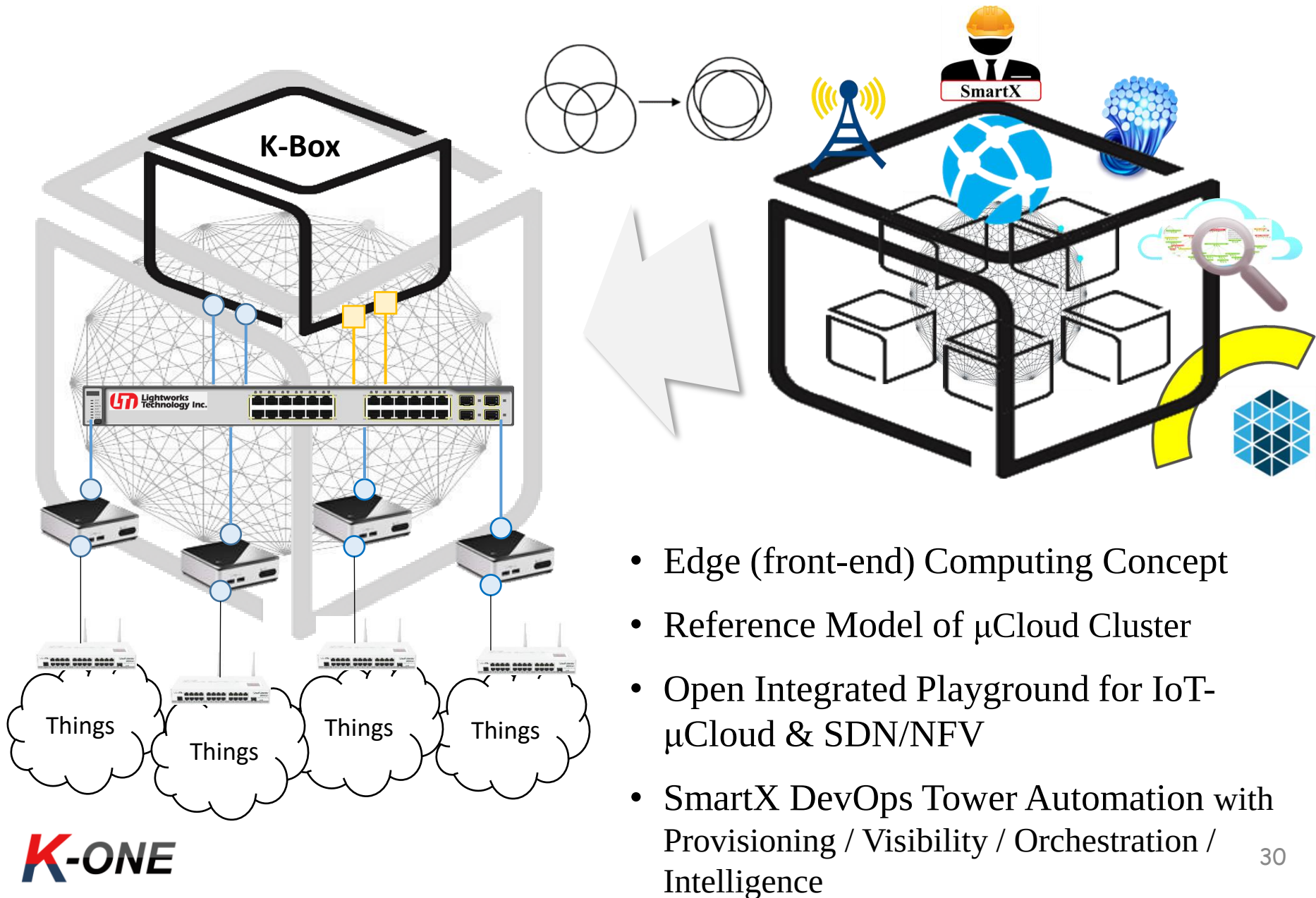
Federated μ Clouds
(SDN/NFV/FastData)



K-ONE
OF@TEIN

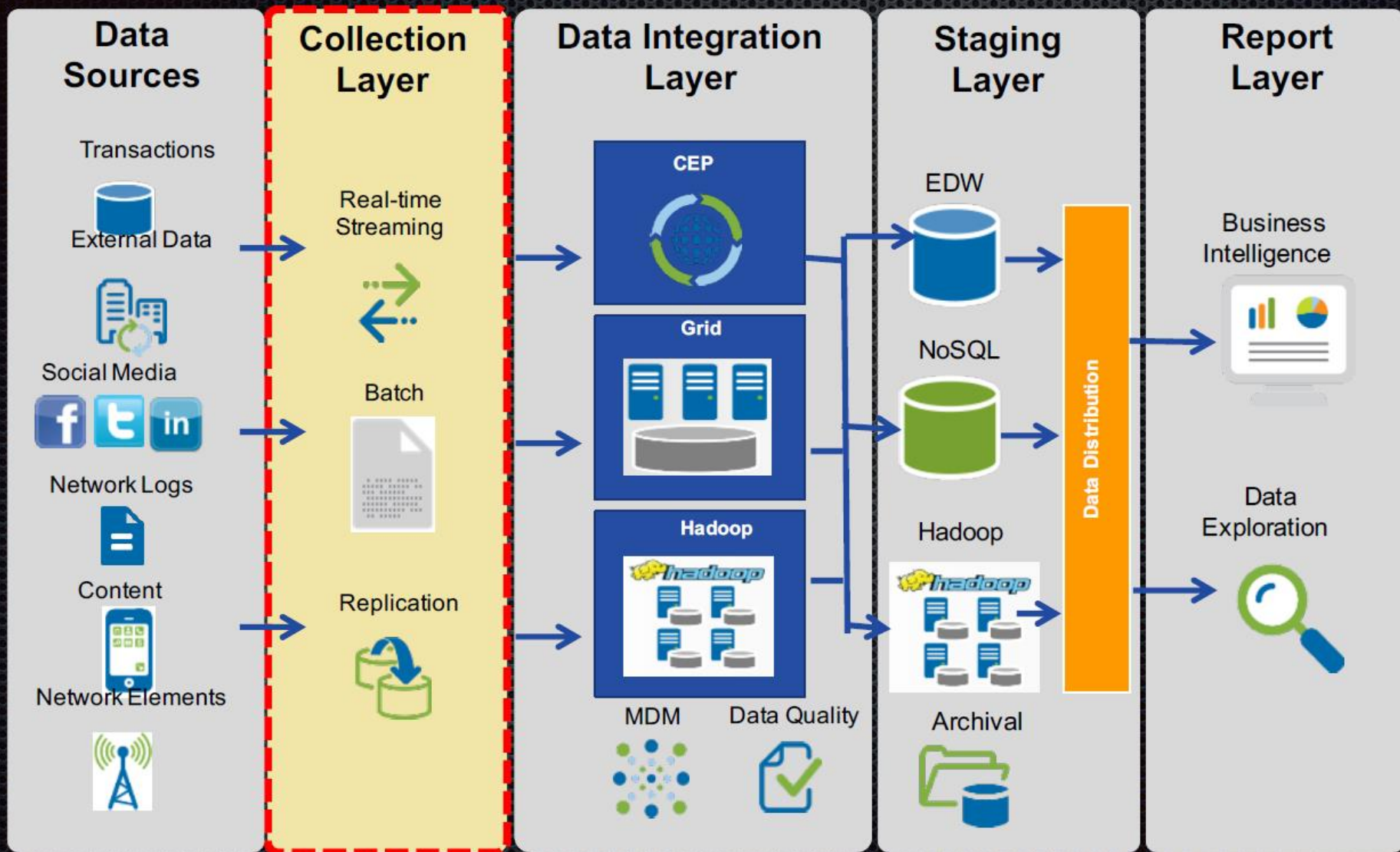


K-Cluster Early Prototype (2016 Spring)



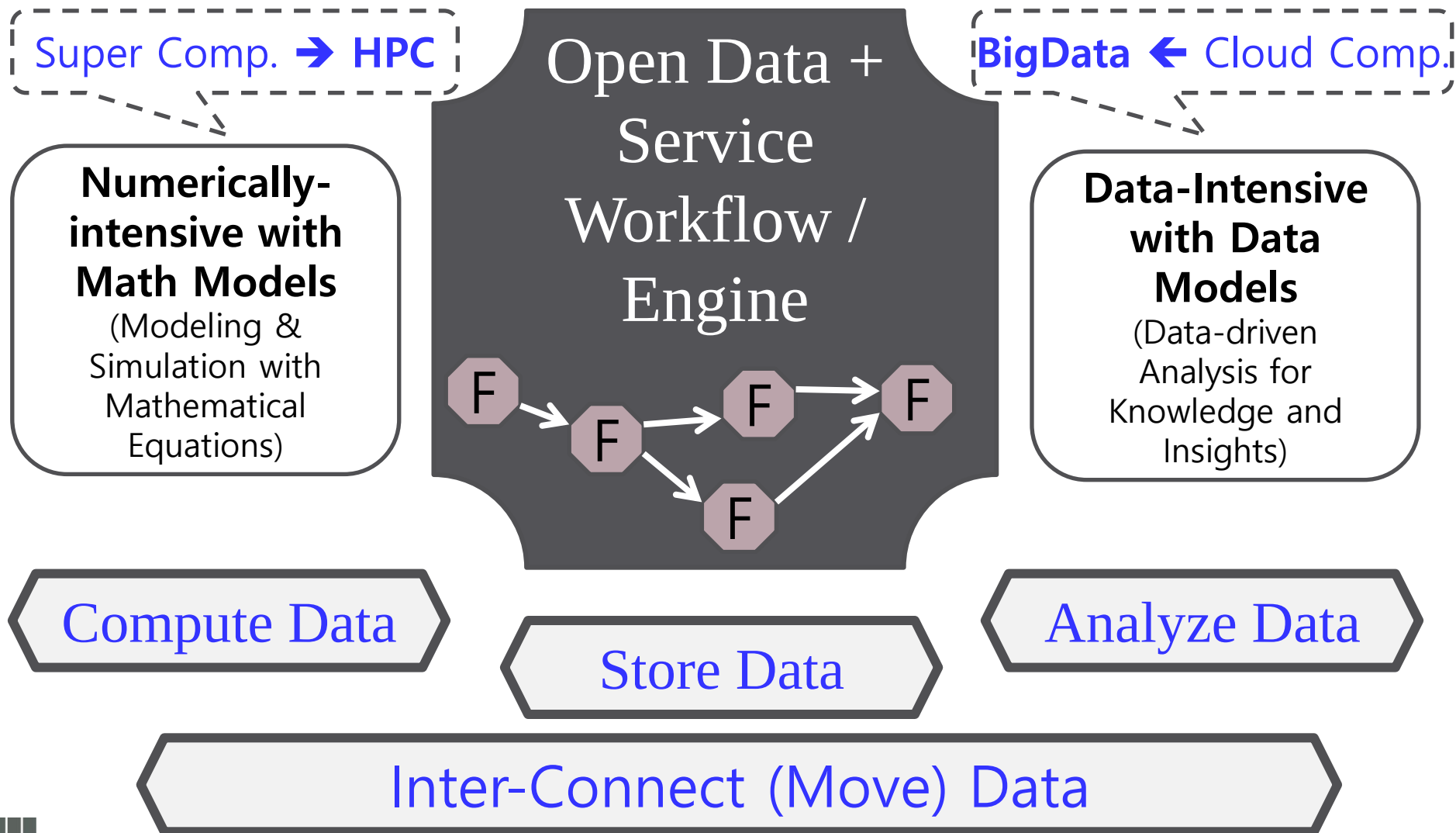
- Edge (front-end) Computing Concept
- Reference Model of μ Cloud Cluster
- Open Integrated Playground for IoT- μ Cloud & SDN/NFV
- SmartX DevOps Tower Automation with Provisioning / Visibility / Orchestration / Intelligence

Data Science Workflow

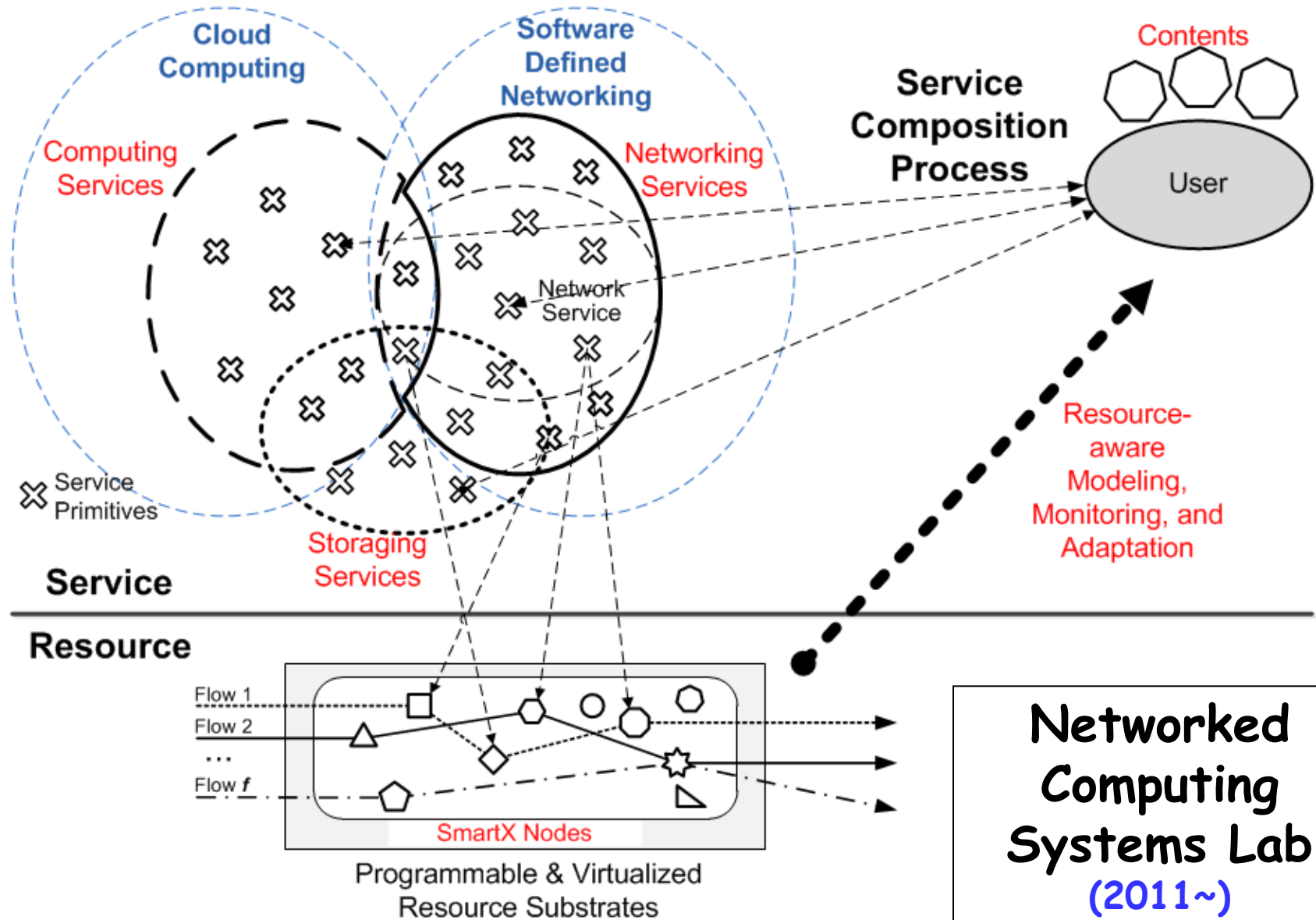


SmartX Services with Open Data & Lifecycle Orchestration

F Functions = MicroServices



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





Gwangju Institute of
Science & Technology



Thank you!

jongwon@gist.ac.kr

Open Networking KOREA



openwincon

Single controller for all wired & wireless networks

<http://opennetworking.kr>

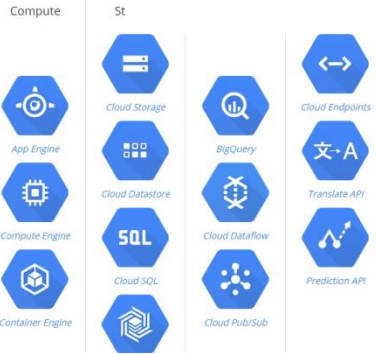
Converged SDI @ Hyper-scale Cloud (Google)

Google Search / Google Maps / MapReduce / Dremel / Gmail

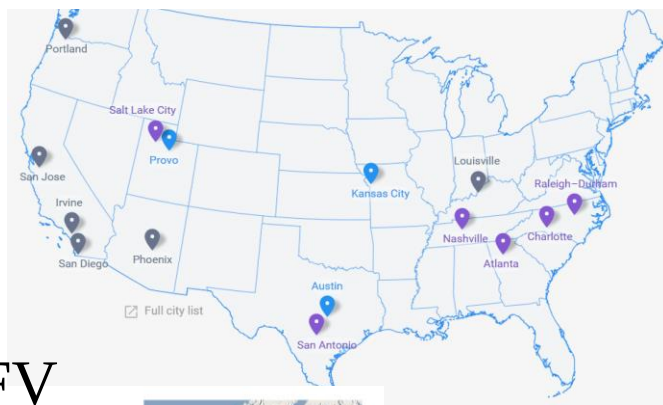


Omega: Distributed scheduling

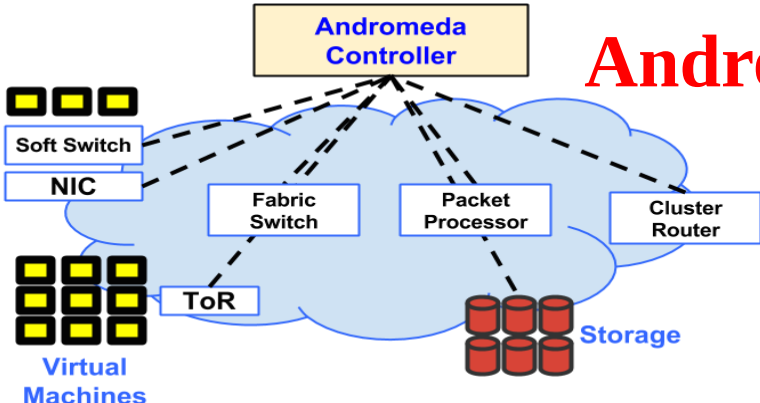
Kubernetes:
Container orchestration



Fiber & FI: Optical & Mobile



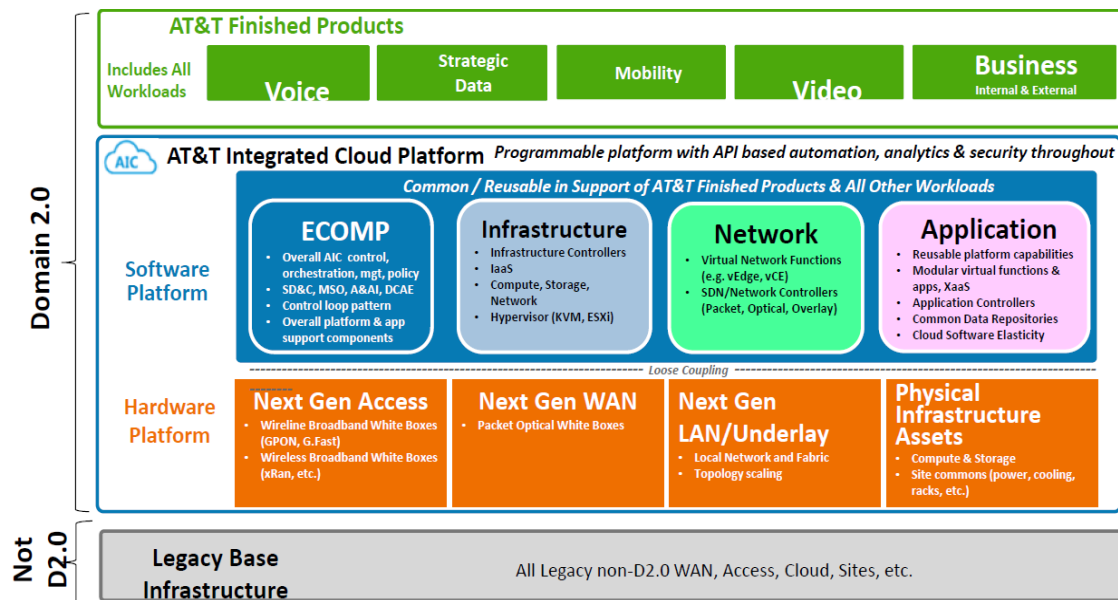
Andromeda: SDN/NFV



B4:
Global SD-WAN

Converged SDI @ Carriers

SDN/NFV Native 5G Architecture: Covering all aspects ranging from devices, infrastructure, network functions, value enabling capabilities and all the management aspects to orchestrate the 5G system



AT&T Domain 2.0:
User-Defined
Network Cloud
(Open / Simple / Scale / Secure)

