

Containerized IoT-Cloud Services over SmartX Playgrounds and their Sustained Orchestration

Tutorial Talk @ APNOMS 2017

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School of Information and Communications
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Smart + X

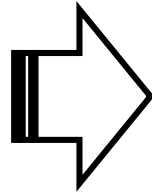
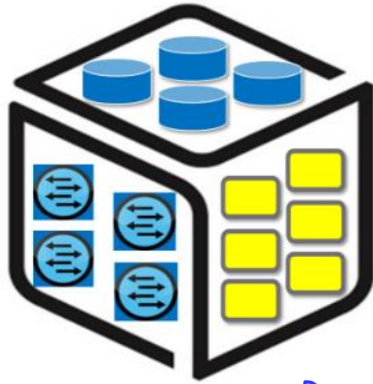
Providing Intelligence

All services that are
Flexible and Adaptable

Provides **Flexible/Agile**
SmartX User-defined
Services and Infrastructure

Realize SmartX Services with Open APIs enabled by SmartX Boxes

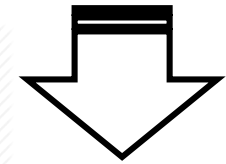
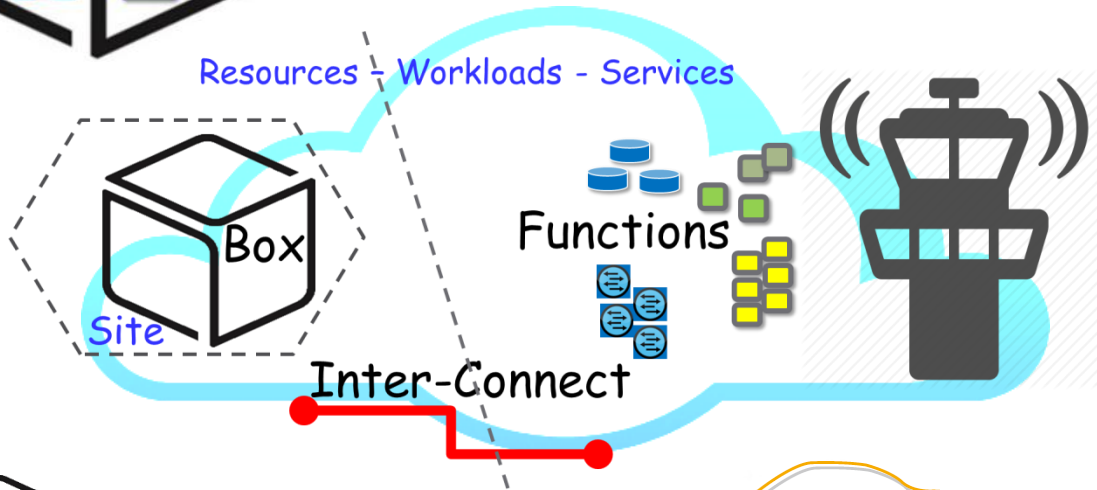
Prepare Program-mable & Virtualized Resource Pools with Hyper-converged **SmartX Boxes**



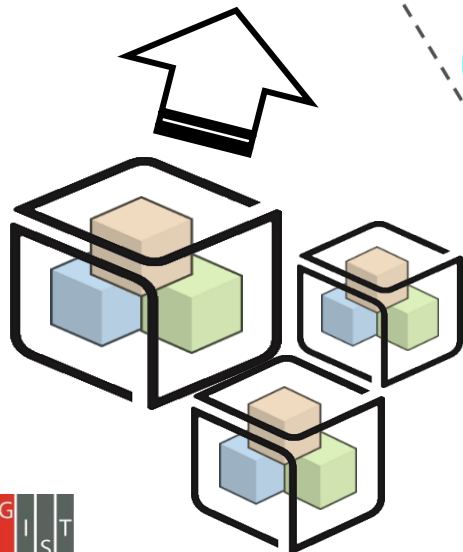
Build **Open APIs** with Inter-connected Functions



Resources - Workloads - Services

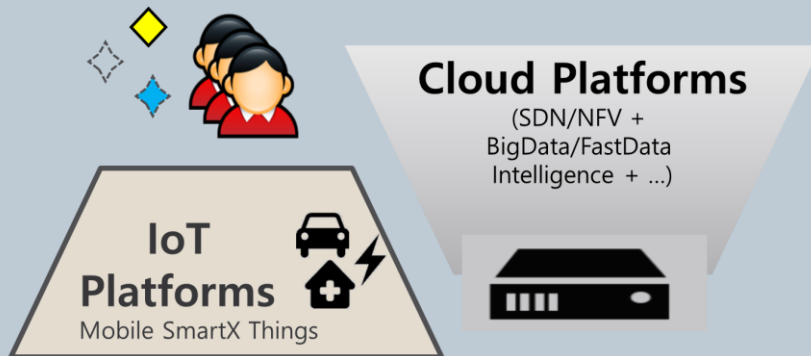


Create Smart Services with **Smart Things, API Tools, and Open Data**



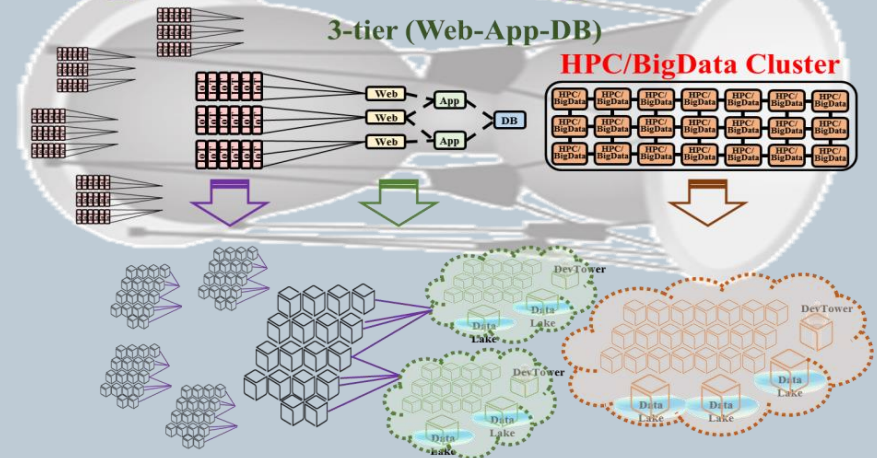
IoT-Cloud Services by Inter-Connecting Functions

Diversified Human-Defined Services



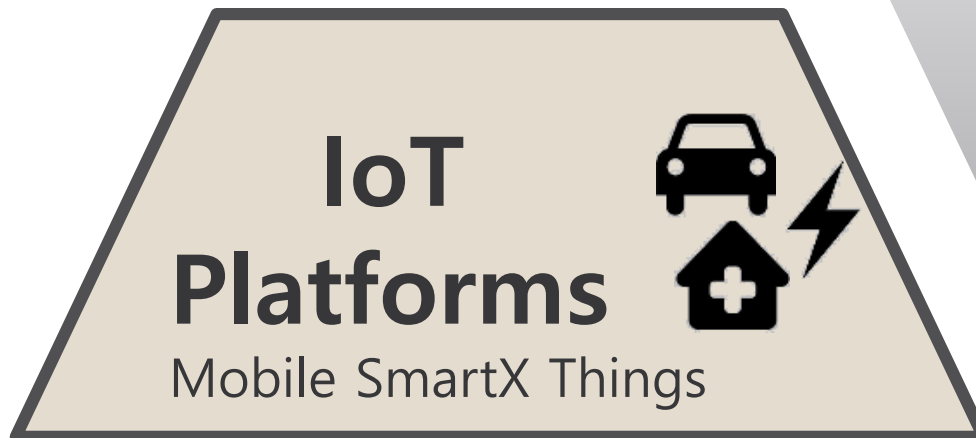
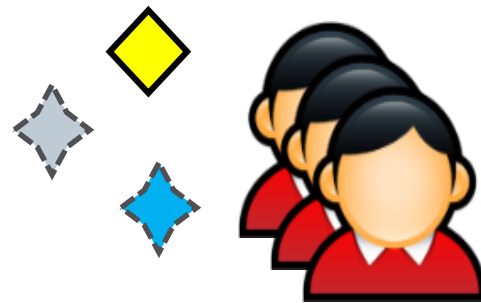
Convergent Software-Defined
Infrastructure

IoT-----Cloud



Enabling IoT-Cloud Services with Connected Platforms over Software-Defined Infrastructure

Diversified Human-Defined Services



Cloud Platforms

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



Convergent Software-Defined Infrastructure

SmartX Services & MicroServices Architecture: **Inter-Connected Functions among Boxes**

Provisioning



Orchestrate



Visibility



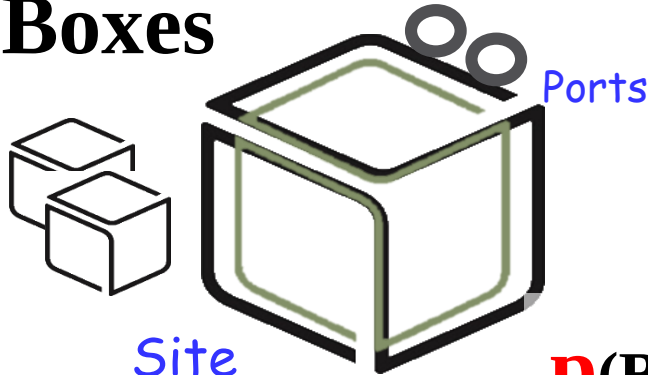
Inter-Connect

Functions

Normal

Tag/Steer/Mapped
+ Secured

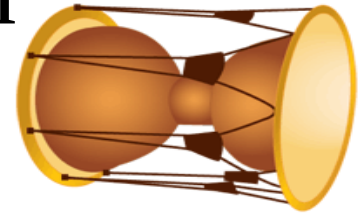
Boxes



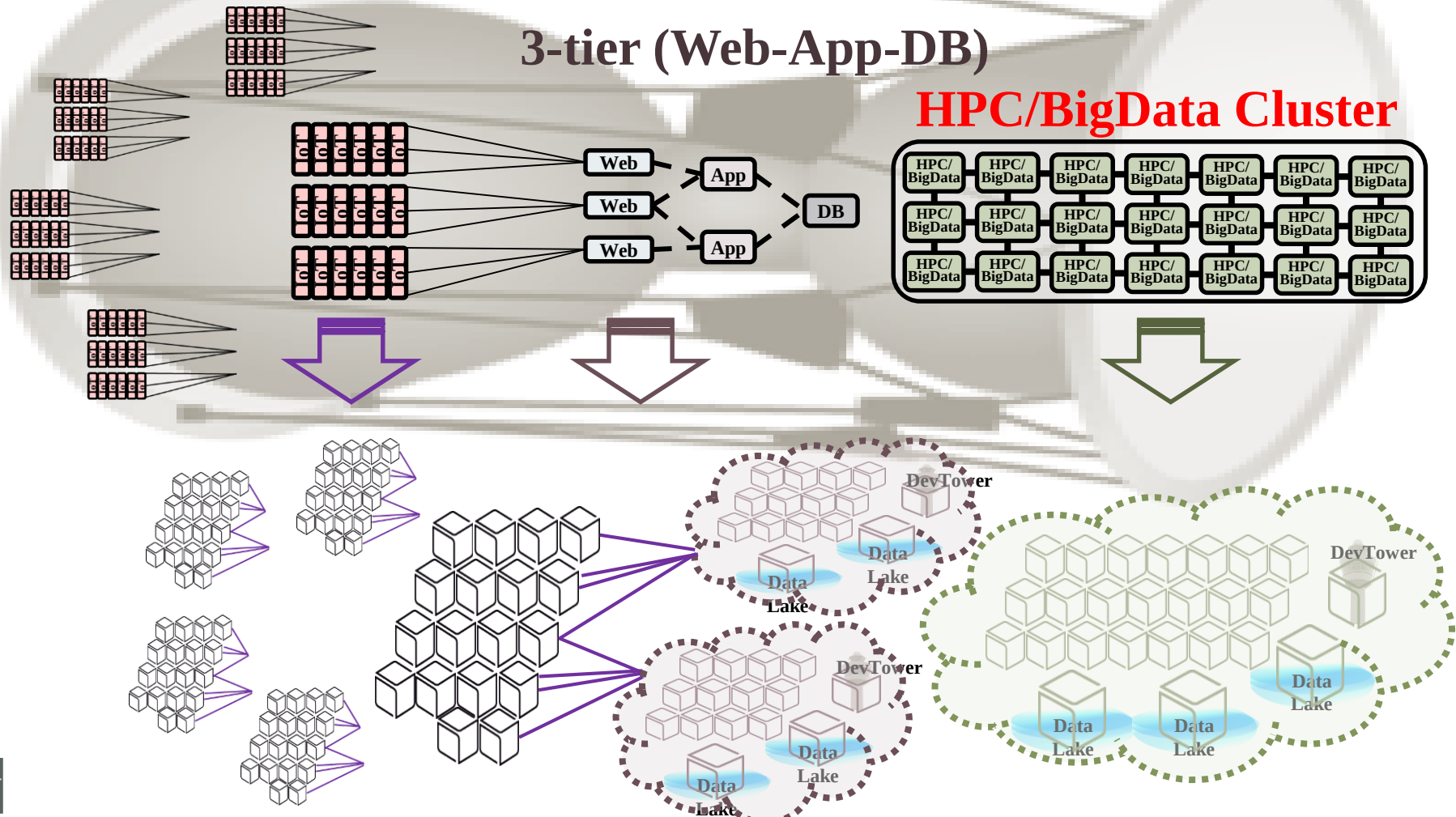
Site

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

Intelligent IoT-Cloud Services with Inter-Connected Functions



IoT-----Cloud

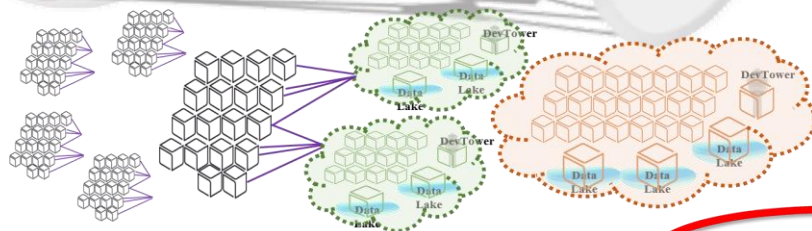
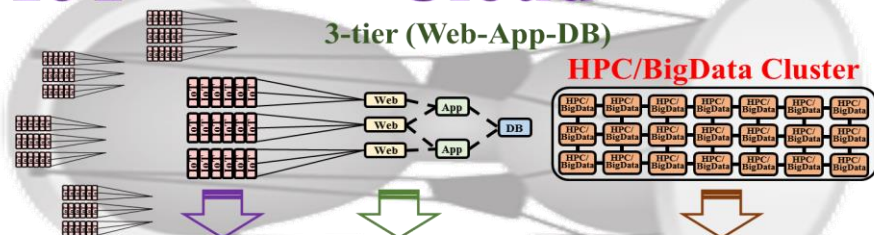


SmartX IoT-Cloud Services for Microservices-based SaaS Applications

IoT-----Cloud

3-tier (Web-App-DB)

HPC/BigData Cluster



Provisioning



Orchestrate



Visibility

SaaS

OverCloud

UnderCloud

Inter-Connect

Functions

Normal Tag/Steer/Mapped

Boxes

Ports

Site

$$\mathbf{p}(\text{Baremetal}) + \mathbf{v}(\text{VM}) + \mathbf{c}(\text{Container})$$

Process containers



SHIFTER

(Monster containers)

app + containers



Machine containers

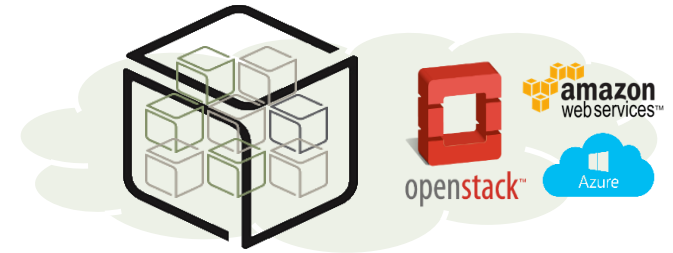


VM hypervisors

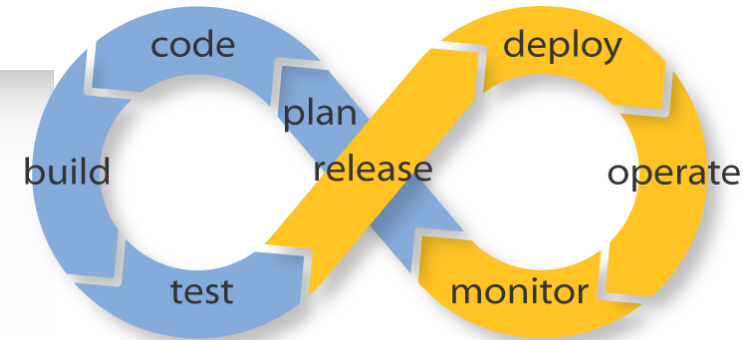
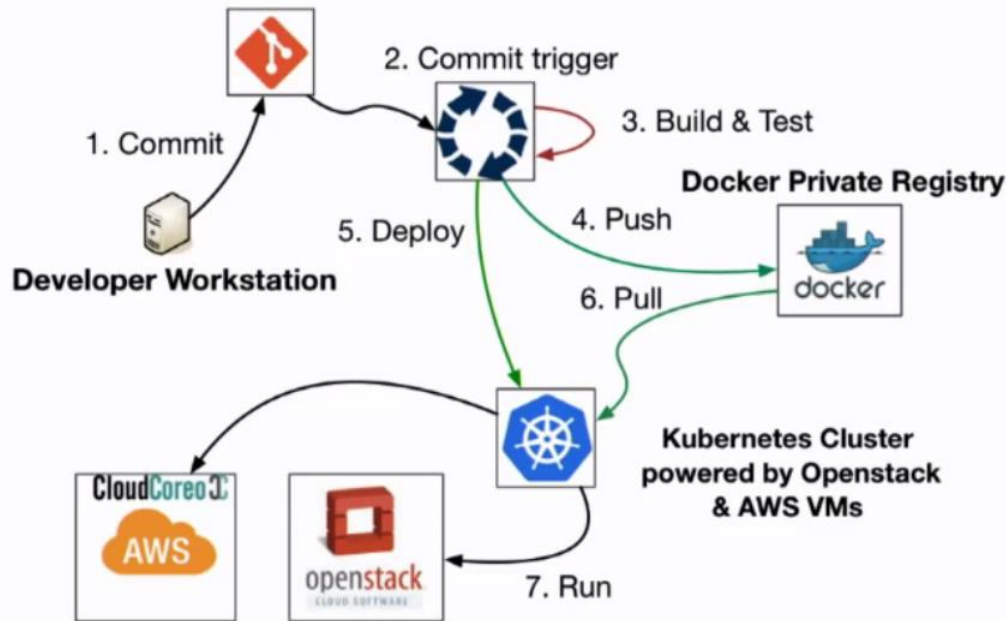


Automated Deployment of Container-based Services over Converged SDI

Composable Software-Defined Infrastructure



Microservice Pipeline

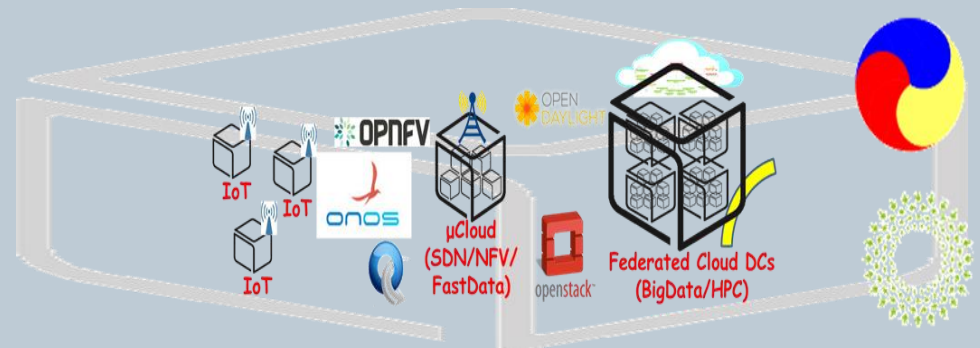
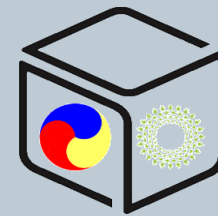
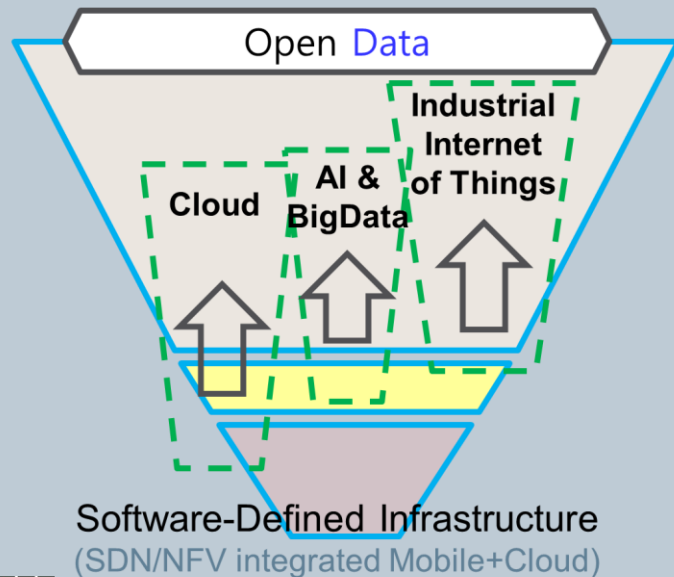


Endless Possibilities: DevOps can create an infinite loop of release and feedback for all your code and deployment targets.



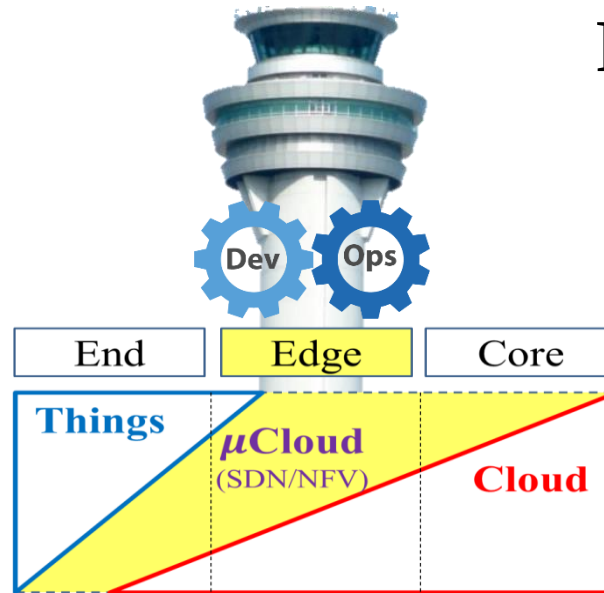
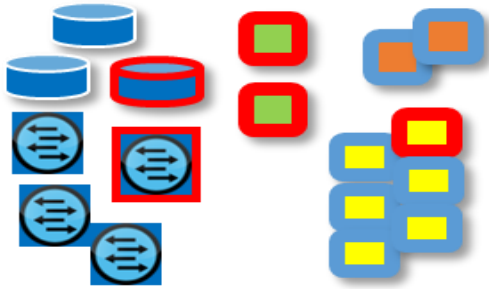
Container-based Orchestration & Dynamic Resource Pooling (Scaling)

Open-Source-leveraged & Hyper-converged / Composable Software-Defined Infrastructure

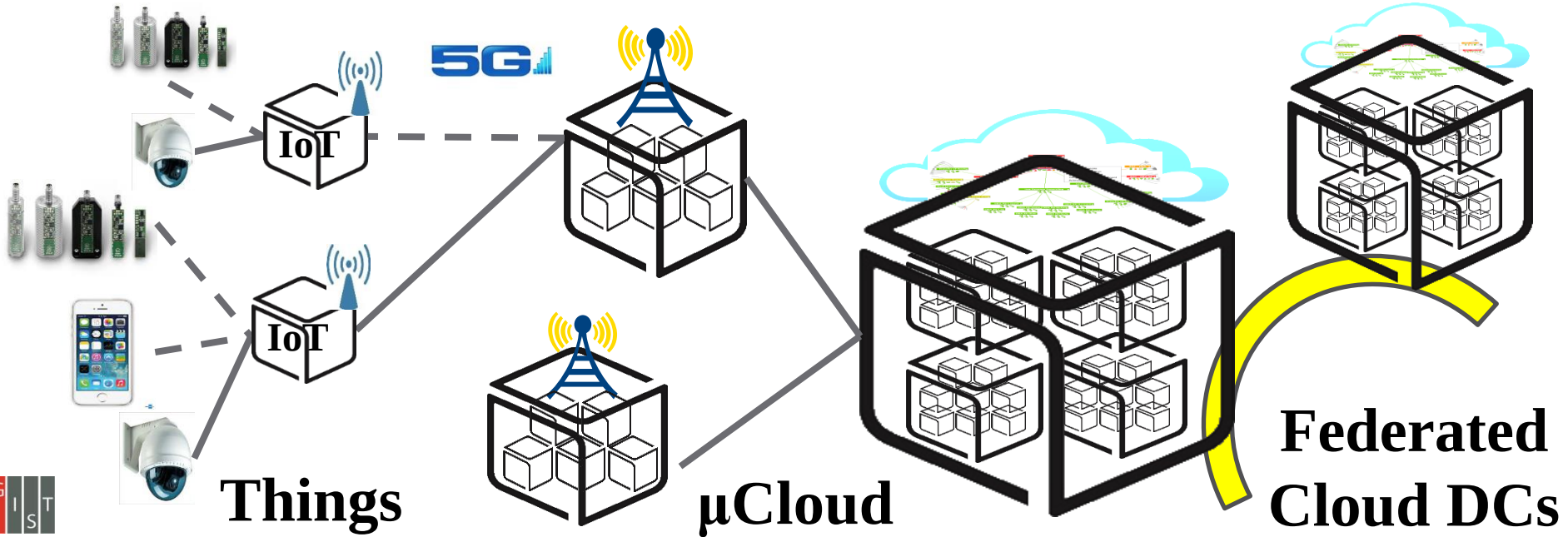
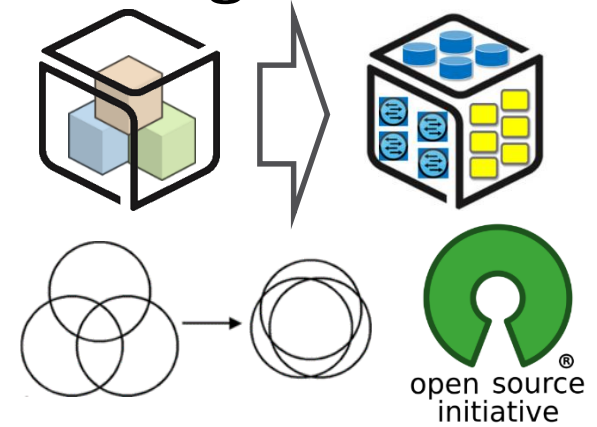


Converged SDI for Diversified Services

Diversified **SaaS** Applications



Resources in Hyper-convergent Boxes

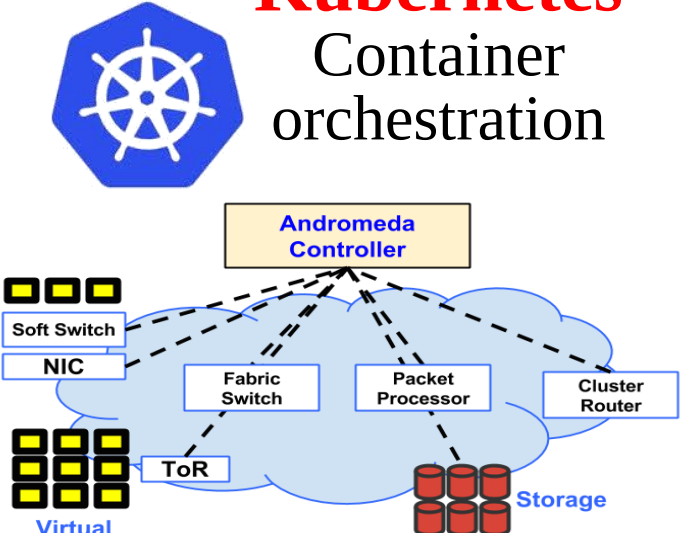


Converged SDI @ Hyper-scale Cloud (Google)



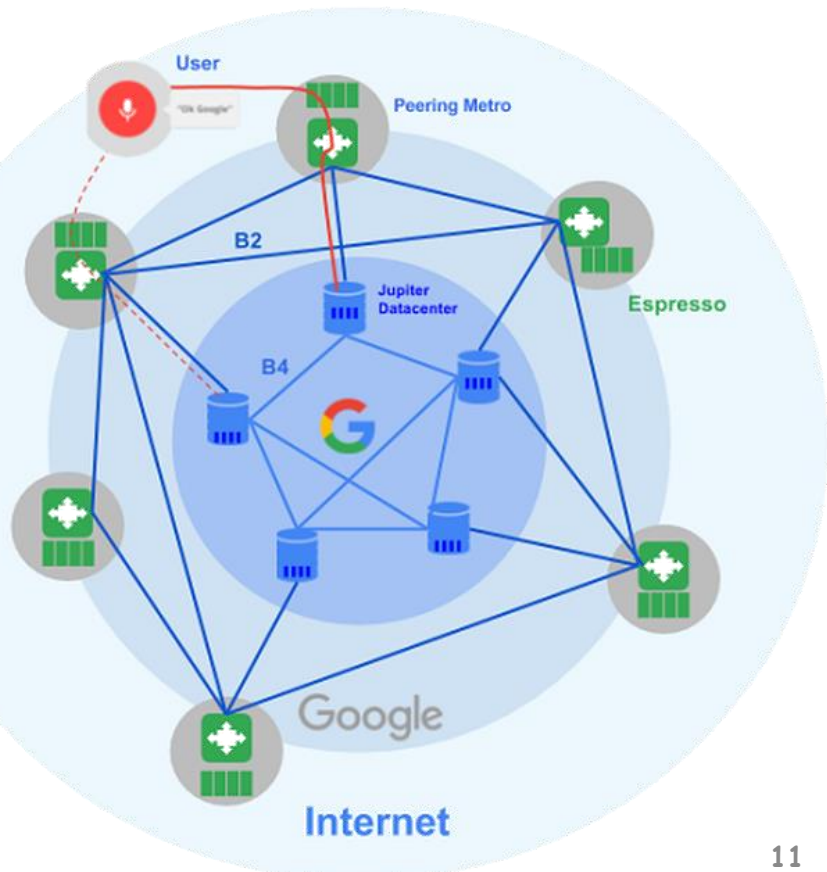
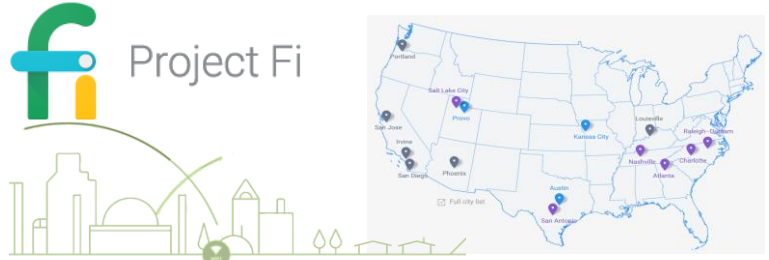
Omega
Distributed
scheduling

Kubernetes
Container
orchestration



Andromeda SDN/NFV

FI Mobile & Fiber Optical



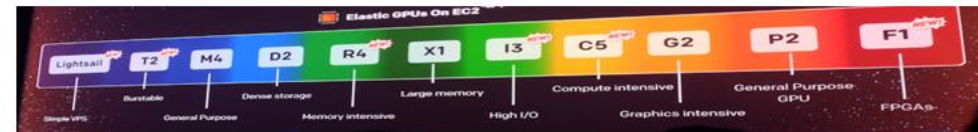
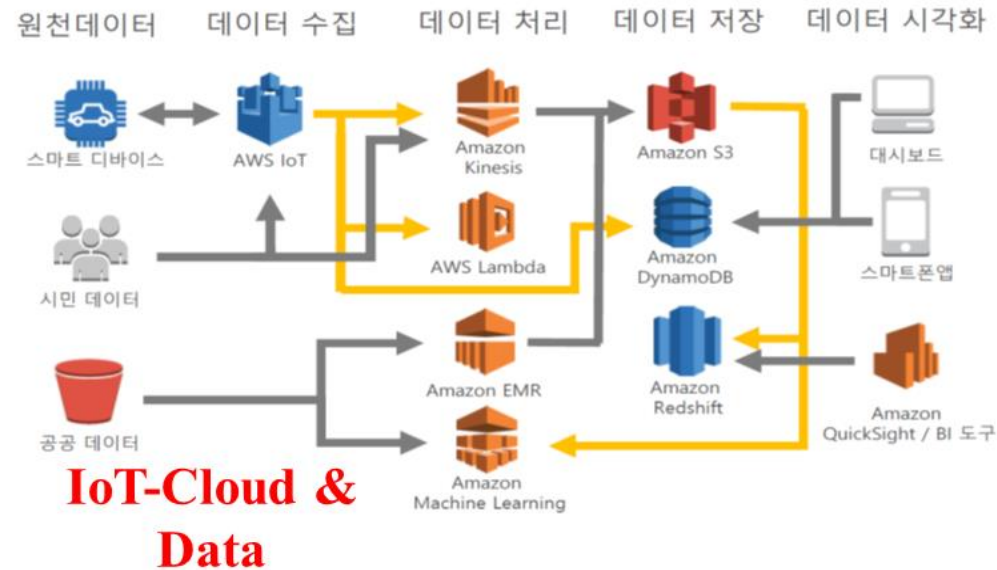
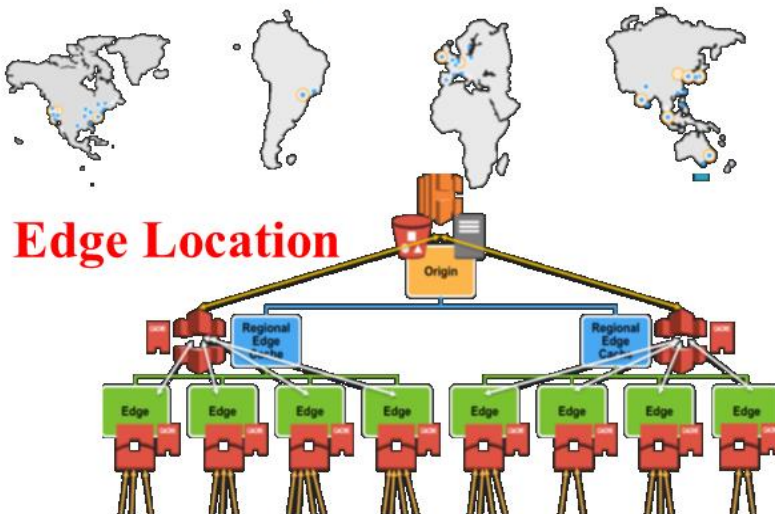
B4 Global
SD-WAN

Converged SDI @ Hyper-scale Cloud (AWS)

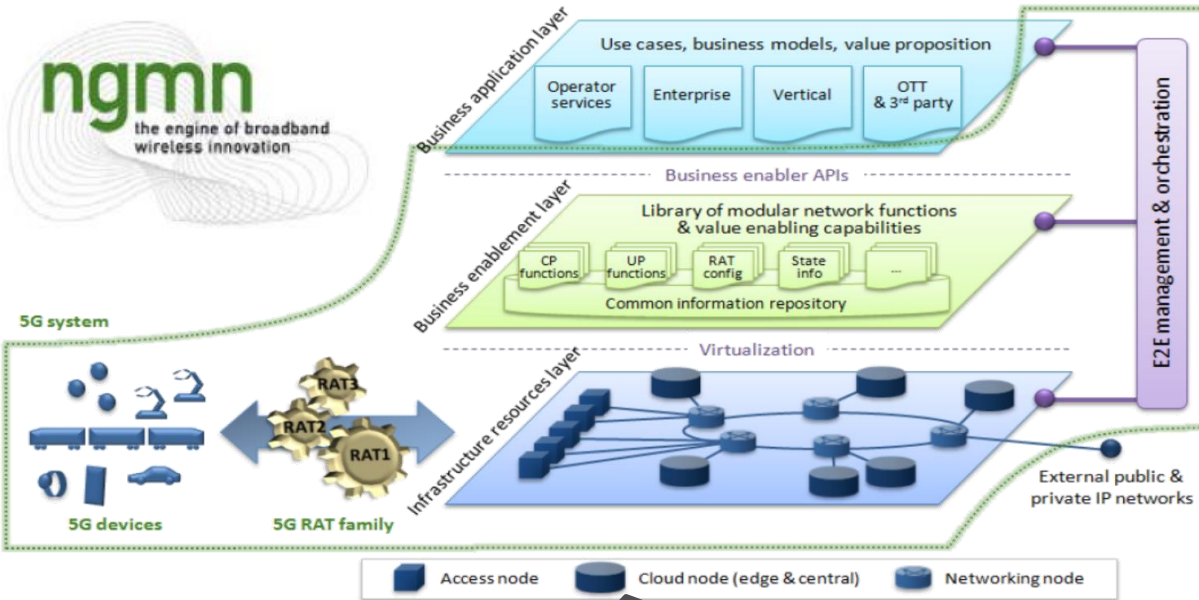


73 POPs
48 Cities
24 Countries
9 Regional Edge Caches
5 Continents

North America South America EMEA APAC



5G-ready Converged SDI @ Carriers (AT&T)



Edge Cloud: ~ 1000 zones

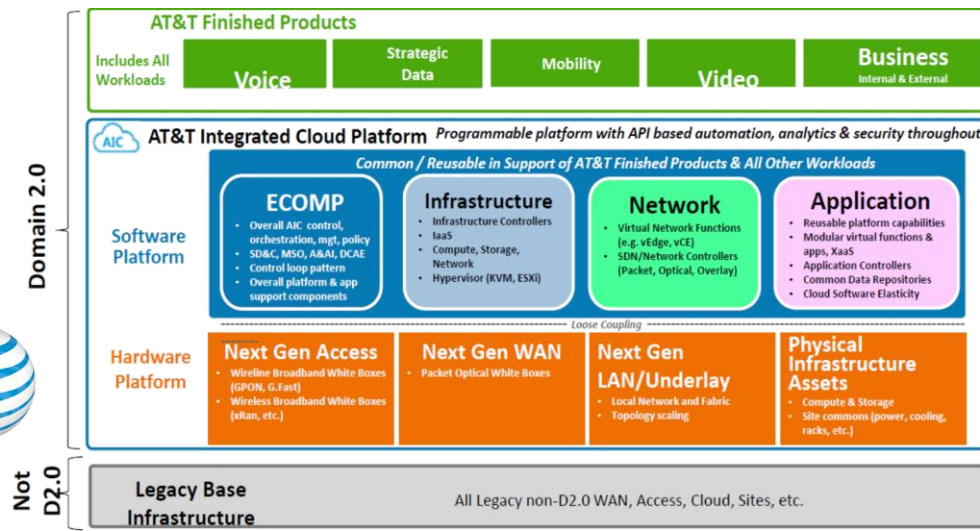
SDN/NFV Native 5G Architecture: Covering all aspects ranging from devices, infrastructure, network functions, value enabling capabilities and all the management aspects to orchestrate the 5G system



AT&T ECOMP (Enhanced Control, Orchestration, Management & Policy) Architecture

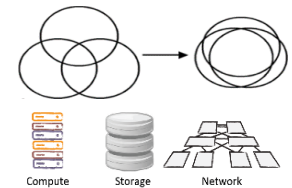
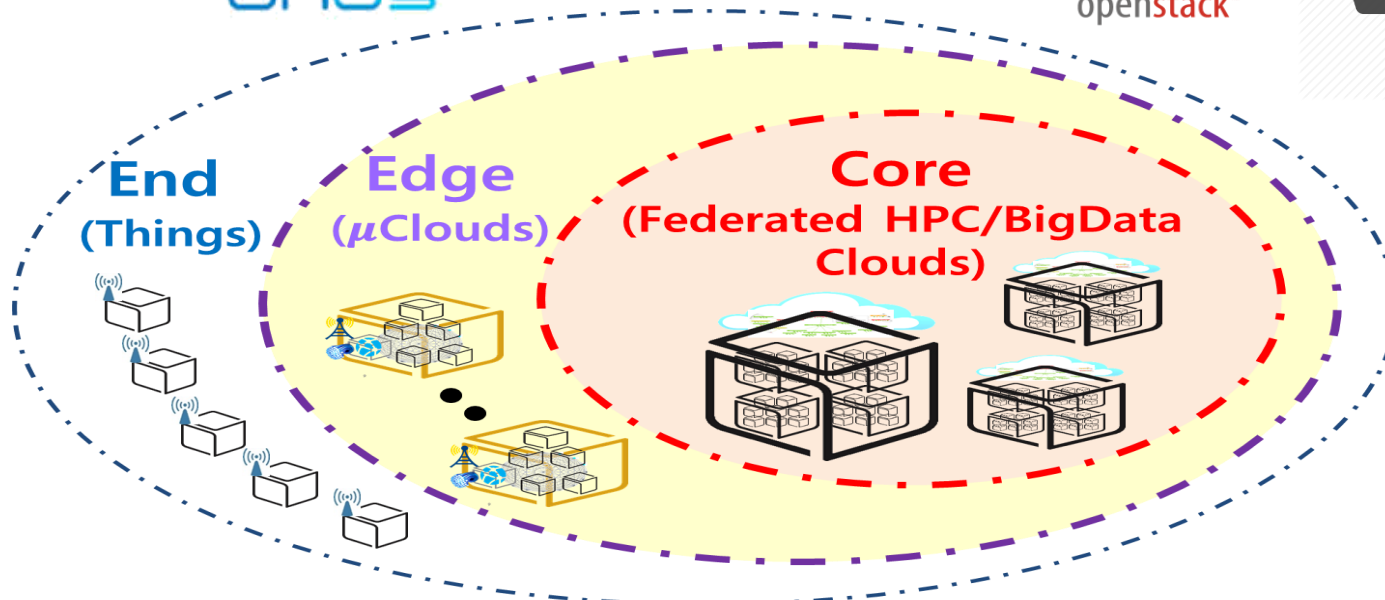
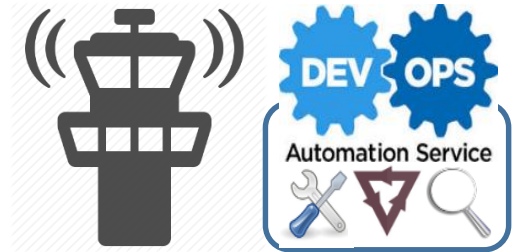


AT&T Domain 2.0:
User-Defined Network Cloud
(Open / Simple / Scale / Secure)

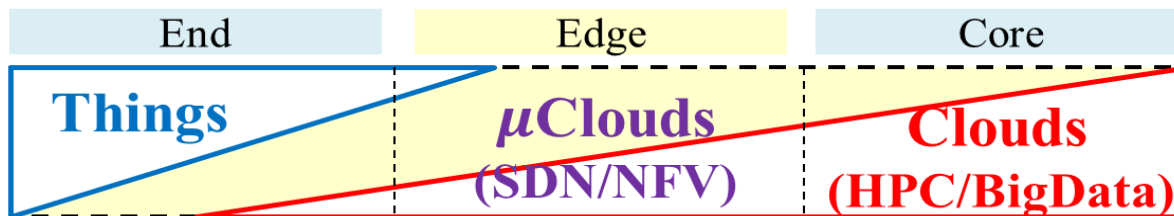
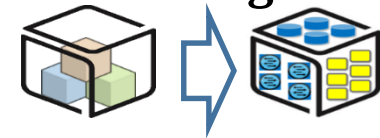


Upcoming Transformation toward Converged & Composable SDI (SDN/NFV/Cloud Integrated)

DevOps Tower



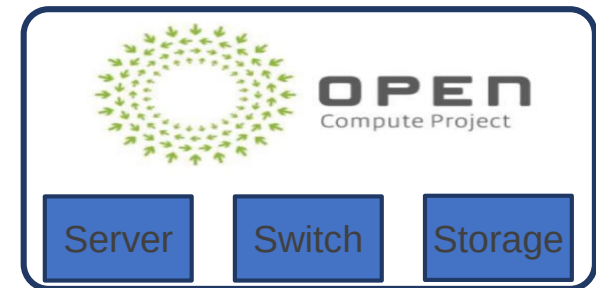
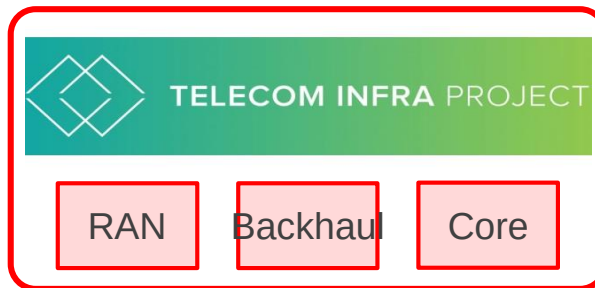
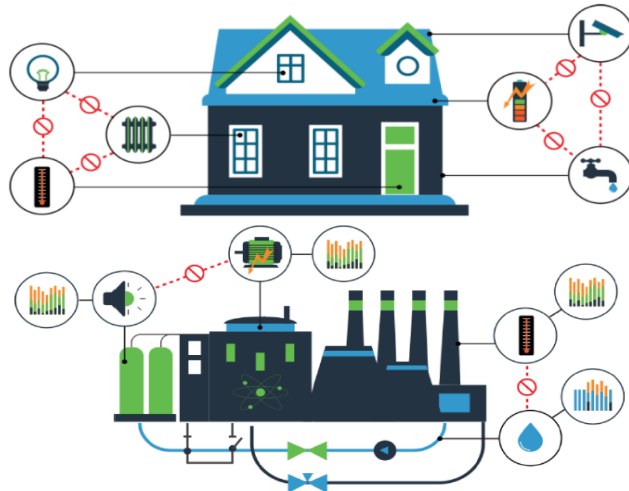
Converged



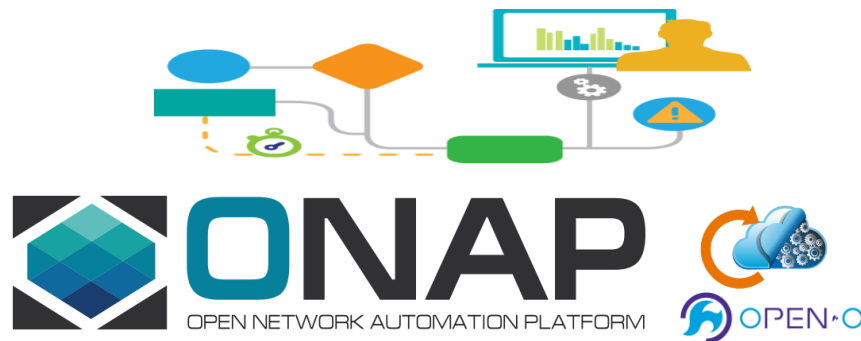
Slices



Open-Source Software/Hardware for Converged SDI



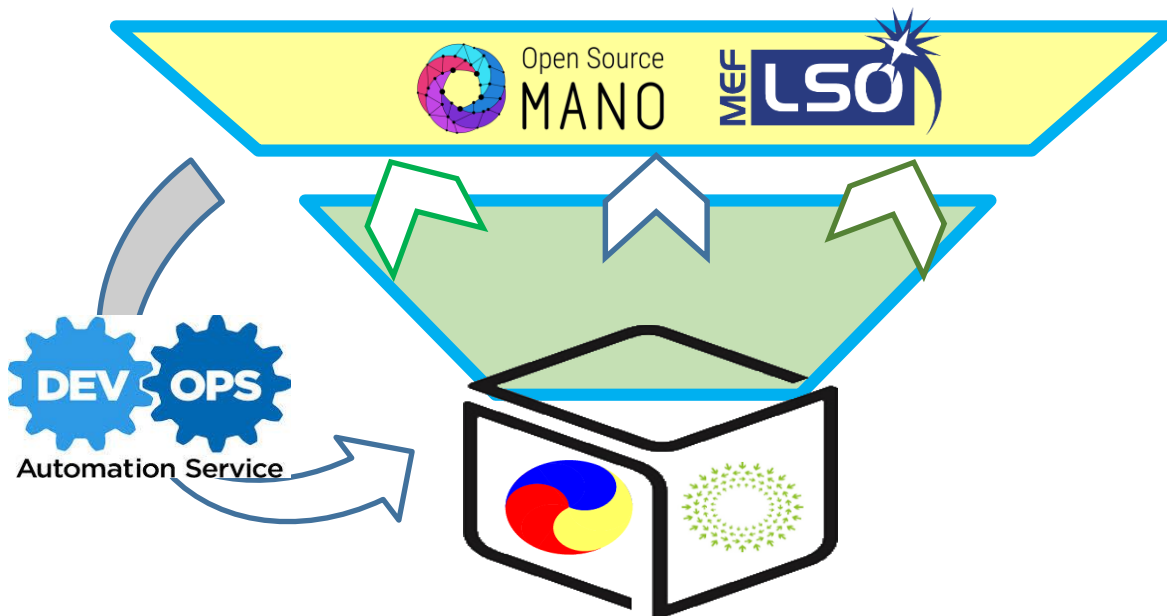
Open-Source Intelligent Automation with Workflow-based Services Lifecycle Orchestration



Intelligent
Services Lifecycle
Orchestration
(Enhanced Control,
Orchestration,
Management & Policy)

Reconfigurable
Platforms

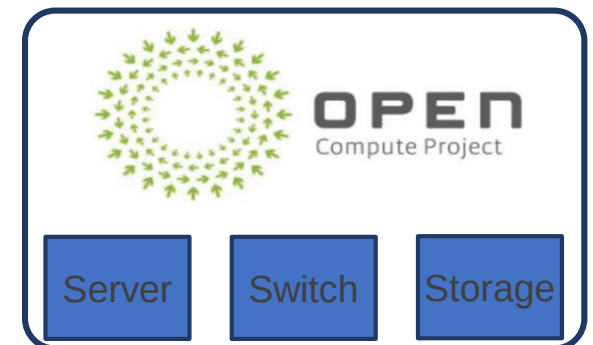
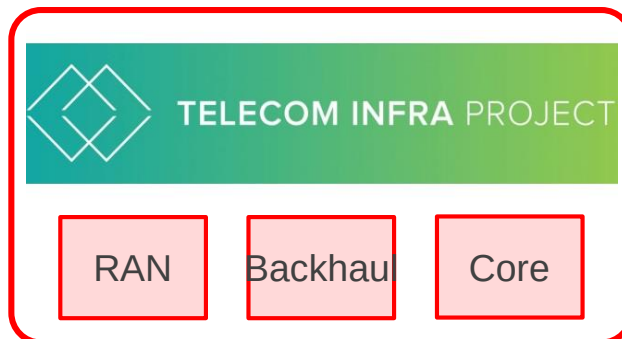
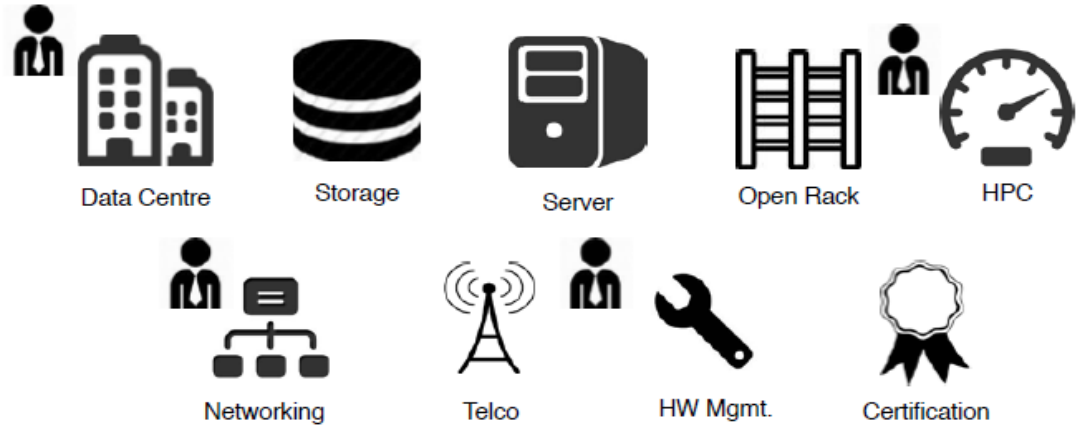
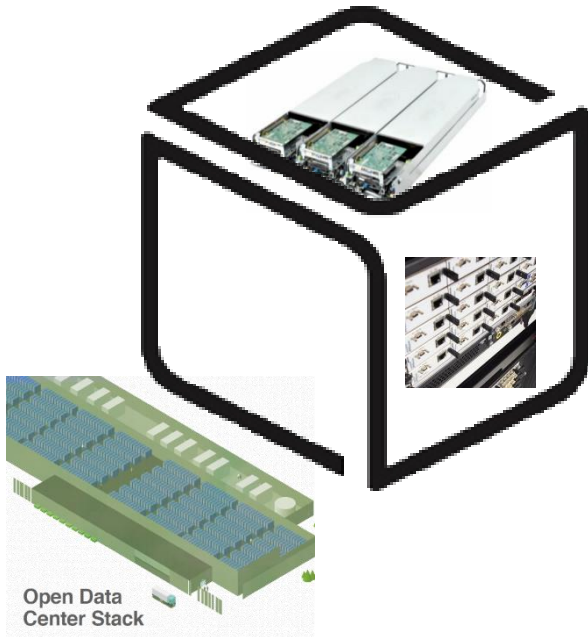
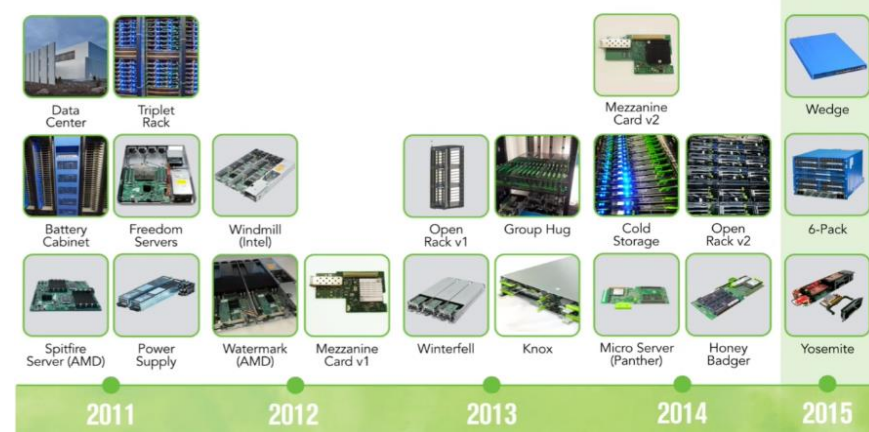
Open & Convergent
Resources



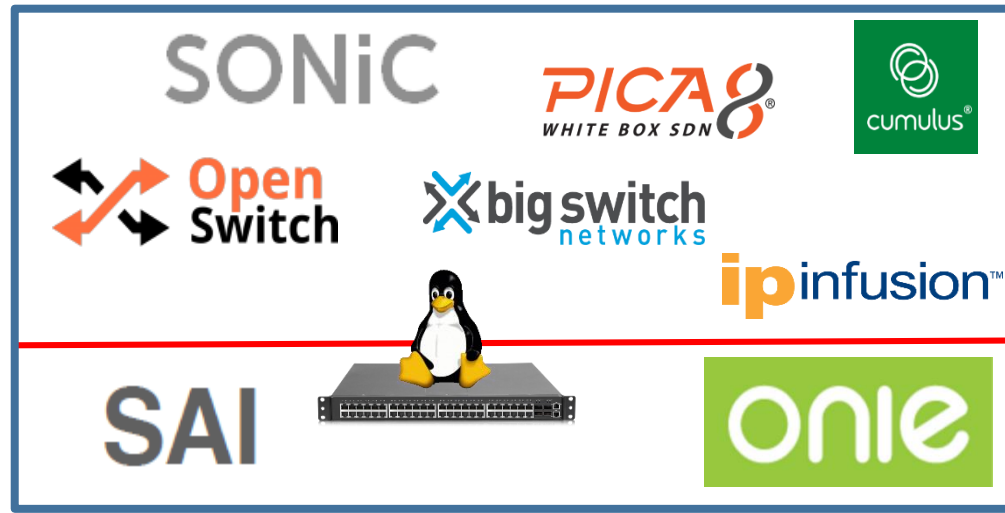
ons
OPEN NETWORKING *2*
HARMONIZE, HARNESS, CONSUME



Open-Source Hardware for Converged SDI & OCP/TIP



Open Software & Hardware for White-Box Switches



Application, management, tools

Monitoring, Management, Deployment Tools, Cutting Edge SDN

ARISTA



metaswitch

CANONICAL



Switch Platform

SONiC

ARISTA



edge-core NETWORKS

ingrasys



SONiC

Merchant Silicon

Switch Abstraction Interface (SAI)

BAREFOOT NETWORKS

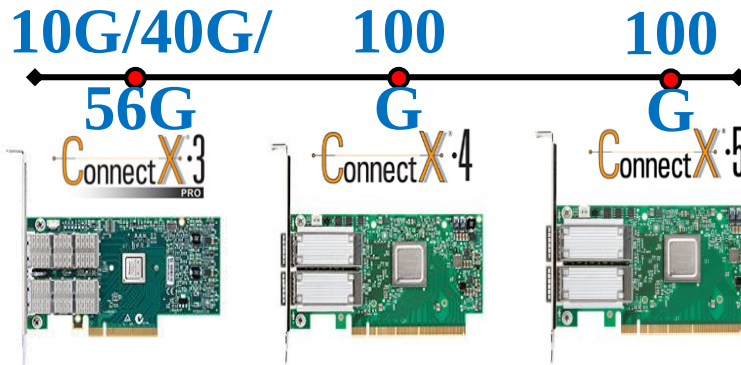


SAI

NoviFlow
switching made smarter



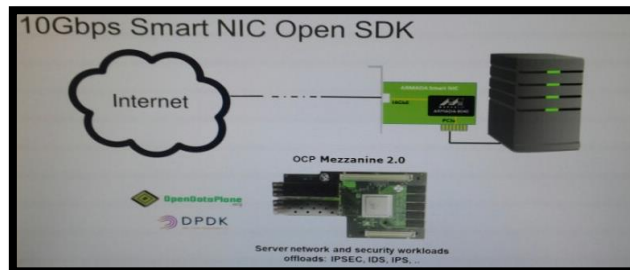
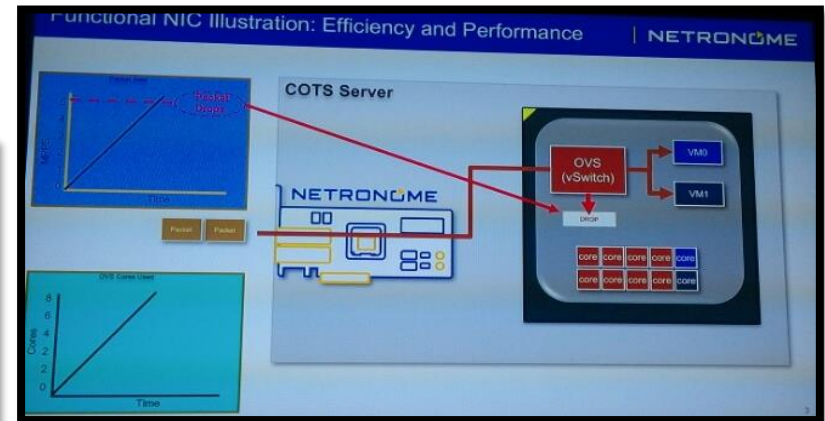
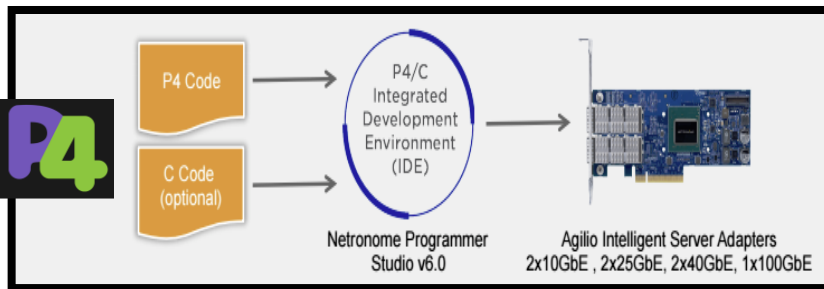
Programmable Hardware: Smart NICs



❖ RoCE (RDMA over Converged Ethernet) v2

- RDMA Transport offload with zero-copy
- Low cost/power for performance-centric DC applications
- Traffic Classification at the L2 improving network efficiency
- Single Ethernet wire for IPC, LAN and SAN
- Transcends L3 networks
- Support IP multicast

NETRONOME



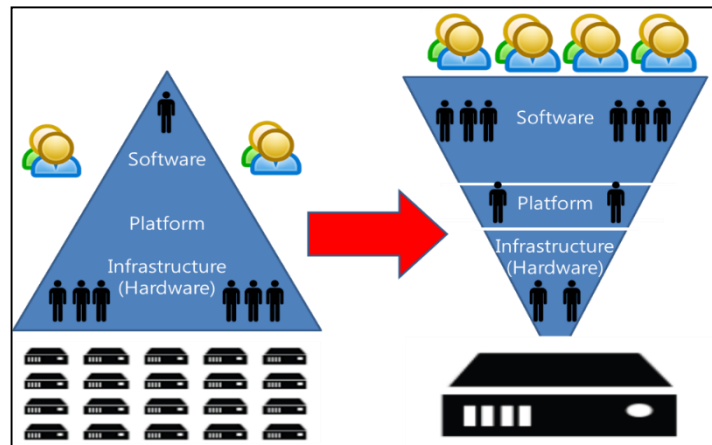
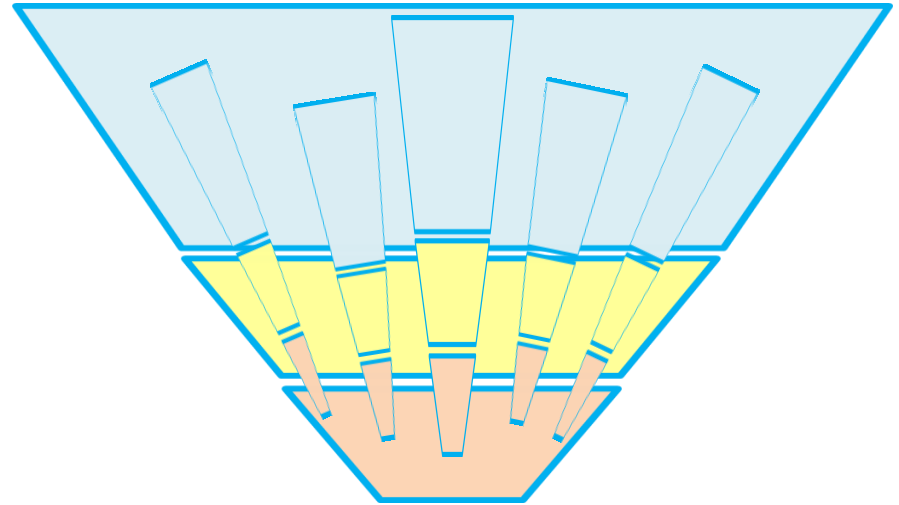
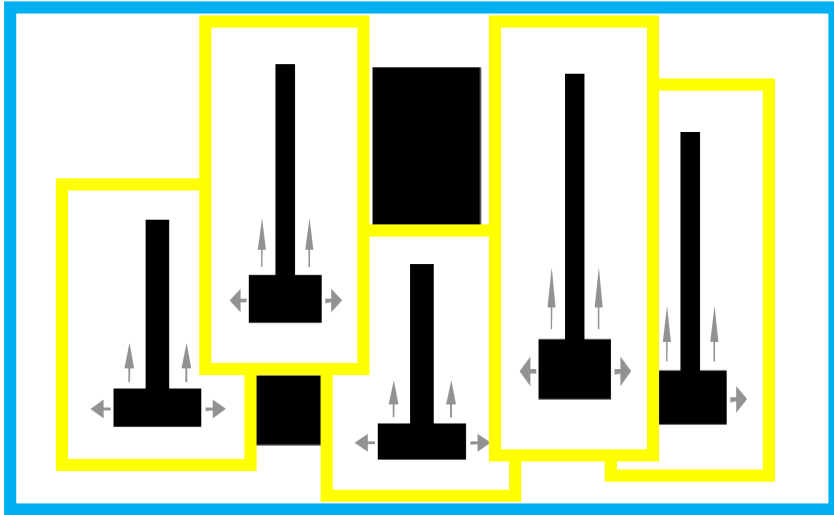
ARMADA A7040
Smart NIC Open SDK
Quad core A72 as PCIe
Endpoint with 10G
Ethernet



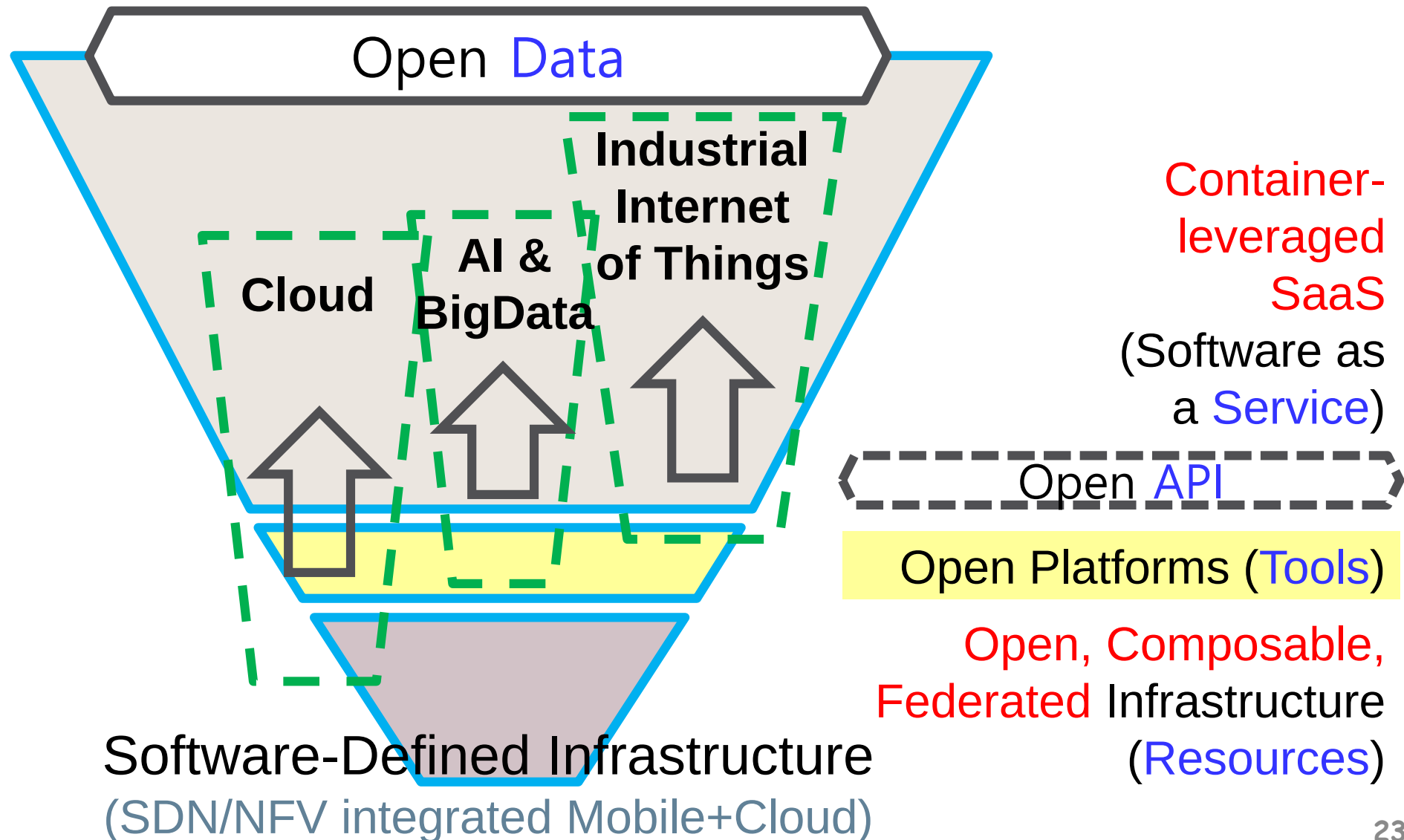


Infrastructure vs Platform vs Services

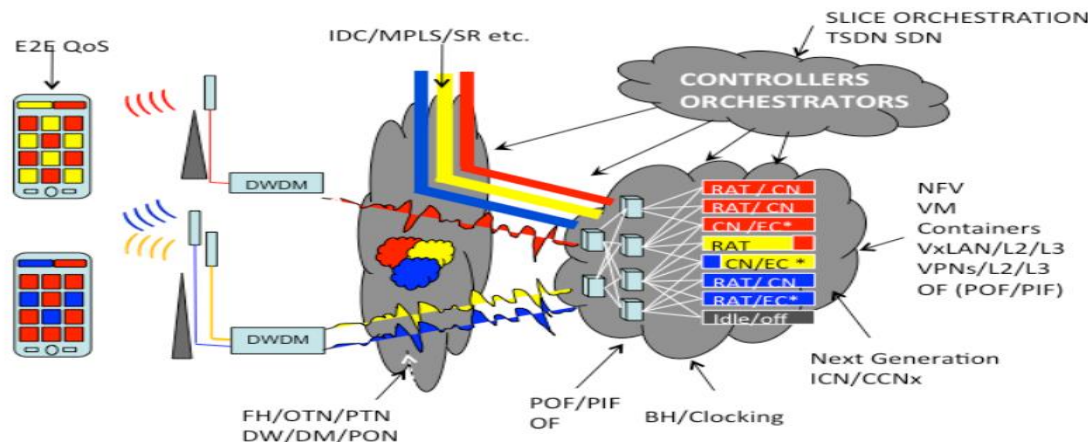
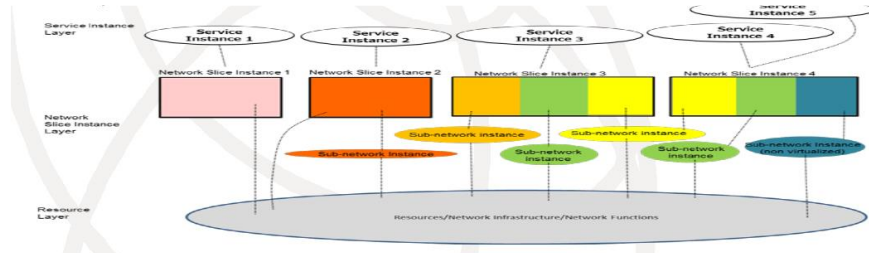
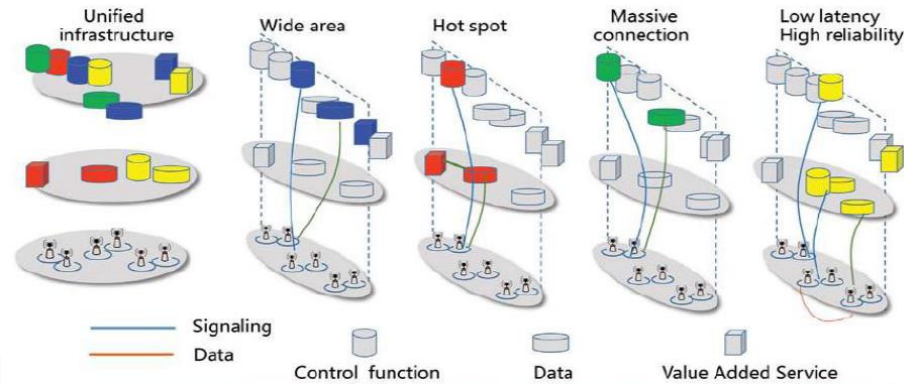
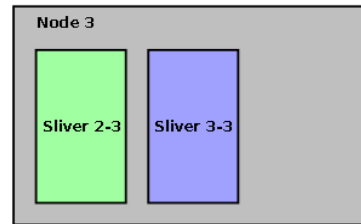
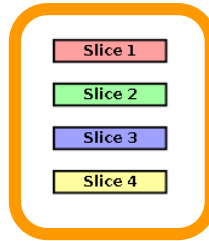
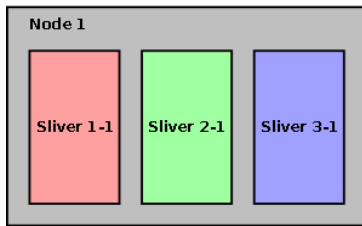
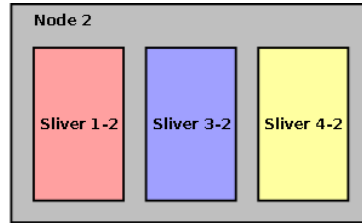
Toward Razor-thin Platform that becomes "Composable"



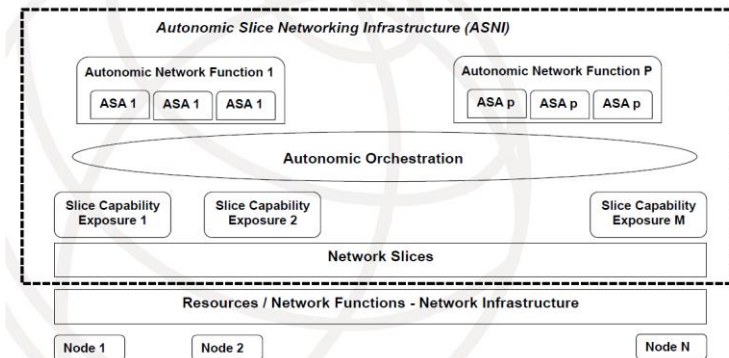
Domain-Specialized Diversified Services over Software-Defined Infrastructure



Composable Infrastructure Slices over Converged SDI



*EC = Mobile edge computing and distribute cloud

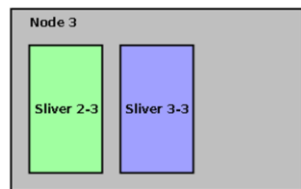
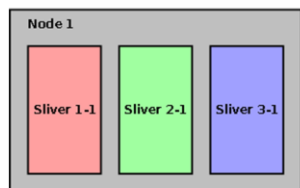
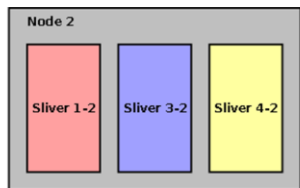


Autonomic Slice Networking - Reference Model

Infrastructure Slices and Resource Slivers



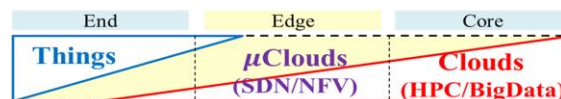
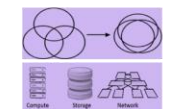
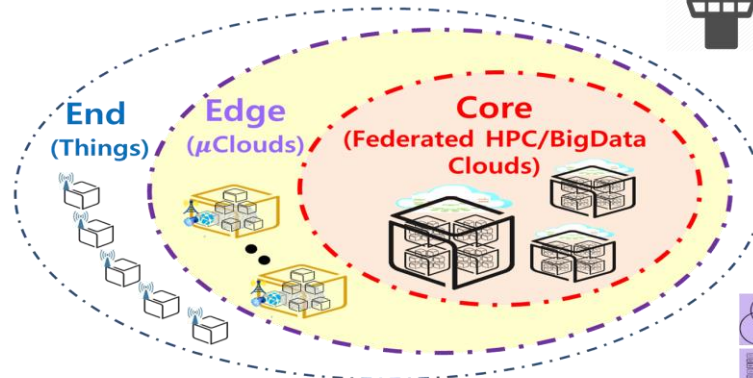
Network
(interconnected)
Slices



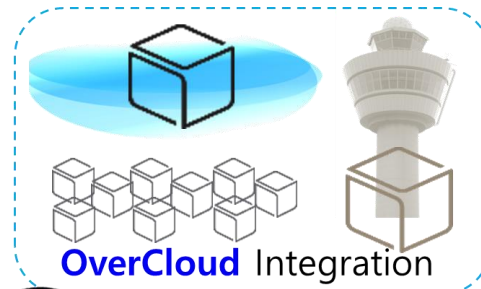
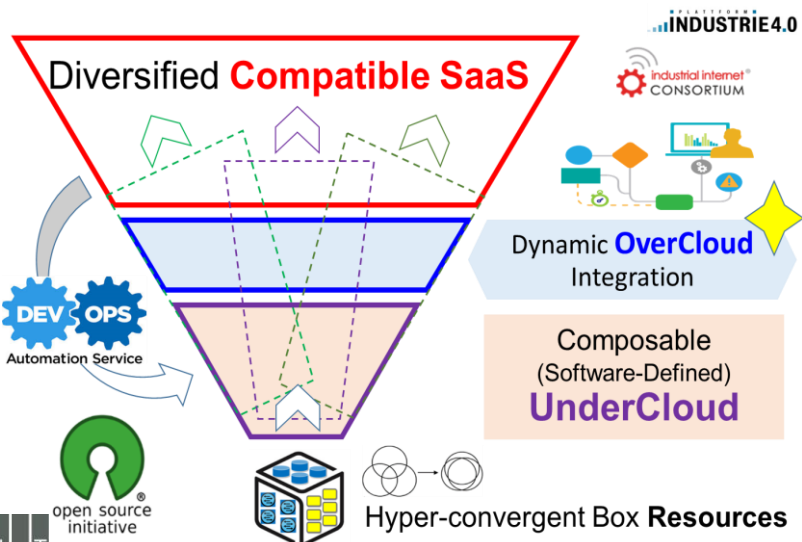
5G

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

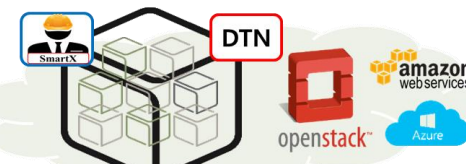
DevOps Tower



Network Slicing & OverCloud



Composable **UnderCloud**



Open/Reconfigurable Data Platform:

Cloud-based HPC/AI-inspired Services over Hyper-converged SDI

Cloud-based HPC/AI-inspired Services

Data Fabric

Reconfigurable **Open Data Platform**

Compute-
Intensive

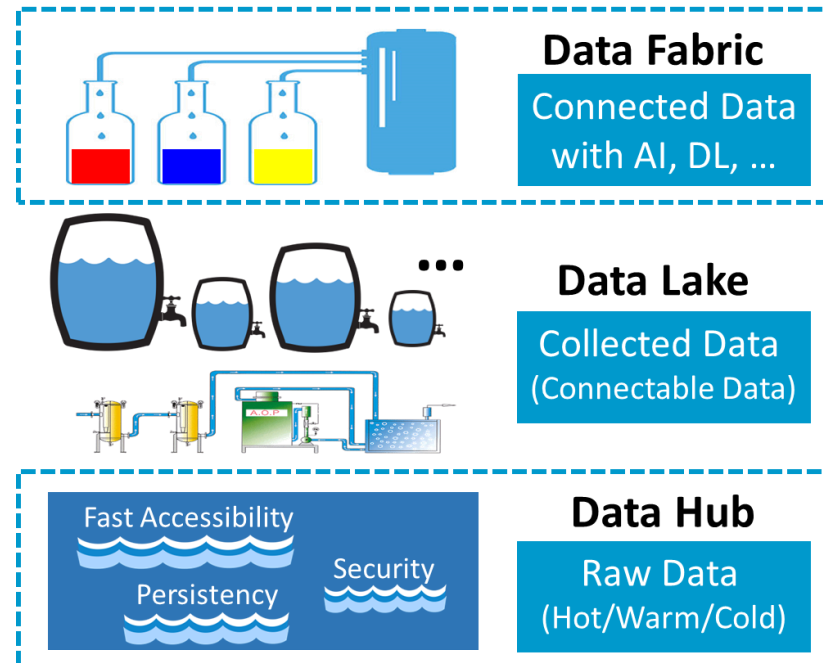
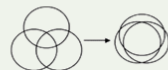
Data Lake

Data/I/O-
Intensive

Data Hub



Hyper-converged
**Software-Defined
Infrastructure**



NSF xDCI (cross-disciplinary Data CyberInfrastructure)



[iRODS](#) – Open source data management, providing automated data virtualization, data discovery and metadata templates via an integrated rules engine.

[CyVerse DE](#) – Workflows, apps, and analysis environment.

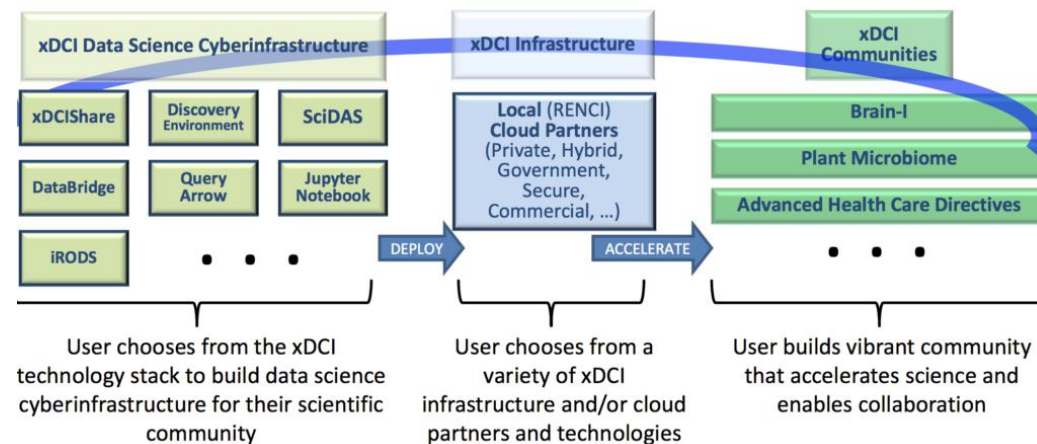
[xDCIshare](#) – Data sharing among team members and with the larger community.

[Jupyter Notebook](#) – Creation and sharing of live code, equations, visualizations and text.

[Query Arrow](#) – Semantically unified SQL and NoSQL query and update system.

[DataBridge](#) – Discovery of relevant datasets and “dark” data.

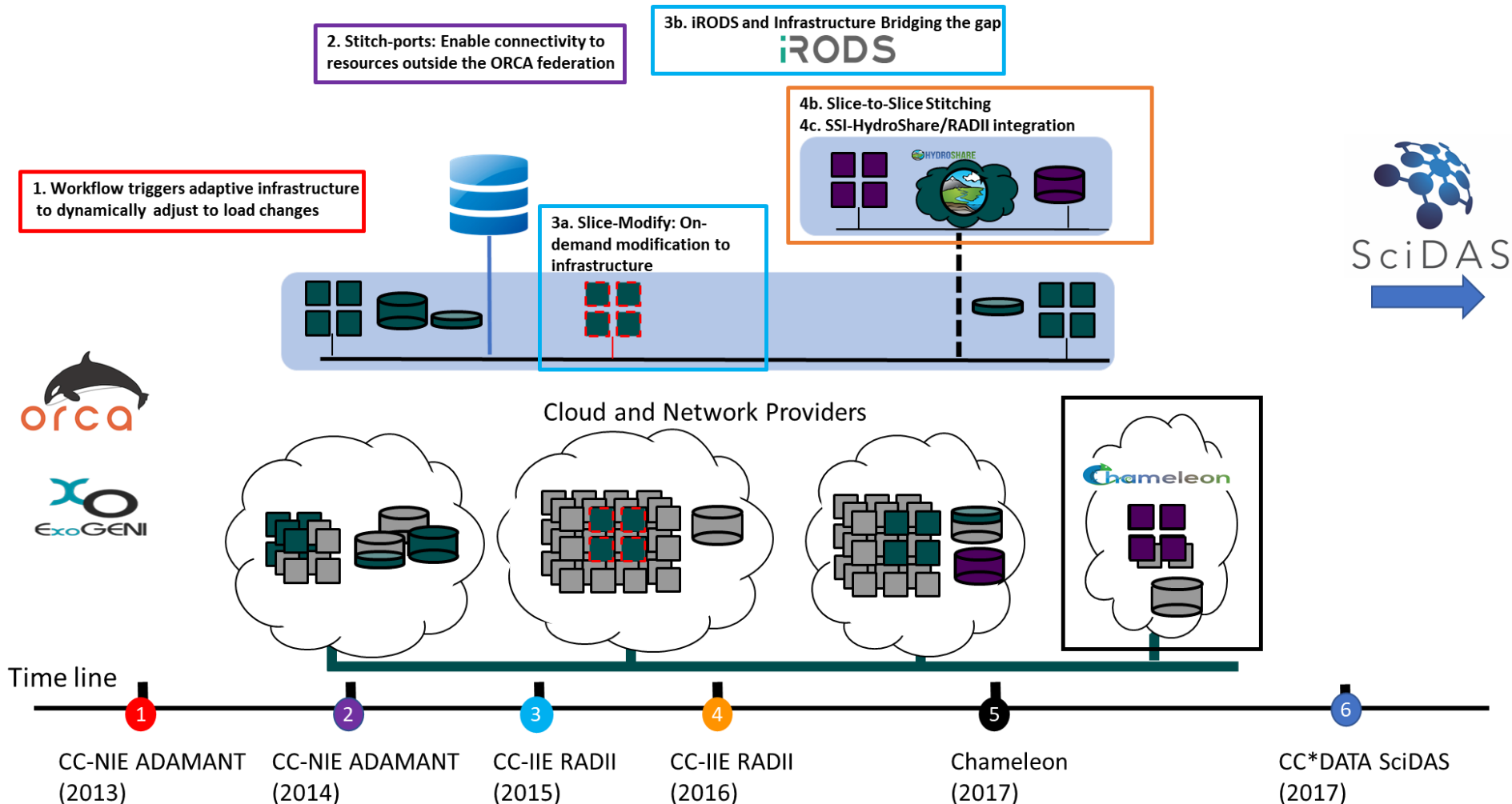
[SciDAS](#) – Fluid and flexible infrastructure for working with and analyzing large-scale data.



“Technology framework that enables their research communities to rapidly deploy robust cyberinfrastructure that can easily ingest, move, share, analyze and archive scientific data in all its varieties”

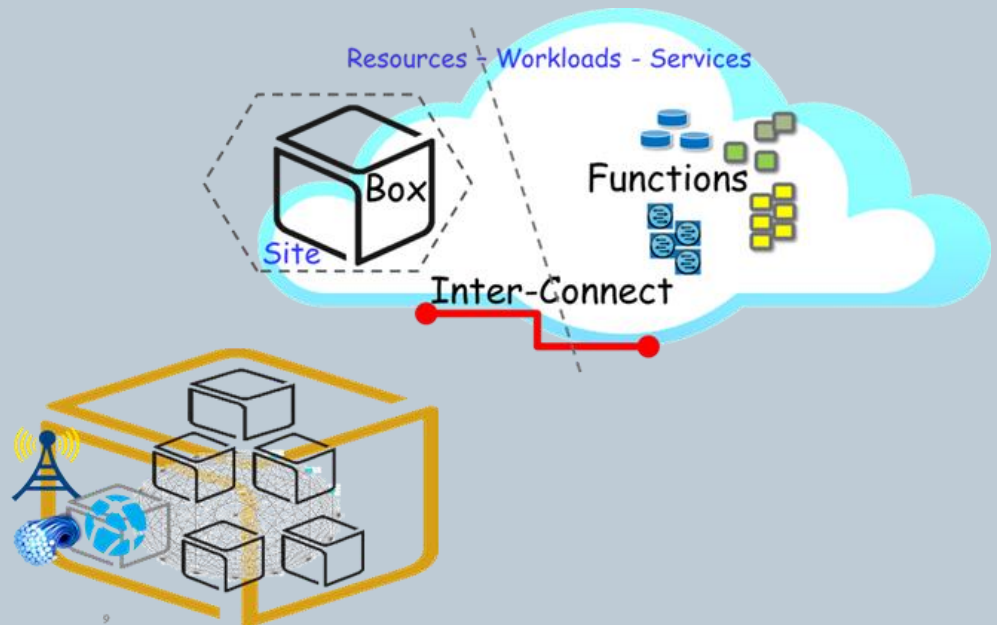
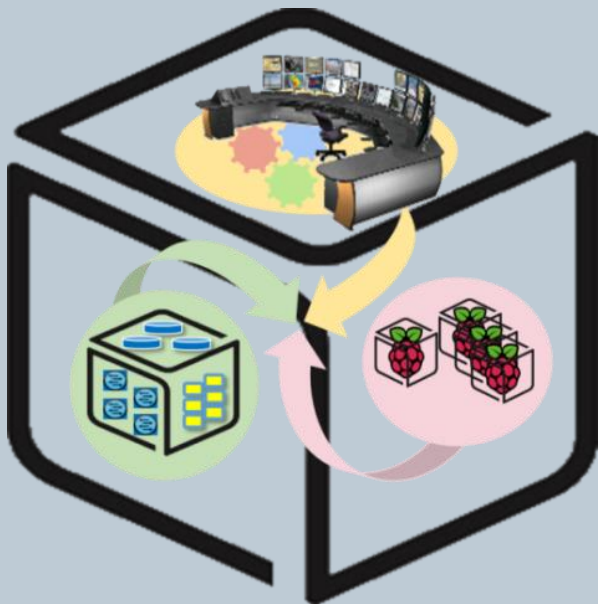
with Technology/Software/Data-Science/Sustainability Concierge

NSF SciDAS: Building Data-centric Infrastructure (2017~)

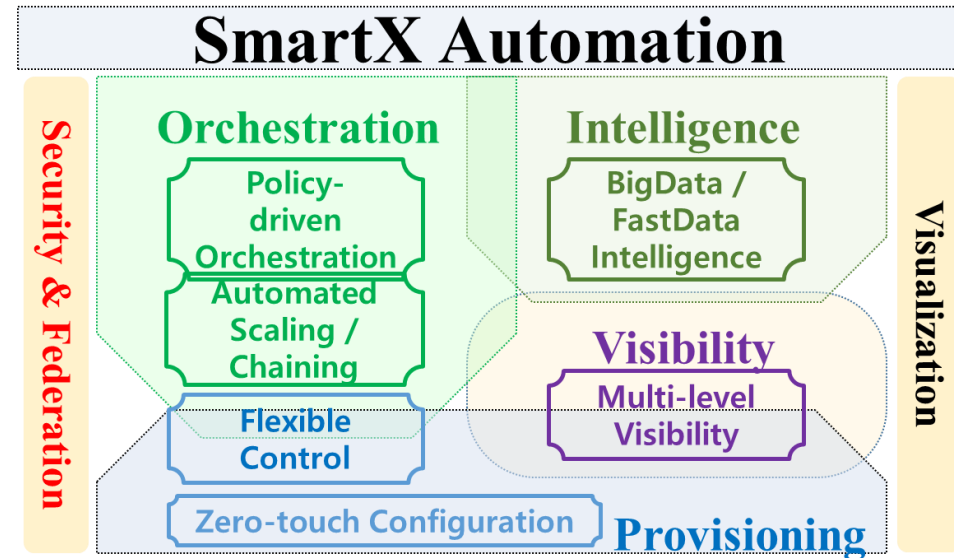
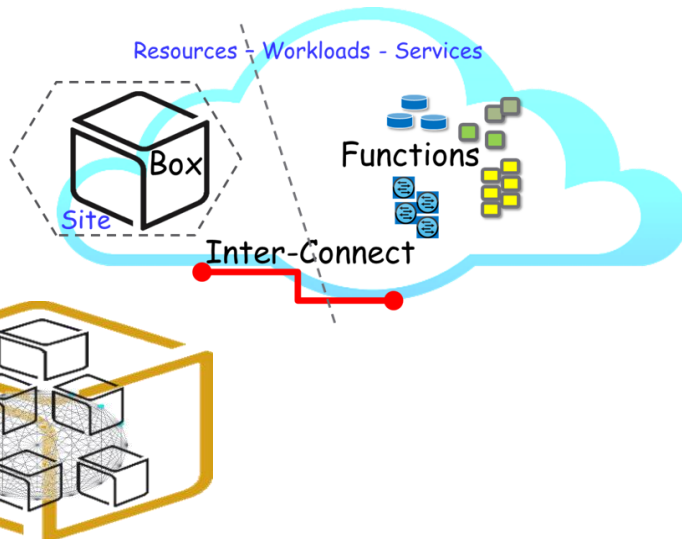
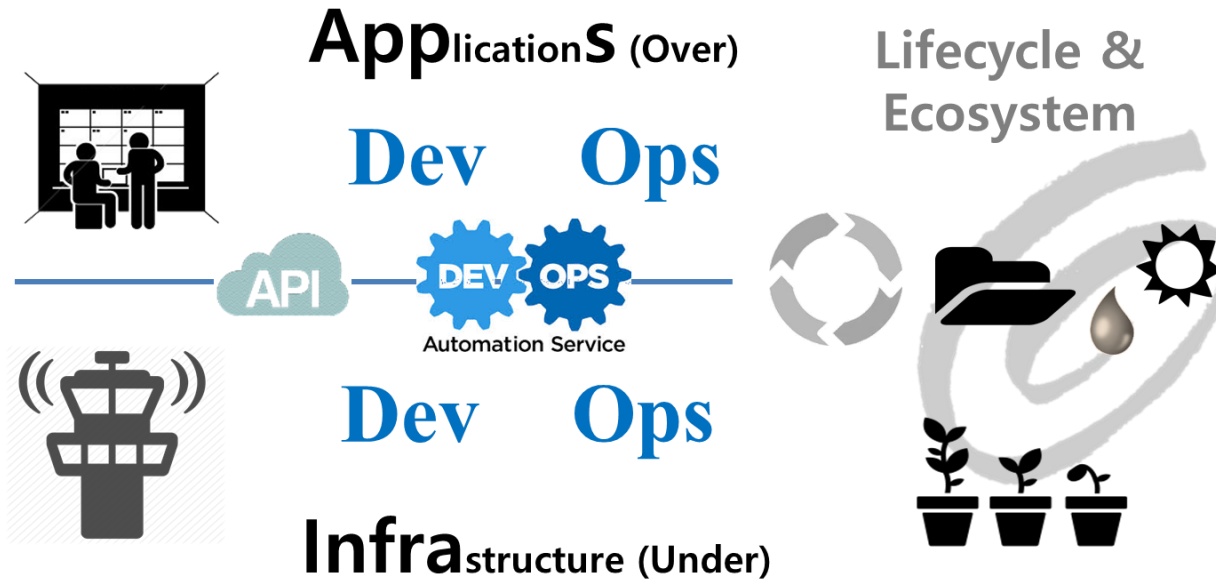


SmartX Playground

(Infrastructure & Platform)
for IoT-Cloud Services



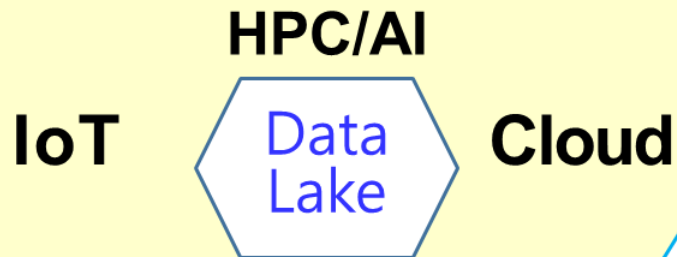
SmartX Automation Framework



Open-Source-leveraged **Open Playgrounds**

(IoT-SDN/NFV-Cloud (HPC/BigData) Ready)

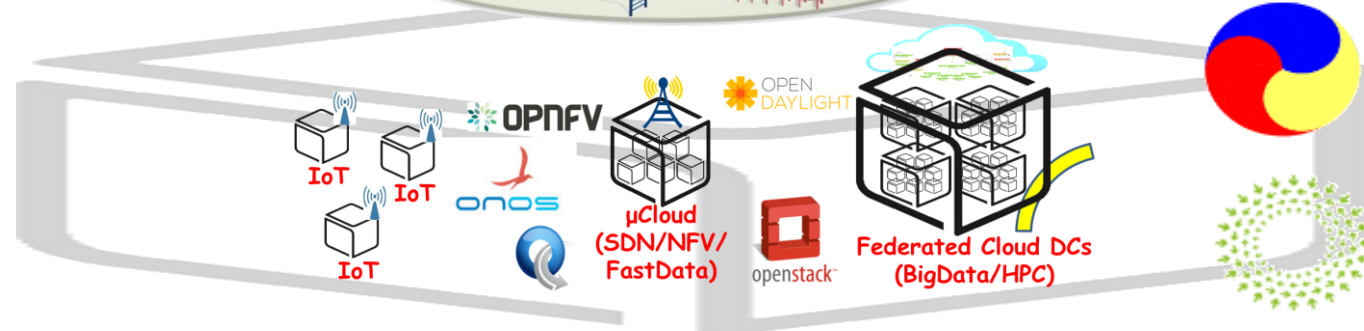
Container-leveraged SmartX IoT-Cloud Services



Open APIs
SmartX Open Platform

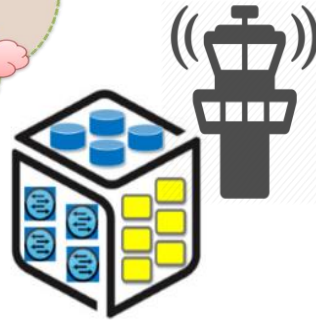
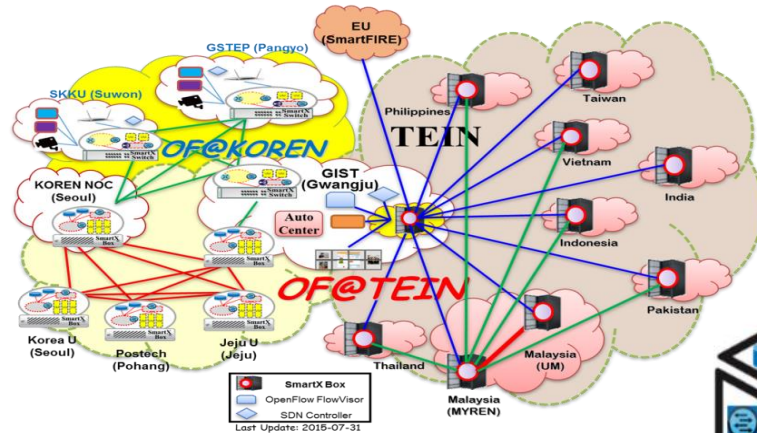
SmartX
Playground

SmartX
Open
Playgrounds

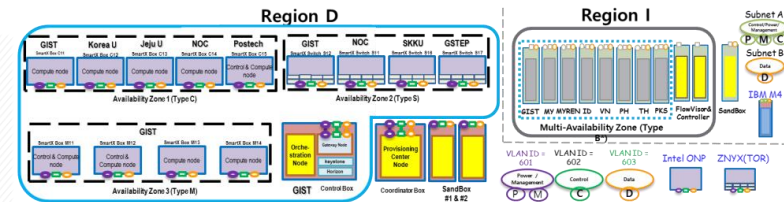
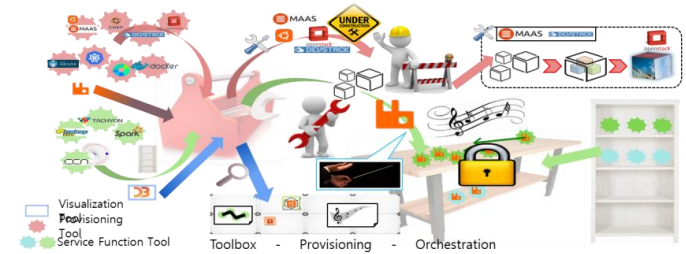


SmartX Playgrounds & SmartX Platform

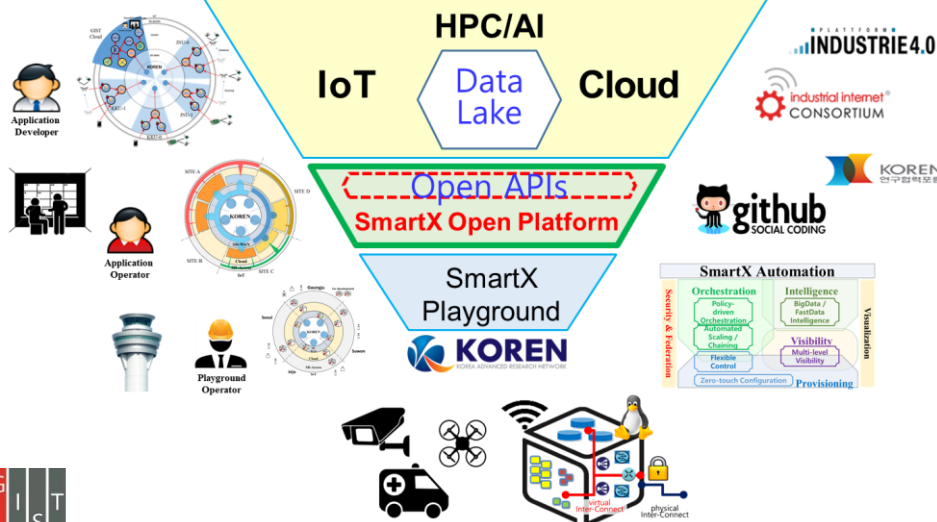
Building/Operating SmartX (OF@KOREN /
OF@TEIN) Playground (2012~2015)



SmartX Playground & Operation Tower (2012~2015)

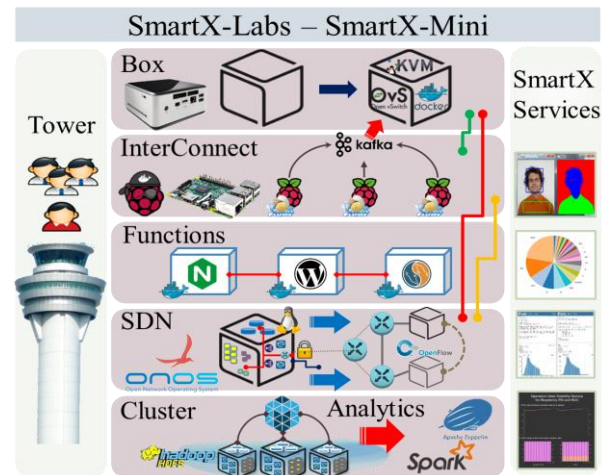


Container-leveraged SmartX IoT-Cloud Services



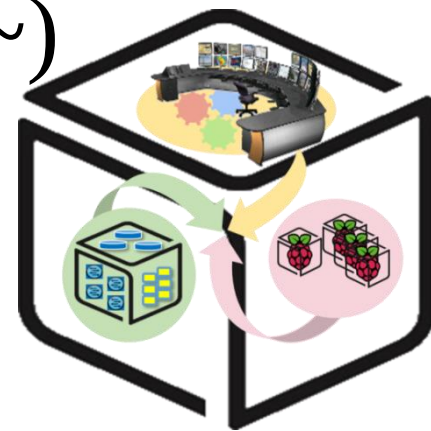
SmartX Labs – SmartX Mini

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



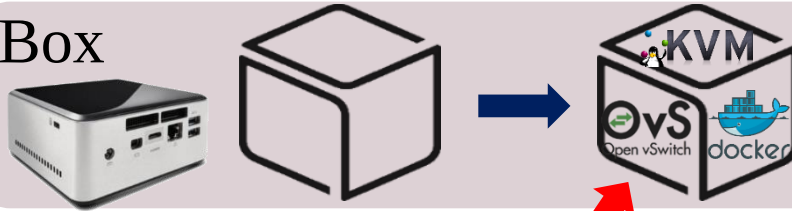
SmartX Labs – SmartX Mini (2015~)

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

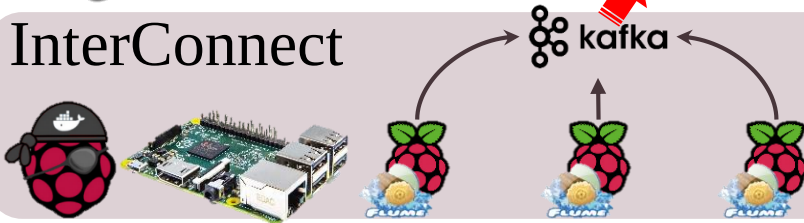


SmartX-Labs – SmartX-Mini

Box



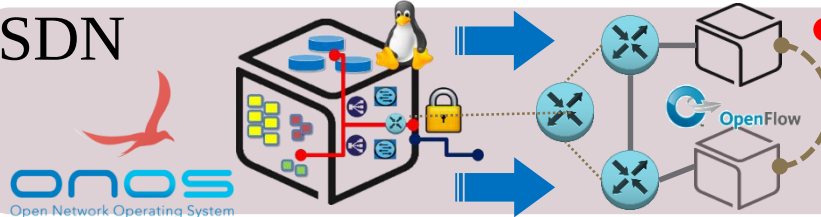
InterConnect



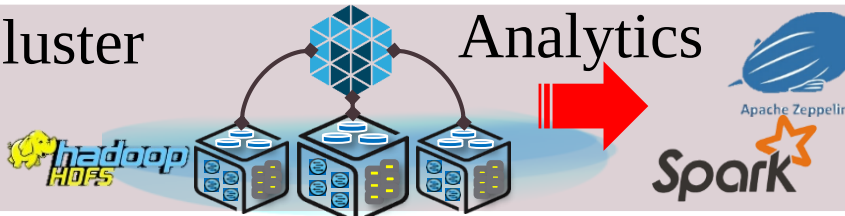
Functions



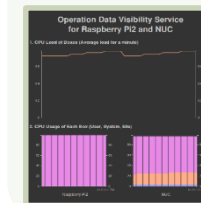
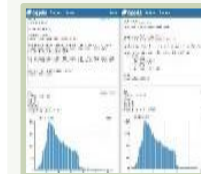
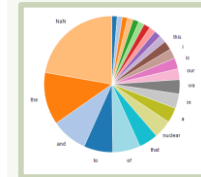
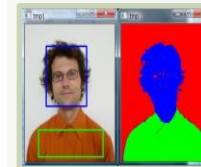
SDN



Cluster



SmartX
Services



Tower

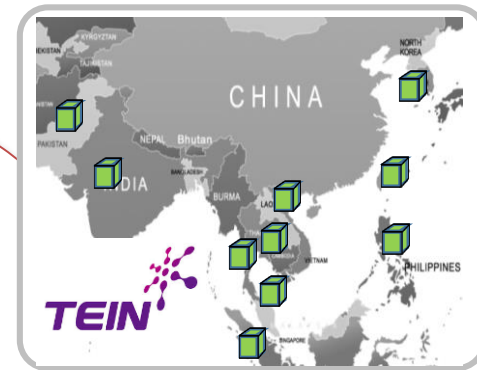


SmartX Composable Playgrounds (2016)

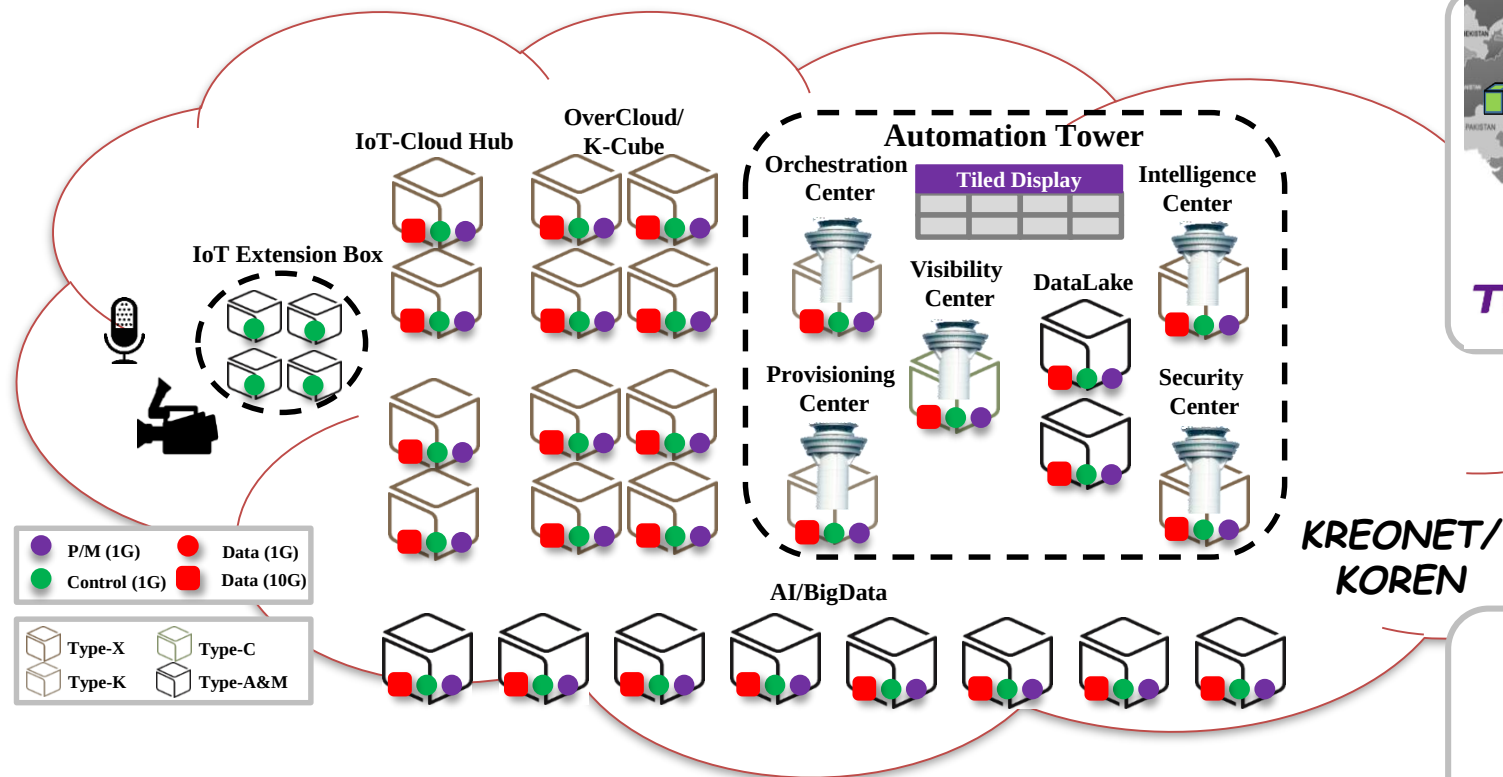
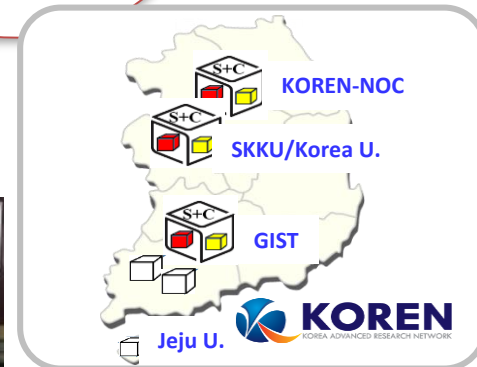
GIST NetCS, OF@KOREN, OF@TEIN

GIST NetCS Playground

OF@TEIN Playground

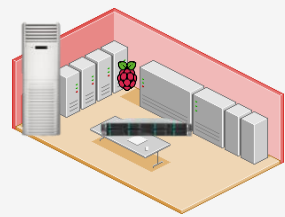
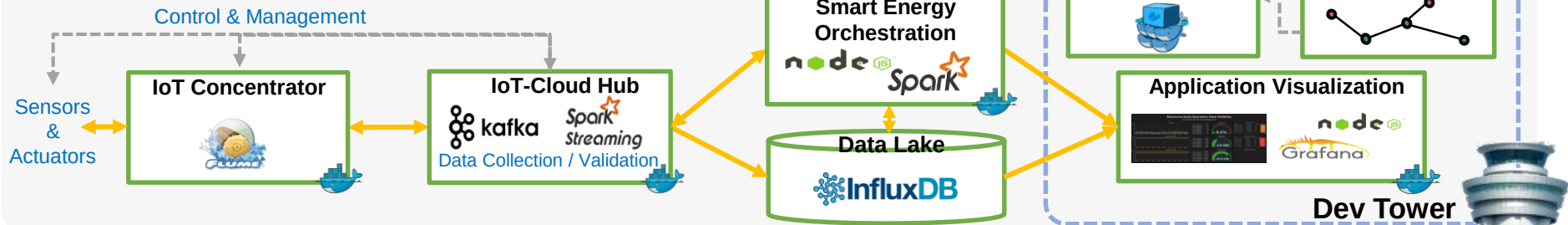


OF@KOREN Playground

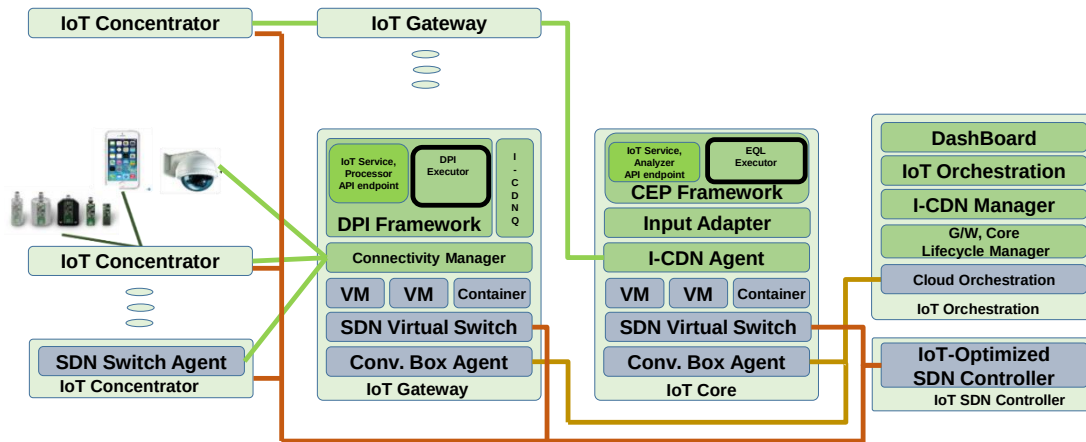


SmartX IoT-Cloud Services over Composable SDI for Smart Energy Domain (2014~2016)

Smart Energy IoT-Cloud Services for Mini Data Center



Mini DataCenter



Dev Tower Ops Tower

IoT Orchestration

I-CDN Manager

IoT SDN
Controller

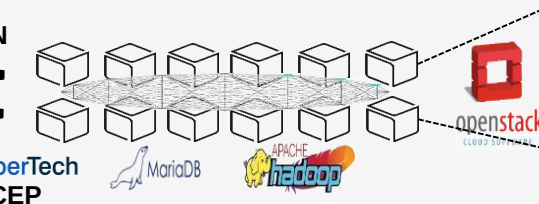


Cloud Orchestration

IoT Gateway



IoT Core



DevOps Tower Resources



SmartX Playground Visibility & Security (2015~)



SmartX-
MultiView



SmartX-
MultiSec

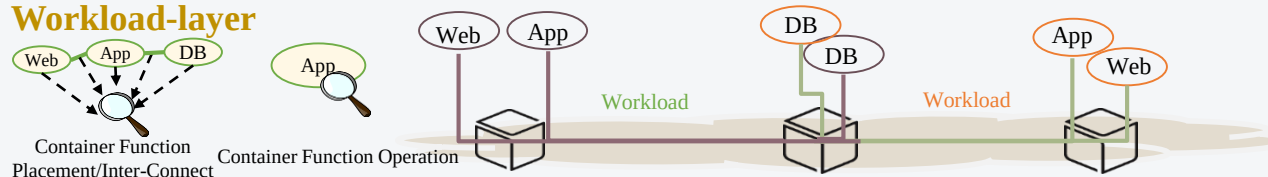
MultiView/MultiSec Framework

Security Operation

Vulnerability assessment

VPN-aaS, Firewall-aaS, IDS

Workload-layer



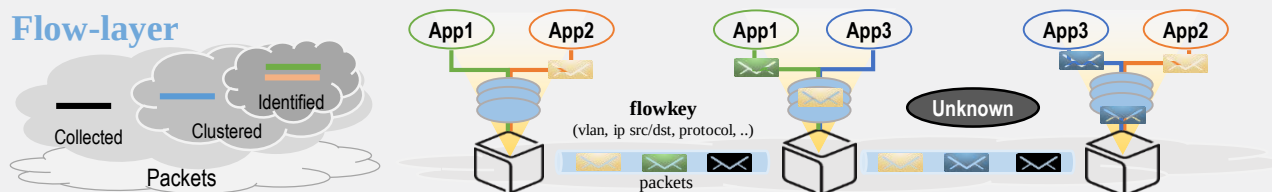
Security Operation

DDos Attacks

Suspicious Flows

Monitoring rules

Flow-layer



Security Operation

Device association

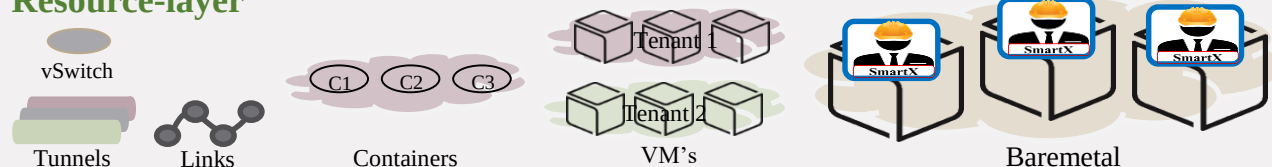
Policy management

Trusted VMs

Vulnerability assessment

Authentication, token, catalog, RBAC

Resource-layer



Visibility Collection & Validation

Visibility Integration

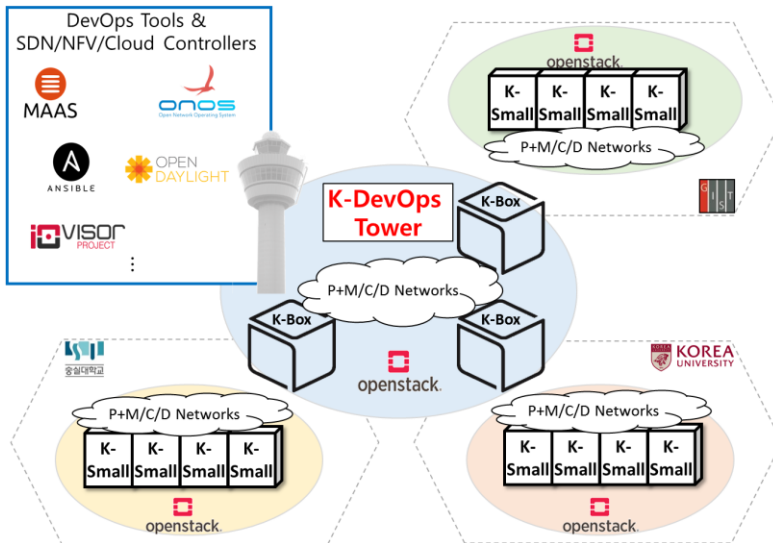
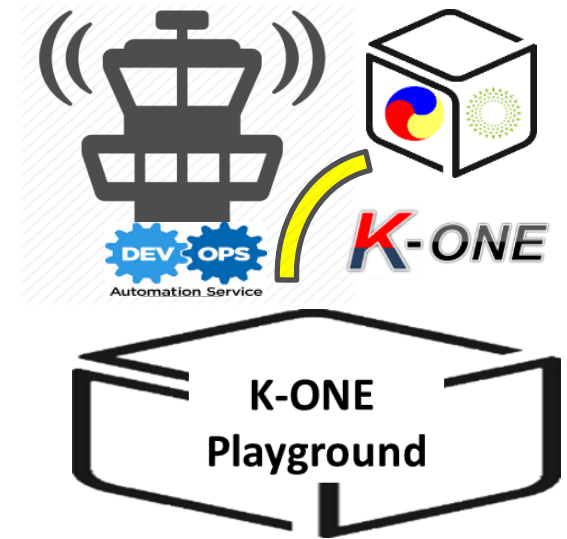
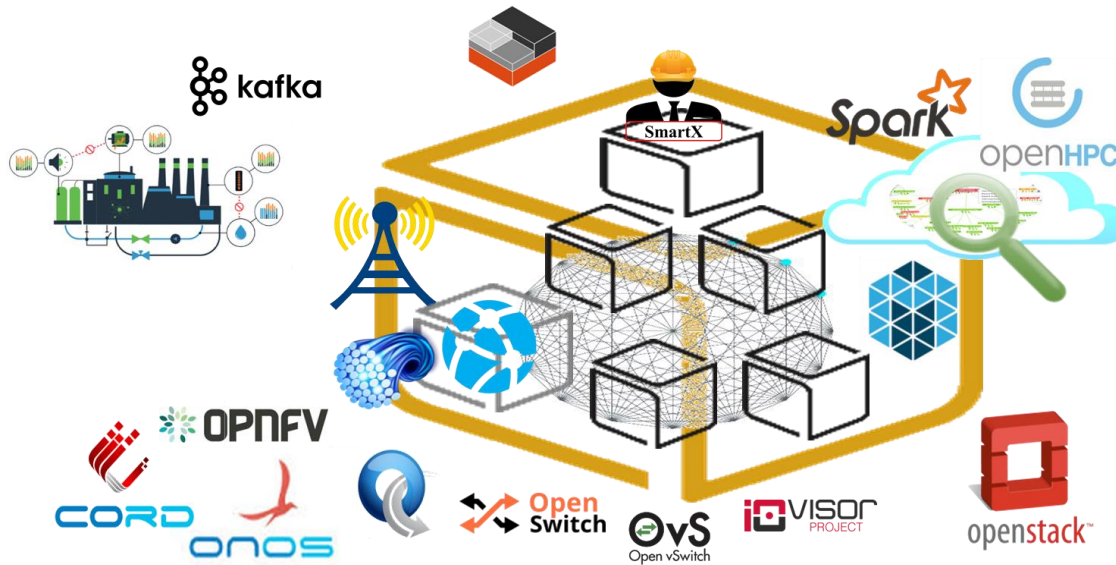
Visibility Staging & Visualization

Intelligence

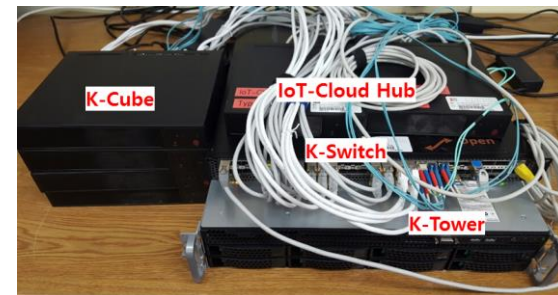


Visibility DataLake &
Analytics

K-ONE Composable Playground (2016~)



Federation of Multi-Site / Multi-Access μ (Edge)Clouds
(IoT - SDN/NFV/FastData - Cloud +HPC/BigData)

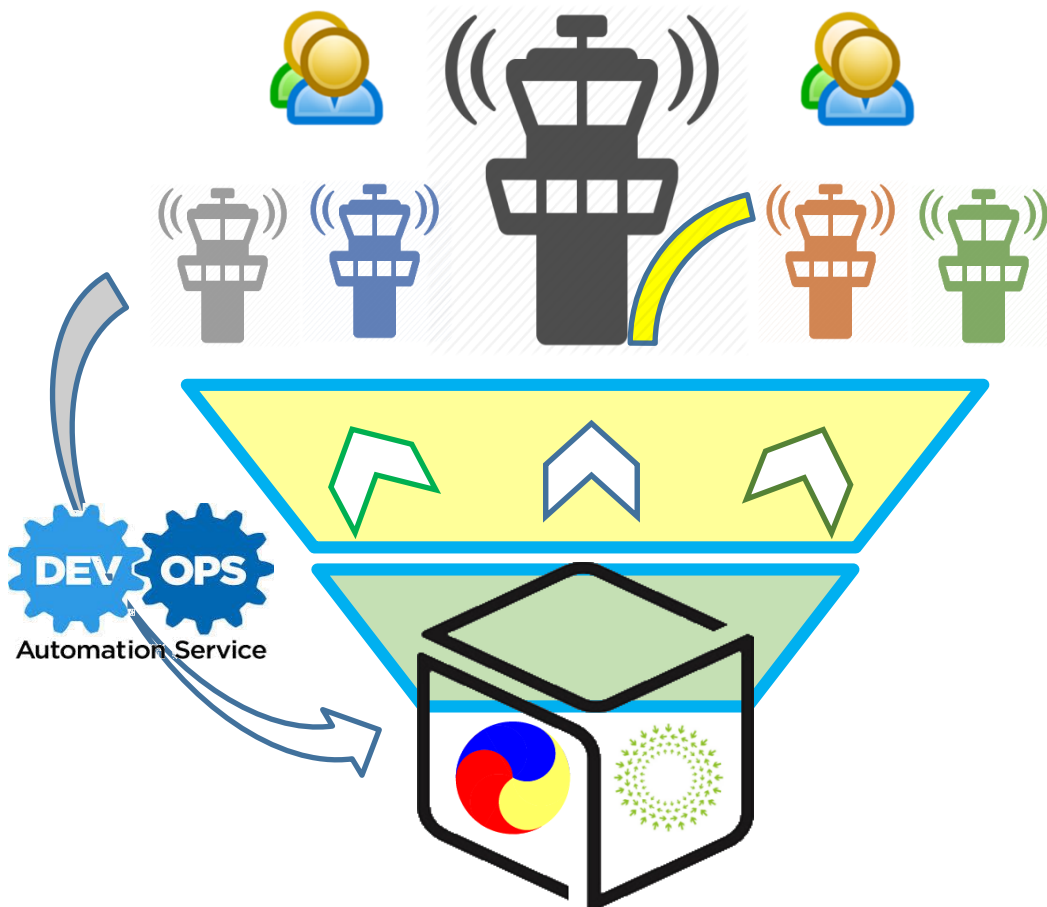
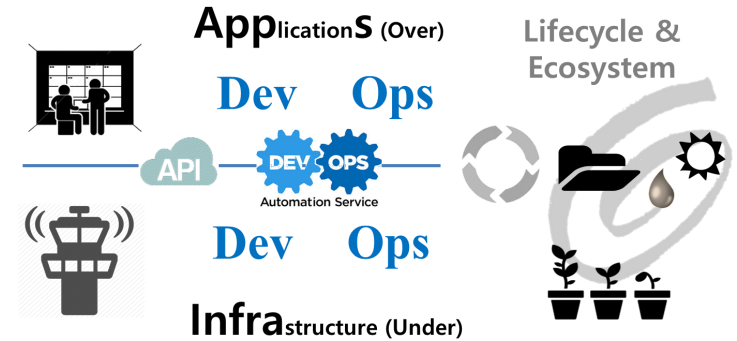




Open Federation of Playgrounds



DevOps-Automated Meta-Operation

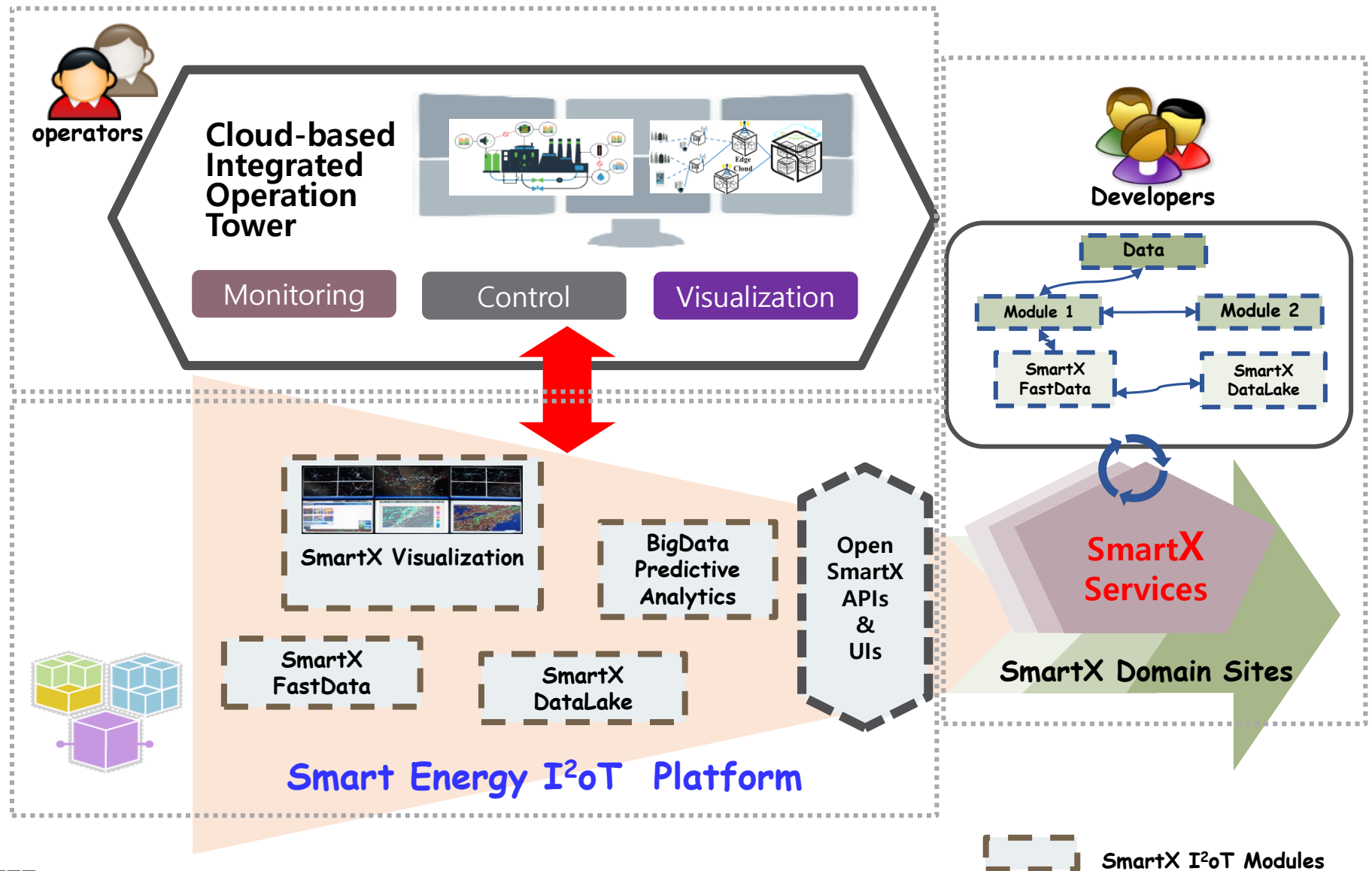


Intelligent
Management &
Orchestration

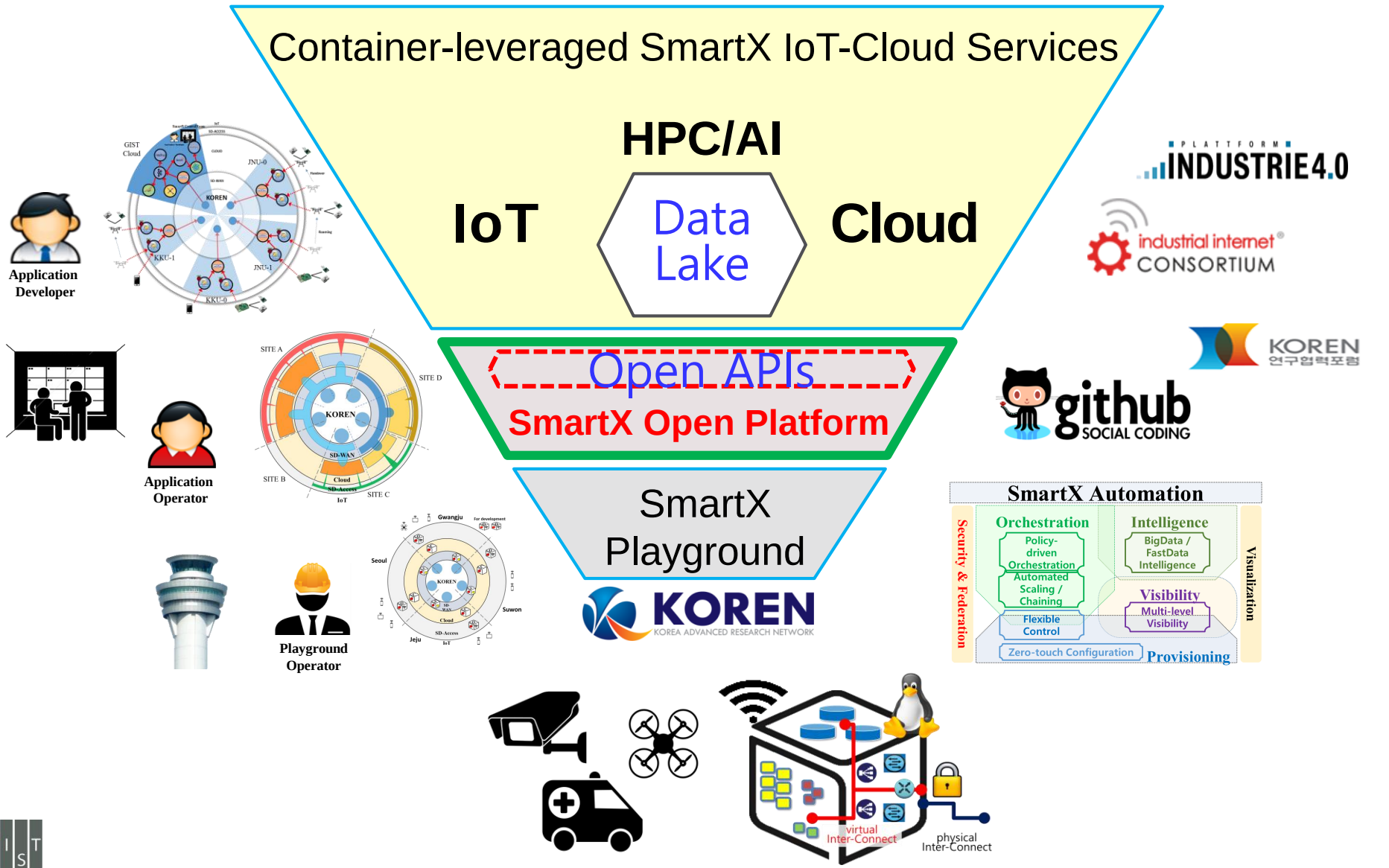
Reconfigurable
Platforms

Open & Convergent
Resources

Toward SmartX I²oT Platform & Operation



KOREN SmartX Open Platform (2017~)



KOREN SmartX Platform: Open Collaboration



KOREN Community

KOREN SmartX
Open-Source Portal
SmartX-Platform/KOREN-Platform



Open Playground

Playground
Introduction

Playground
User Guide

Playground Infrastructure
Description

Open Platform

Platform User
Guide

IoT-Cloud Application
Services Workflow

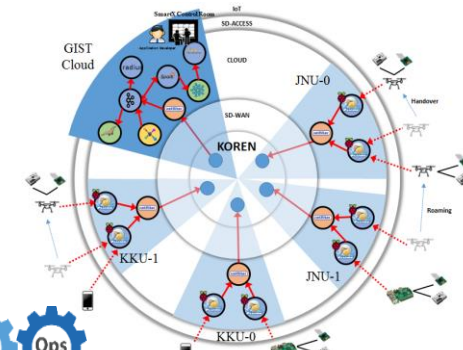
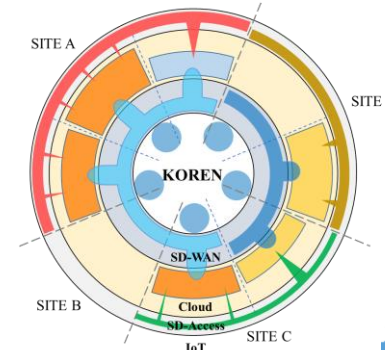
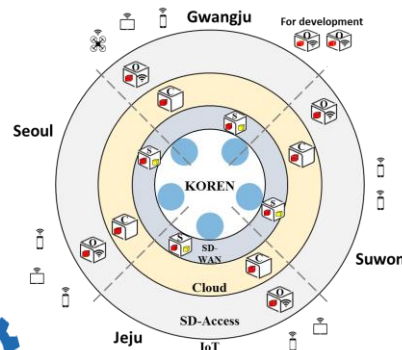
Visibility OpenAPIs
(Open-Source SW)

Orchestration OpenAPIs
(Open-Source SW)

Open Collaboration

Project Roadmap &
Technical Documents

Project Meetings



KOREN
NOC



Playground
Operator



Application
Operator



Application
Developer



Gwangju Institute of
Science & Technology



Thank you!

jongwon@gist.ac.kr