

# Live X+AI Services Realization with Digital Twin Cloud

## OpenRIT 6G Workshop

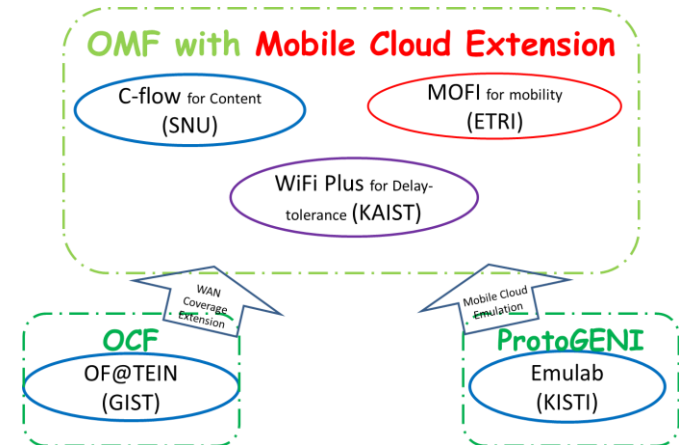
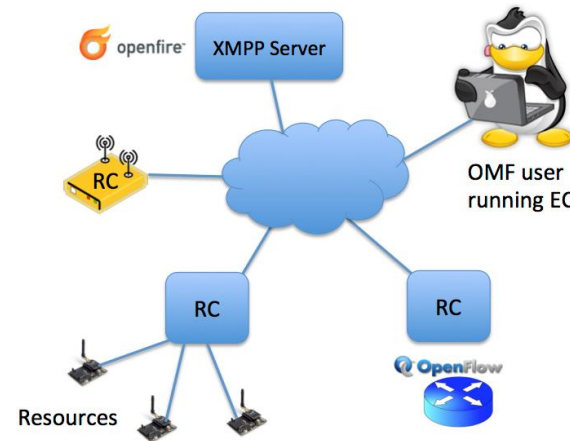
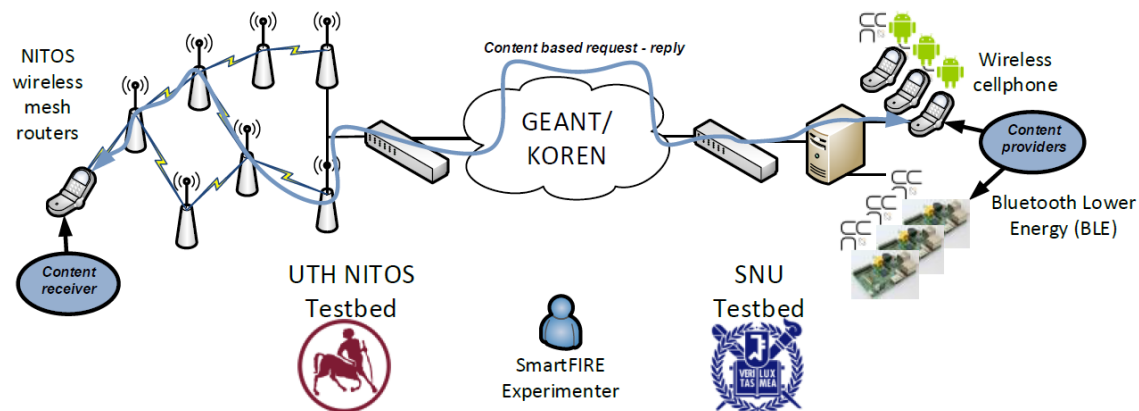
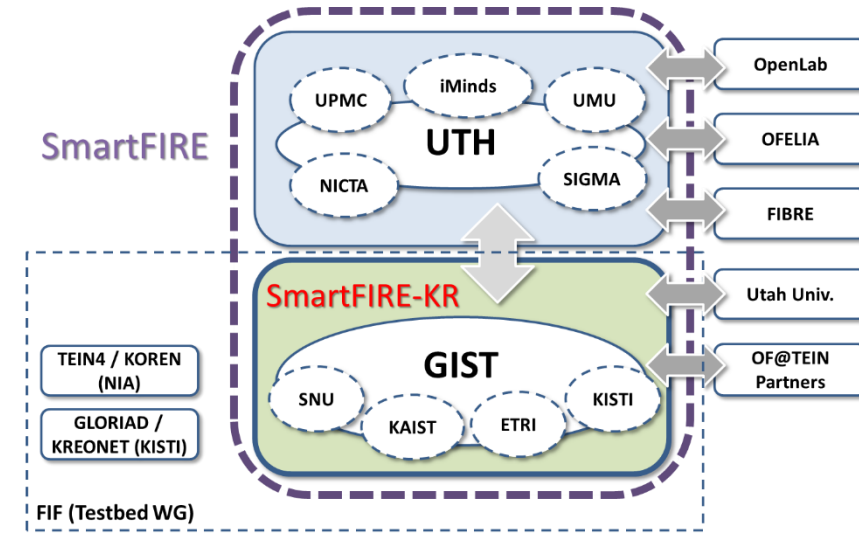
1st International Workshop on Open Research Infrastructures and Toolkits  
for 5G/6G R&D (OpenRIT 6G) @ GSB Conference Center, Univ. of Cape Town

Dr. JongWon Kim

AI Graduate School  
Gwangju Institute of Science & Technology (GIST)



# SmartFIRE (EU-KR Joint) Testbed Collaboration (2012~2015)





OF@TEIN  
KOREN-Project  
(`12.06 ~ `14.12)

Preparation

OF@TEIN+  
Asi@Connect  
(`17.07~`19.05)

Preparation

OF@TEIN++  
Asi@Connect  
(`20.07~`21.06)

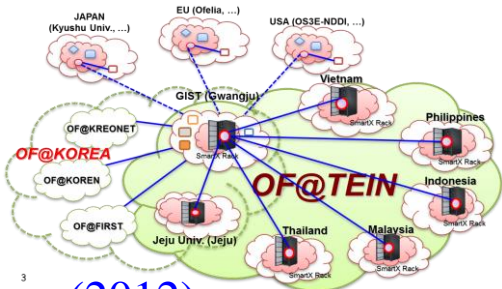
OF@TEIN+++  
Asi@Connect  
(`22.03~`23.06)

OpenFlow@TEIN  
→ →

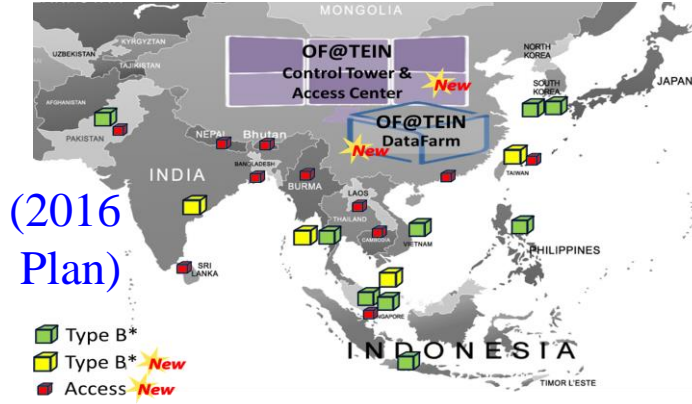


AI-inspired Edge Services  
over Open Federated  
Cloud Playgrounds

Open Federation  
@TEIN

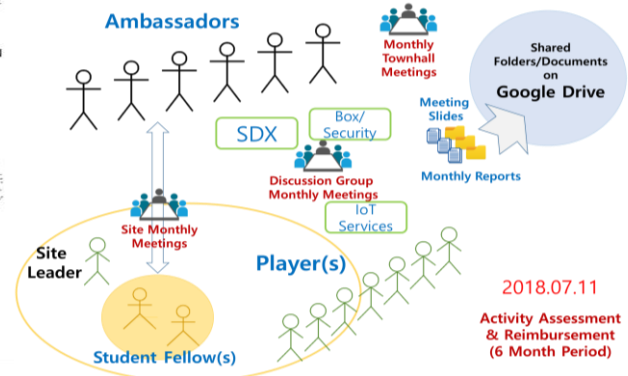


(2012)



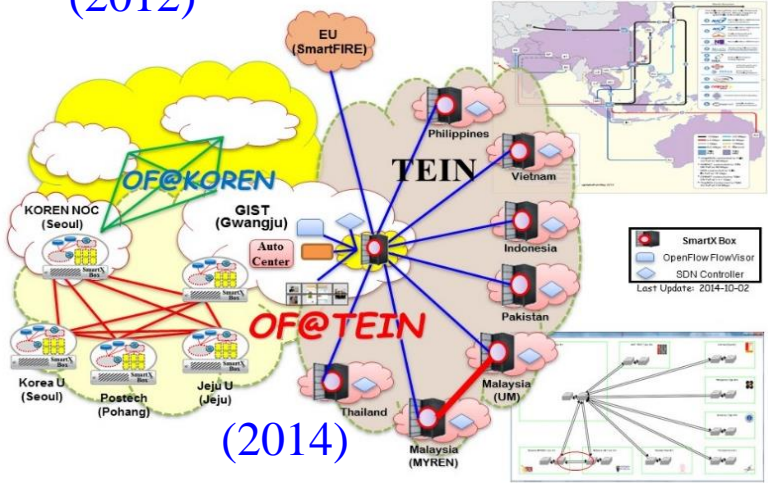
(2016 Plan)

- Type B\*
- Type B\* **New**
- Access **New**

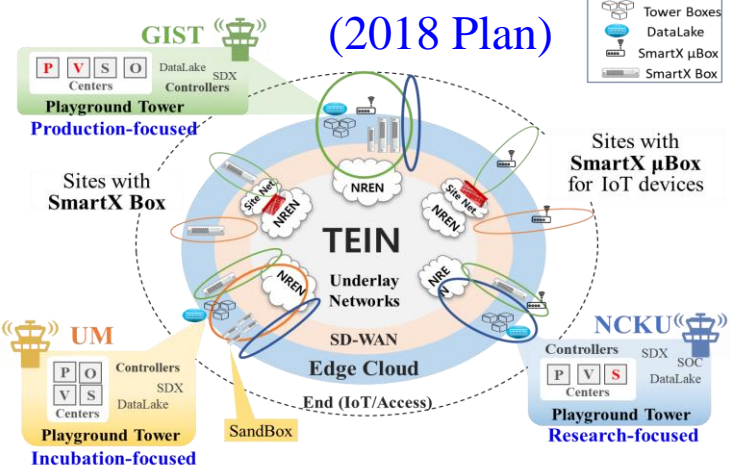


2018.07.11  
Activity Assessment & Reimbursement  
(6 Month Period)

(2018.06~2020.04)

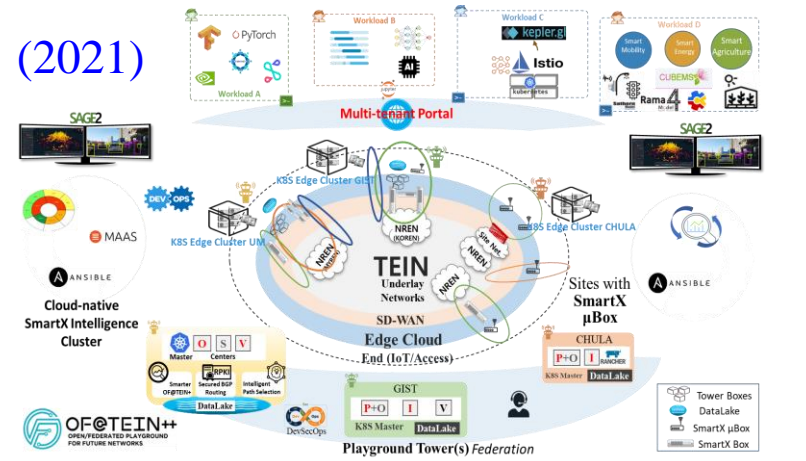


(2014)



(2018 Plan)

(2021)



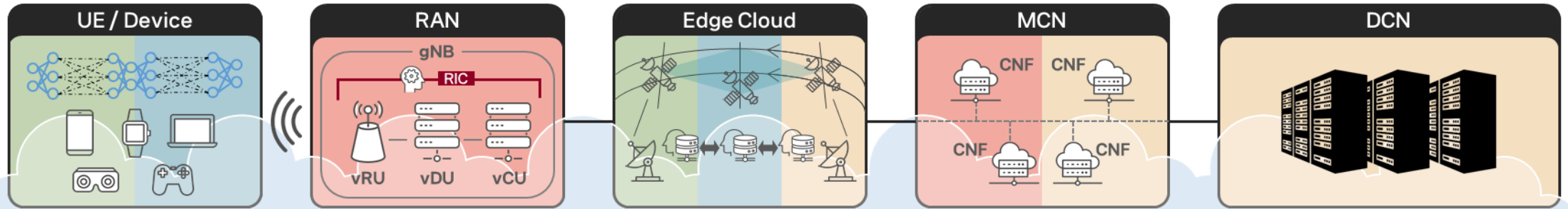
**K** Knowledge-Driven

**O** Orchestration

**R** Resilient

**E** Edge-Centric

**A** Ambient Intelligence



Software-Centric Network Intelligence over E2E Cloud Continuum

**Network-Aware Devices**

**Ambient Edge Cloud**

**RAN-MCN Convergence**

**Cloud System for Telco**

Proposed (Mar. 2024)

10M USD tentative, 5 Years ('24~'28)

~50 MS/PhD Students Out-bound Mobility from 12 established university labs

**Global Collaboration: Fundamentals**

**Global Collaboration: Testbeds**

**5G→6G**

Software-/Cloud-centric Next-gen Communication/Networking

**SoftNET Global Research Center**

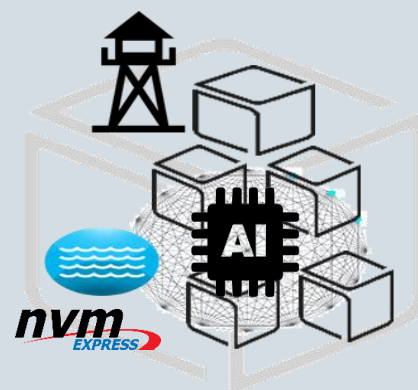


# Data-centric & Cloud-native Edge-to-Cloud Computing

**Data Meshes**  
Fused Data with AI/ML Workflow

**Data Pipelines**  
Open & Connected DataLake

**Data Ponds/Lakes**  
Collected Raw Data (Hot/Warm/Cold)  
Fast & Persistent  
Secured & Confidential

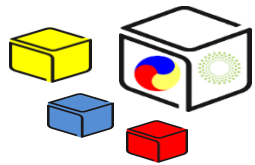
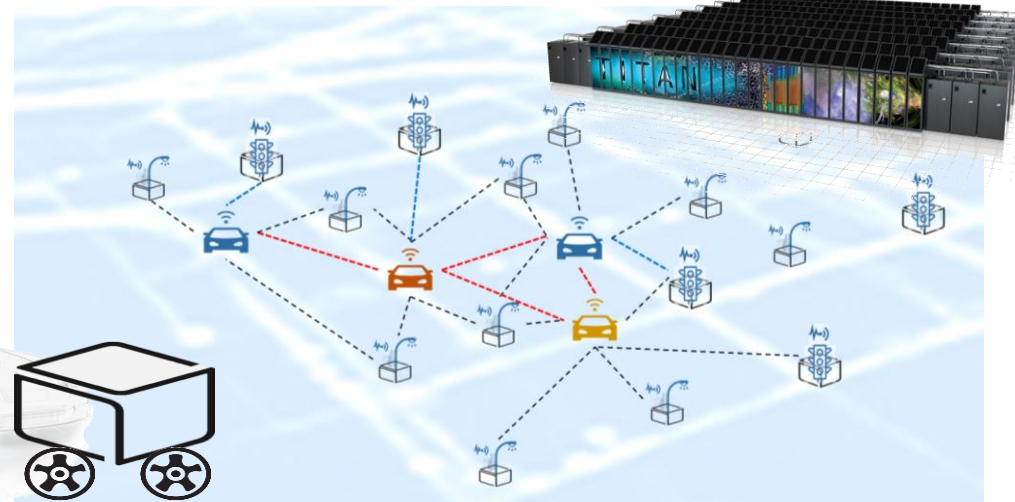
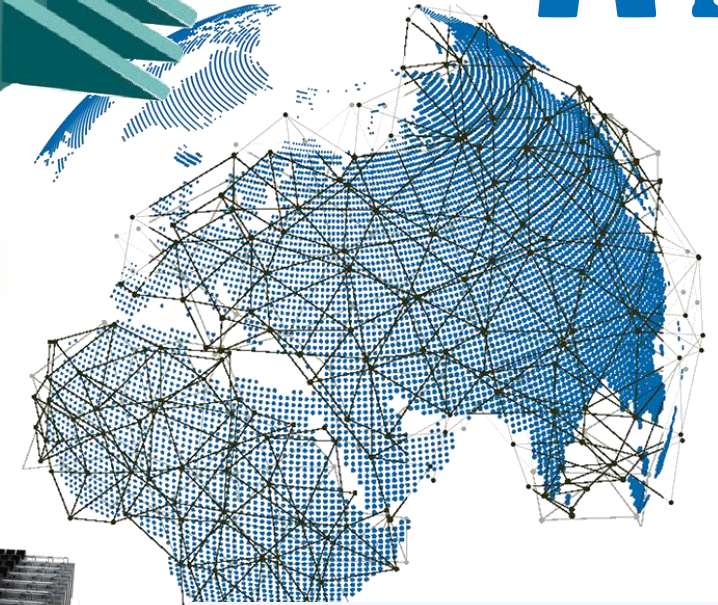
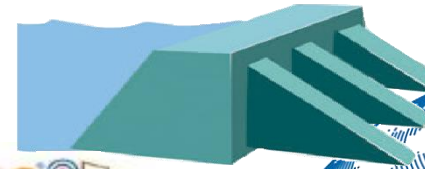


End	Edge	Core
Things	$\mu$ Clouds (SDN/NFV)	Clouds (HPC/BigData)

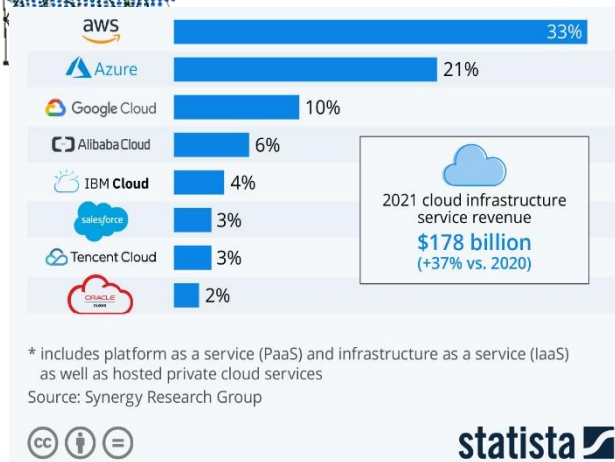
# Computer Systems Everywhere → Digital SOC → D-N-A Infrastructure



Digital SOC (Social Overhead Capital)

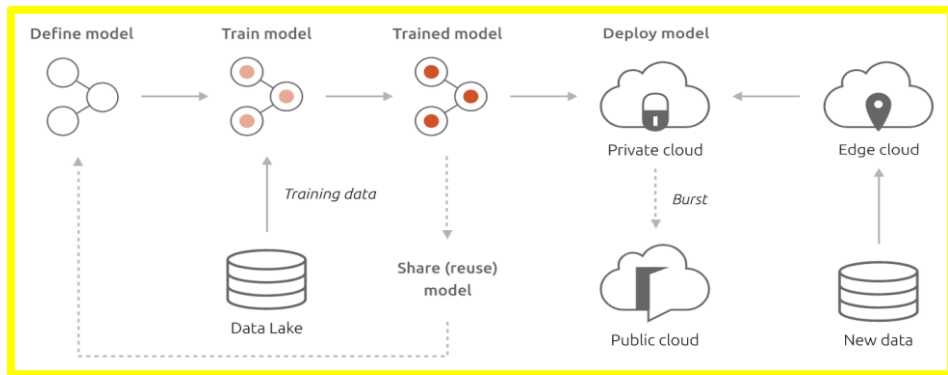
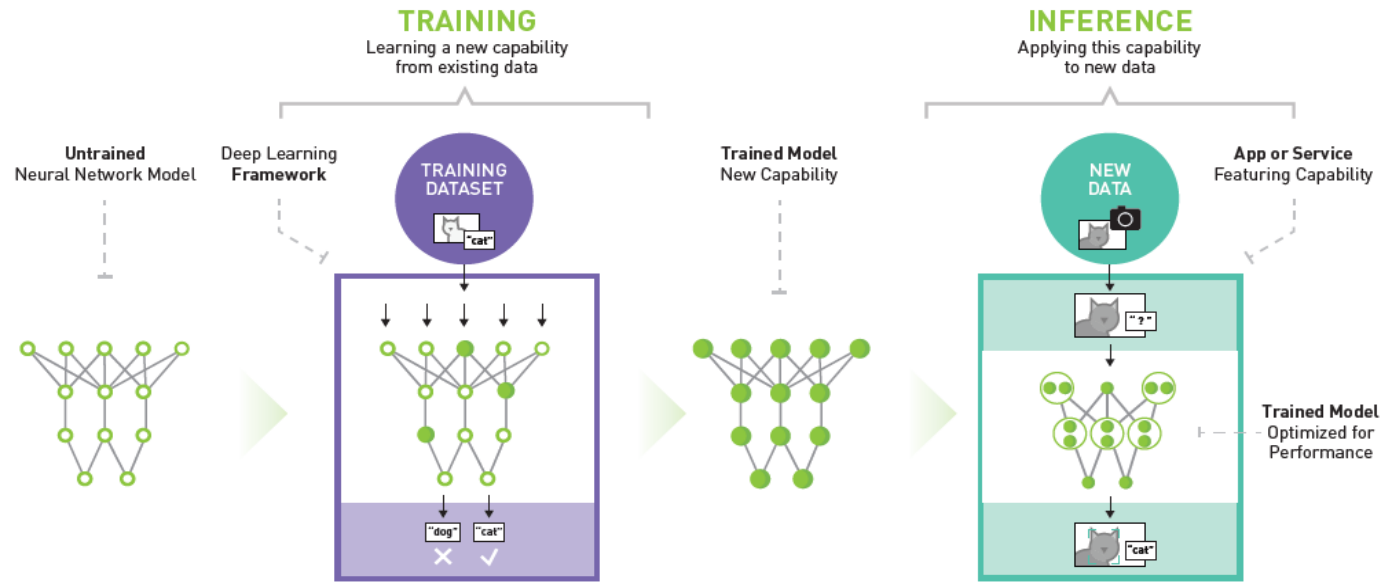
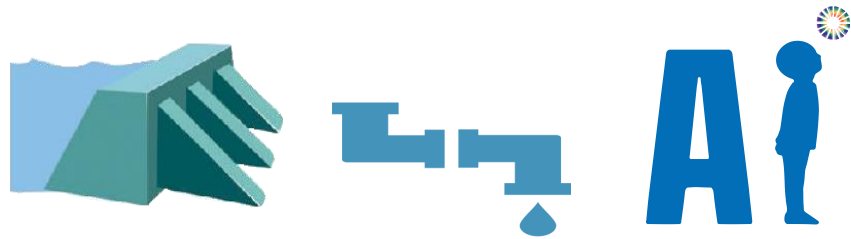


White Box



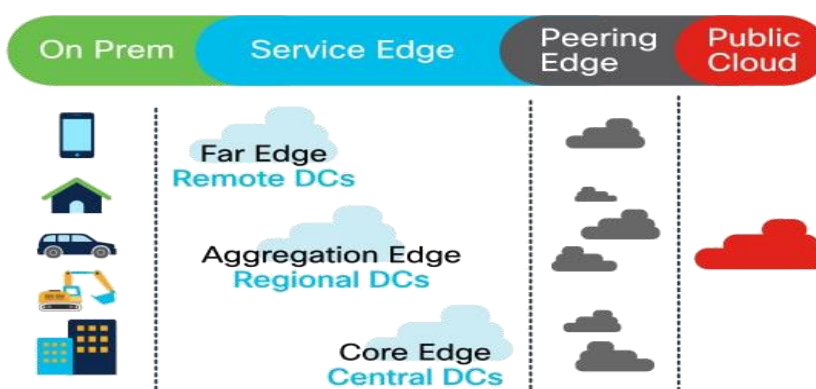


# D-N-A-based X+AI: Training@Cloud & Inferencing@Edge

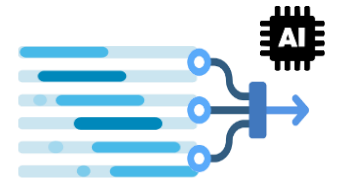


## INFERENCE

## TRAINING



**Live!**  
**AI**



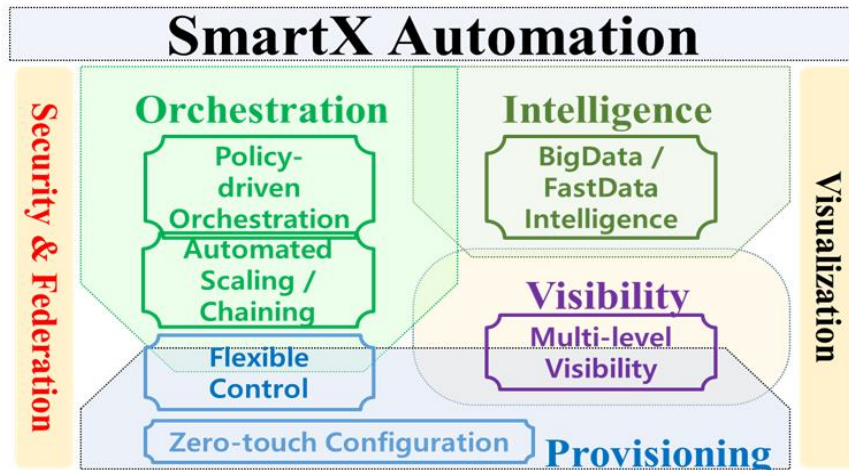
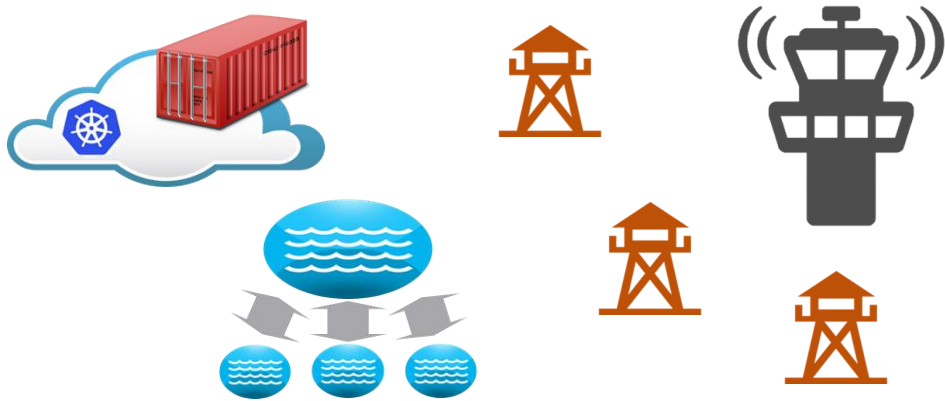
**X**

**+**

**AI**

# Live AI! Cloud-native X+AI Common Platform

Automate First → Accumulate Data → Make it Smart!



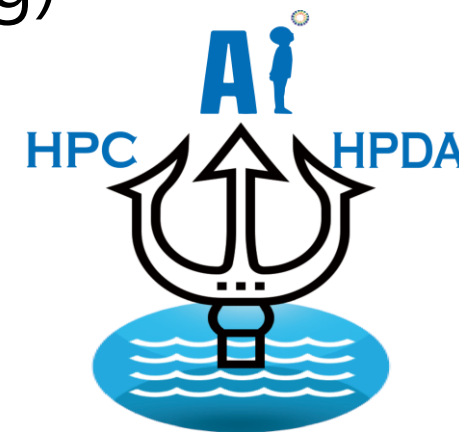
Autonomous & Intelligent

(Provisioning) Re-organize Target Environment, (Visibility) Monitoring First, (Orchestration) Enable Control & Orchestration, (Intelligence) Establish Process & Automate



# D-N-A-based X+AI: Key Infrastructure Challenges

## (AI Resource and Data Accumulation/Sharing)



**AWS SNOW FAMILY**

**SNOWBALL** (Storage Optimized)

- 2.2 GHz CPU
- 4 GB RAM
- 8 TB Storage
- 2.2 GHz CPU
- 4 GB RAM
- 8 TB Storage

**SNOWMOBILE** (Compute Optimized)

- 52 CPU
- 208 GB GPU
- 42 TB Storage
- 52 CPU
- 208 GB GPU
- 42 TB Storage

**SNOWBALL EDGE** (Storage Optimized)

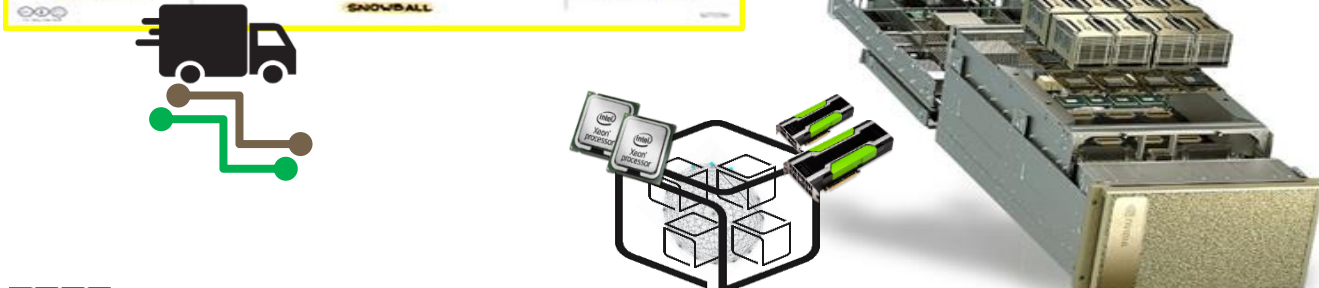
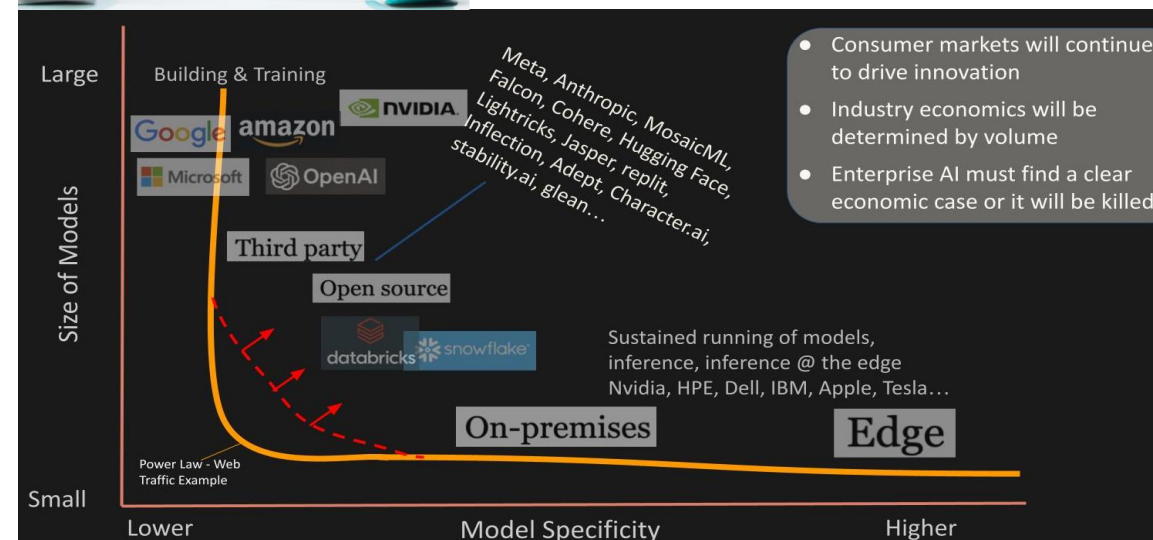
- 80 RAM
- 40 CPU
- 80 TB Storage
- 80 RAM
- 40 CPU
- 80 TB Storage

**SNOWMOBILE** (Compute Optimized)

- 100 PB Storage
- 100 PB Storage
- 100 PB Storage
- 100 PB Storage

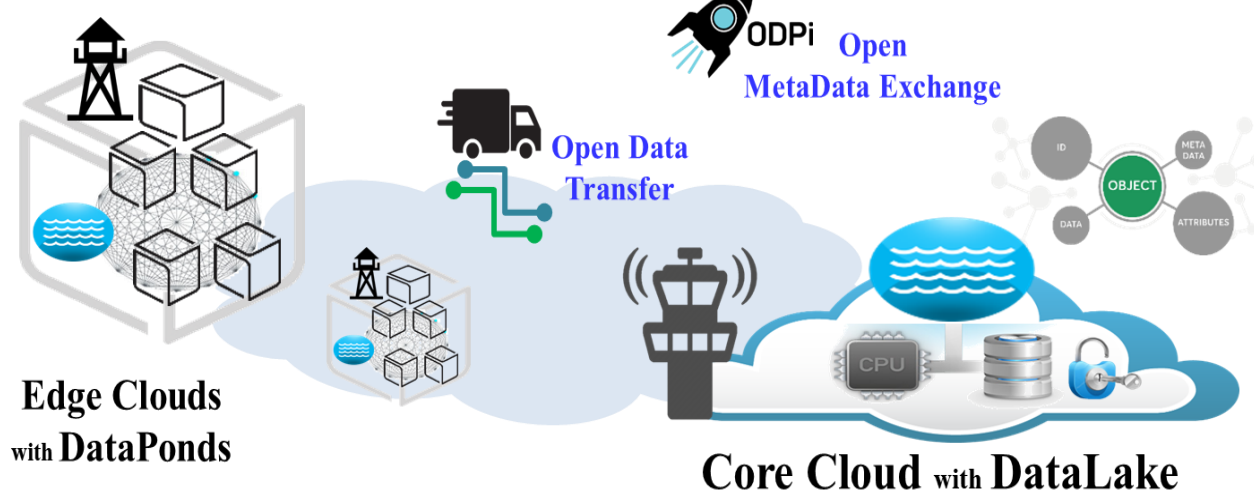
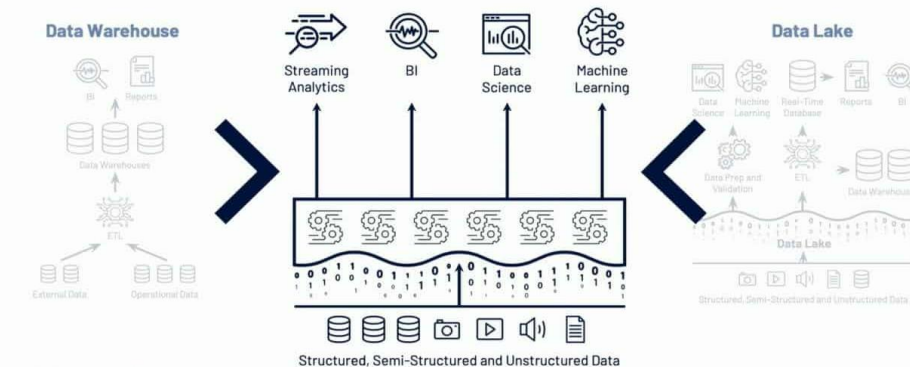
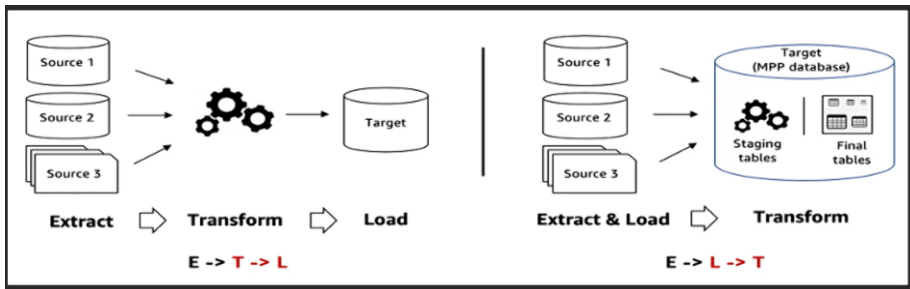
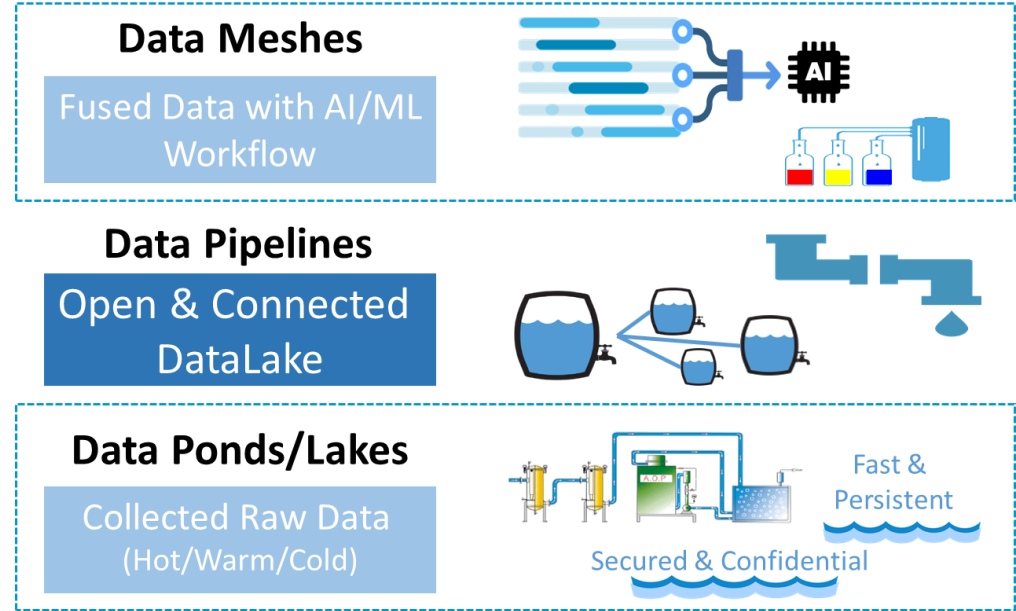
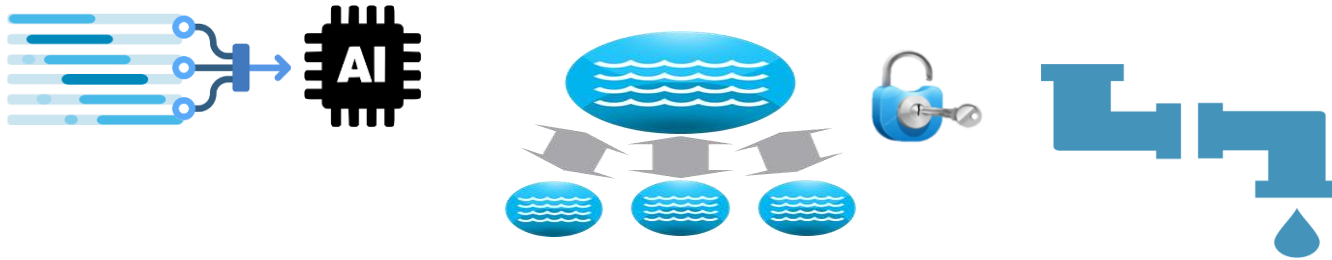
**GPT-3 vs GPT-4**

Parameters - 175,000,000,000 vs Parameters - 10,000,000,000,000



# Data-centric:

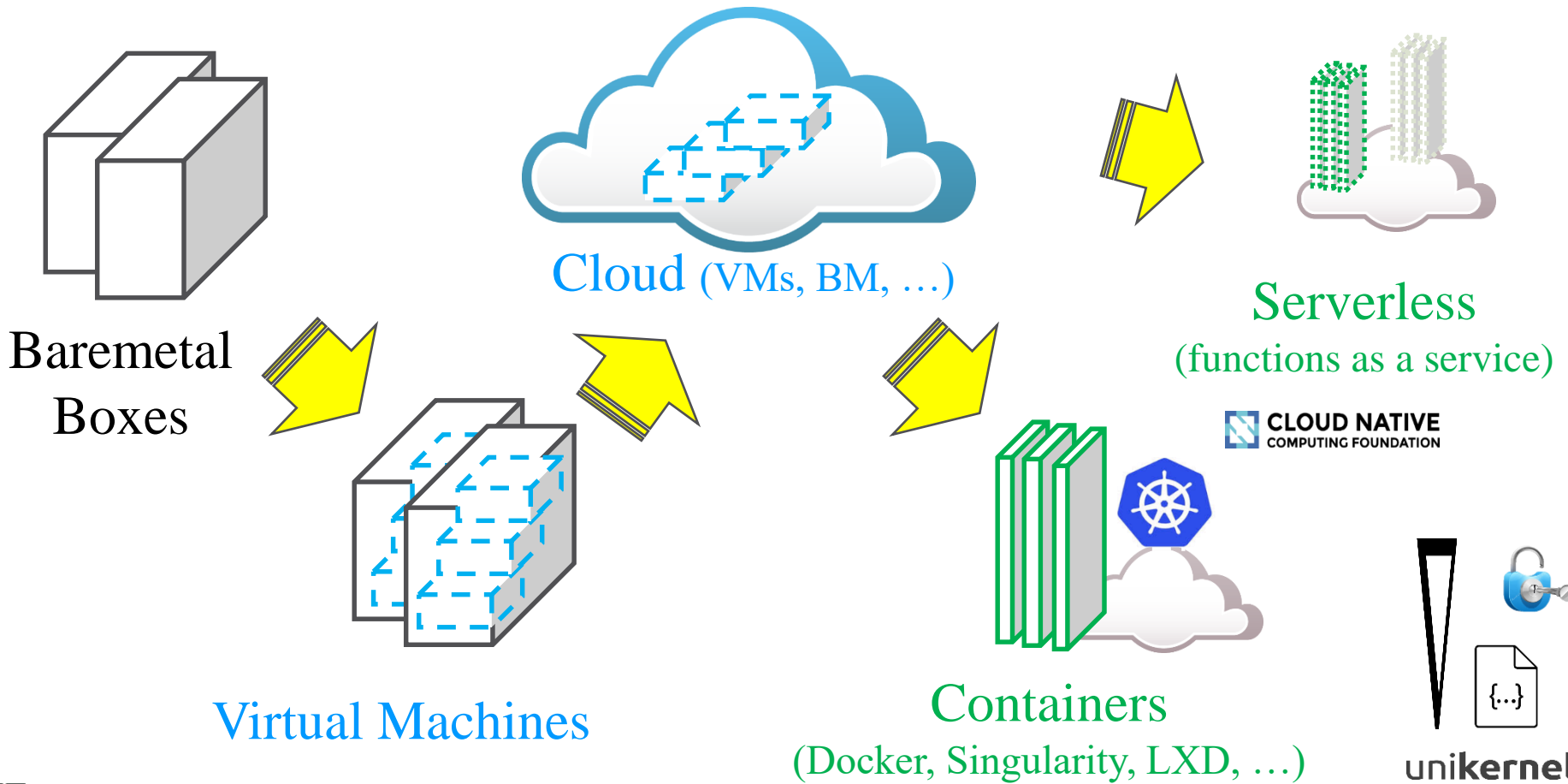
Connected DataLake / Data Pipelines  
+ Data Meshes for AI



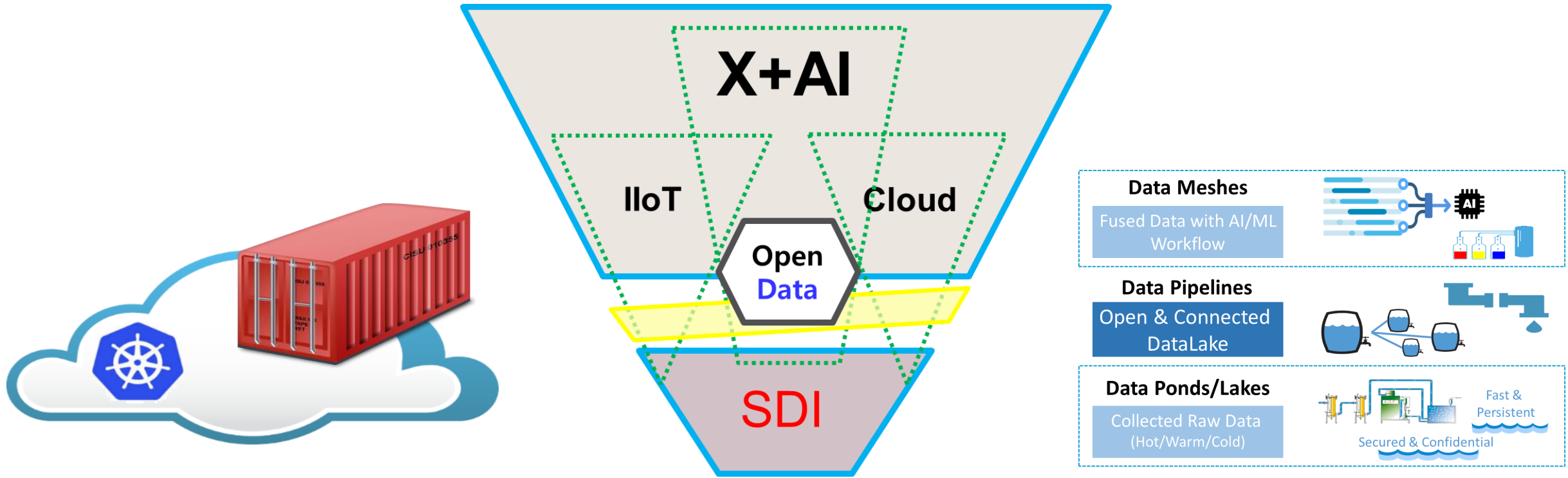


# Cloud-native: From Baremetal to Containers / Serverless

Monolithic Apps      N-tier Apps      **Micro-services**      Nano-services

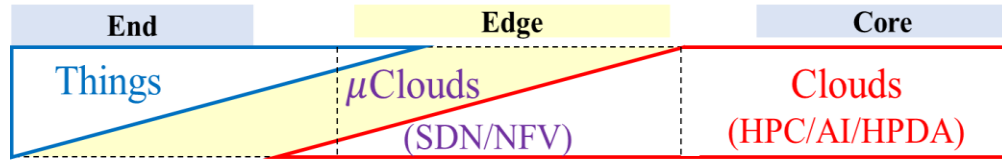


# Flipped Framework for X+AI Service Ecosystem

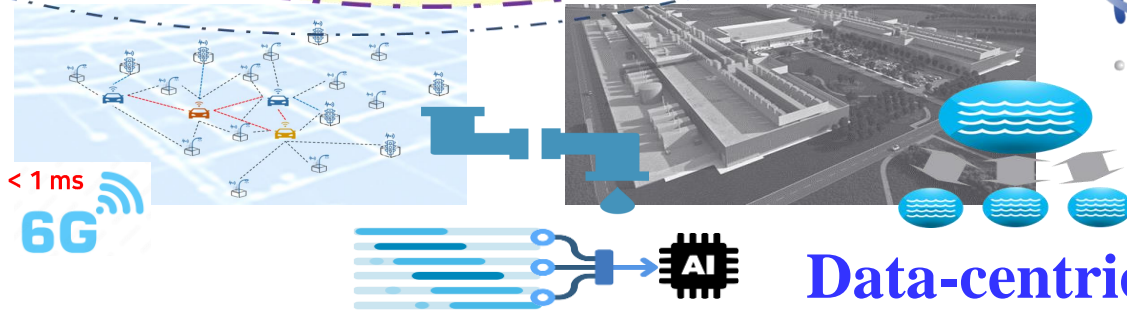
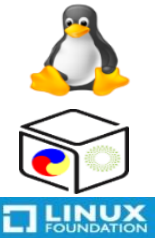
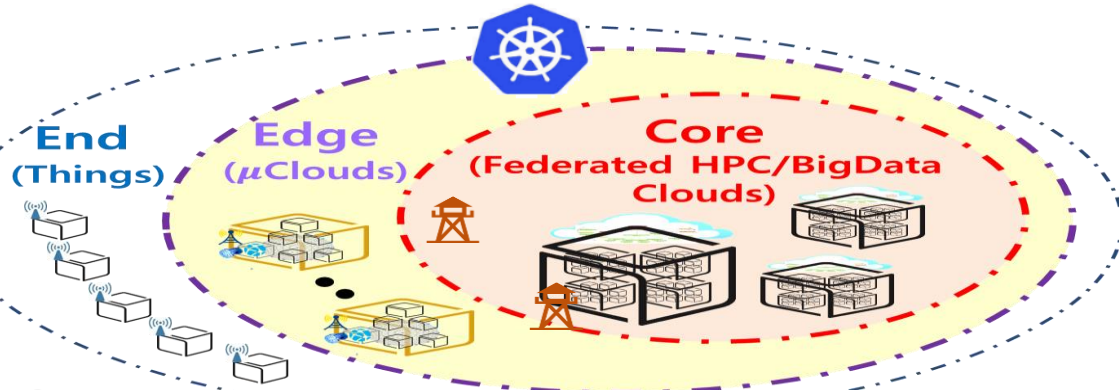


Cloud-native & Data-centric  
Open Infra / Common Platform

# Hyper-connected Fabric Networking for Edge-to-Exascale Core

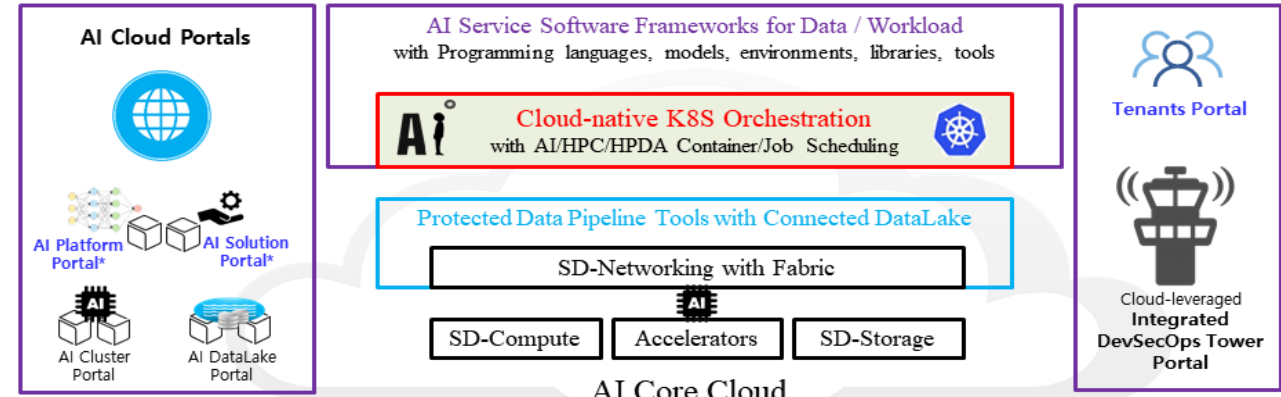
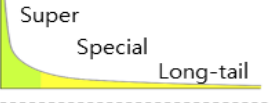


Cloud-native



Data-centric

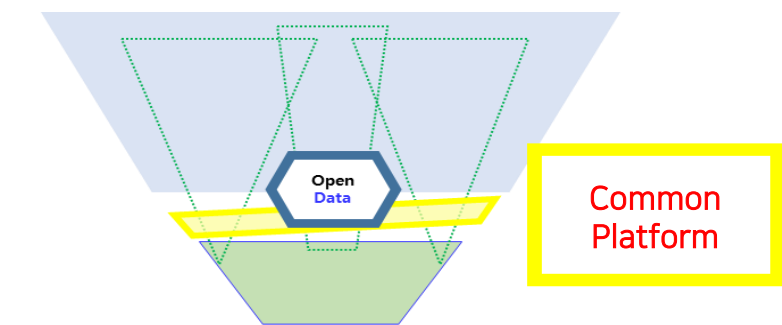
AI-inspired Domain-specialized Services Realization with DevSecOps-automated Workflows



Cloud-leveraged OpenAPI Portals  
(ID Federated, Customizable, ...)

Automated Infrastructure Operation  
(Composability, Visibility/Security, Accountability, ...)

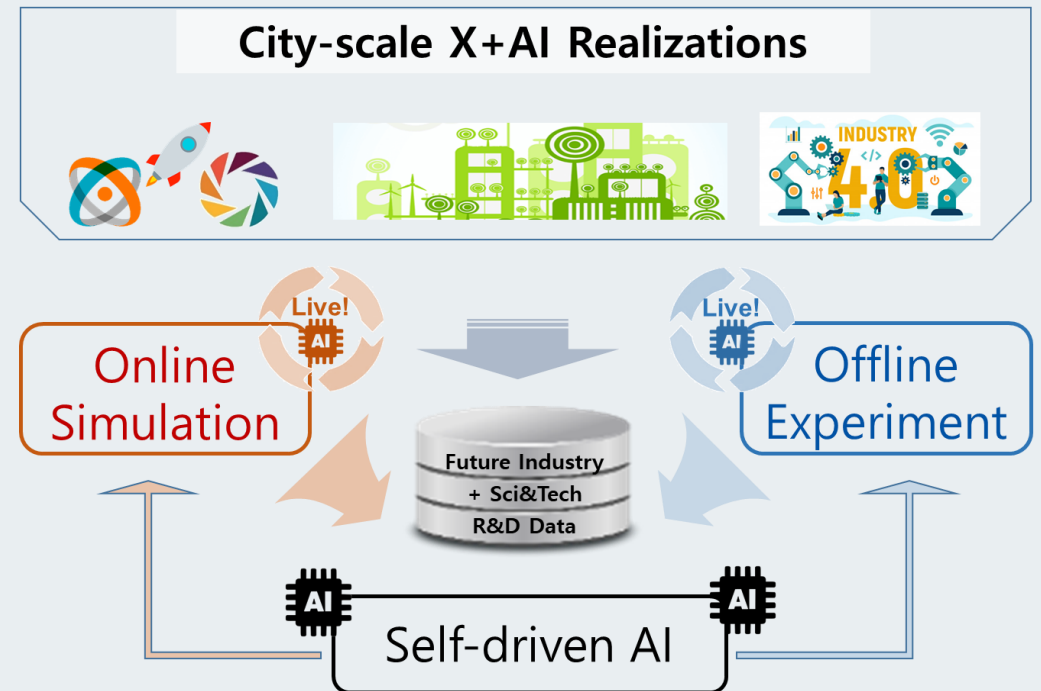
Common Platform



Open Infrastructure

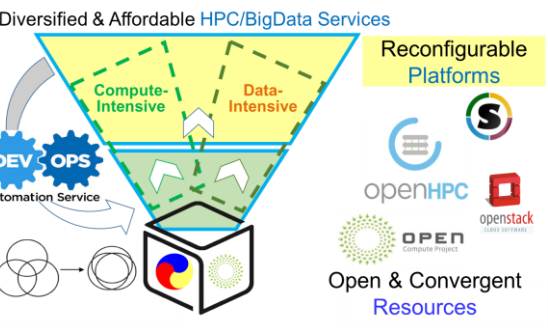
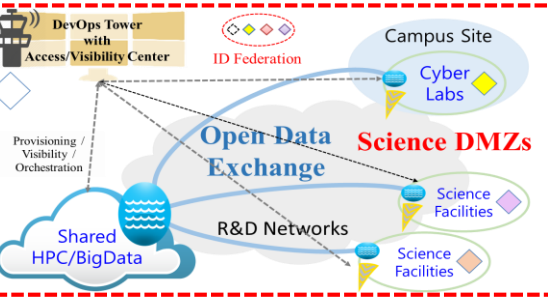
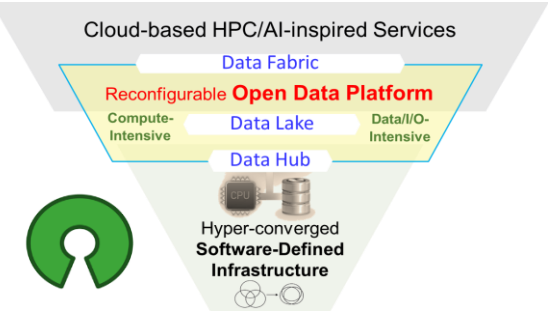
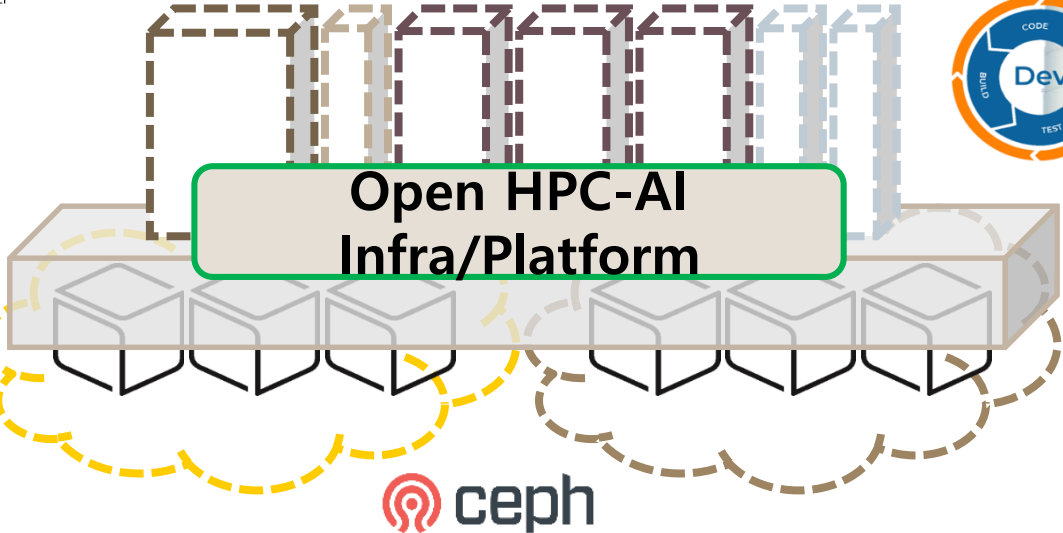


# Live & City-scale X+AI Services with HPC-AI-leveraged Digital Twin Cloud

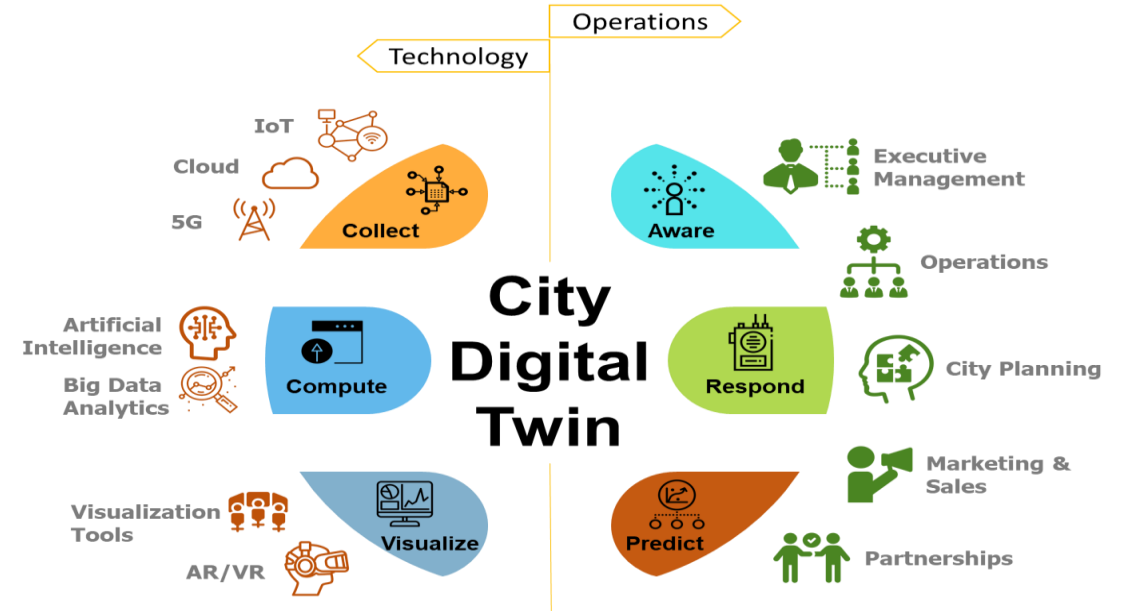
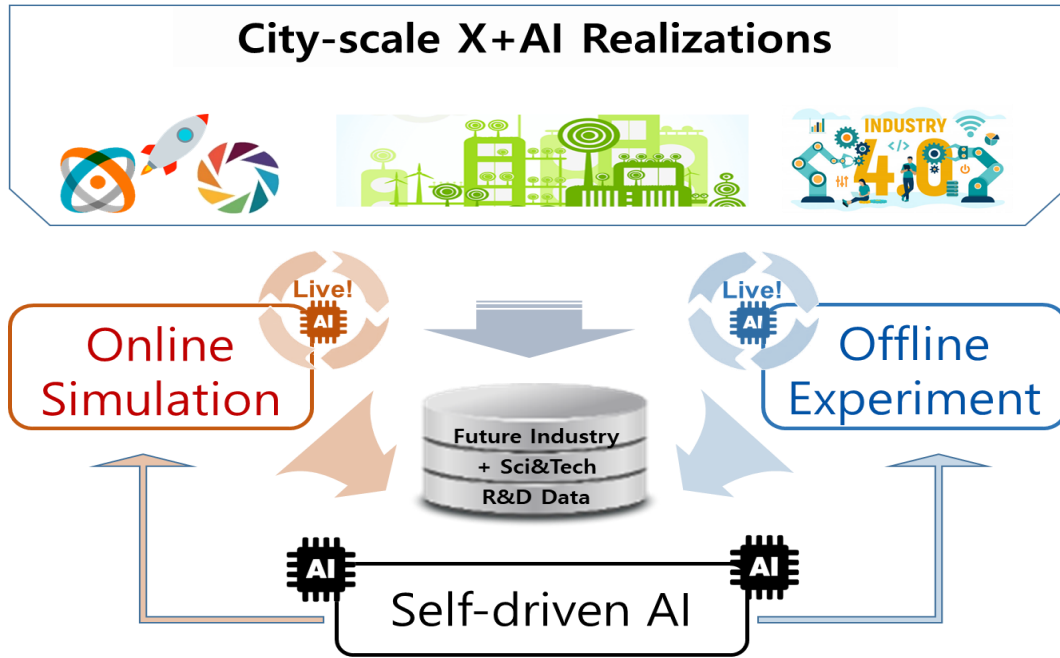


# Open-Source HPC-AI Reference Model Candidates

## Open HPC-AI SaaS Marketplace

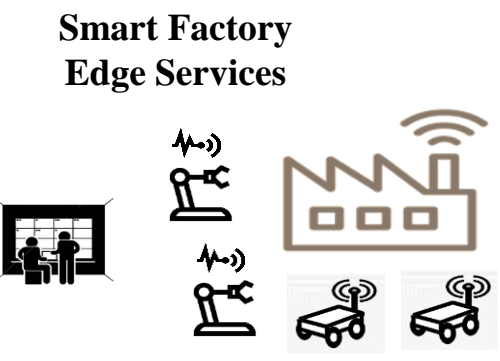
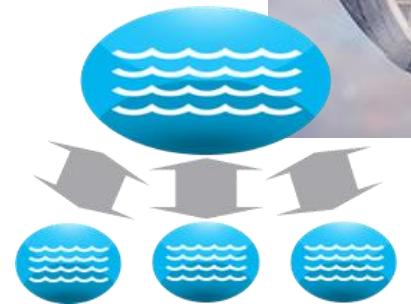
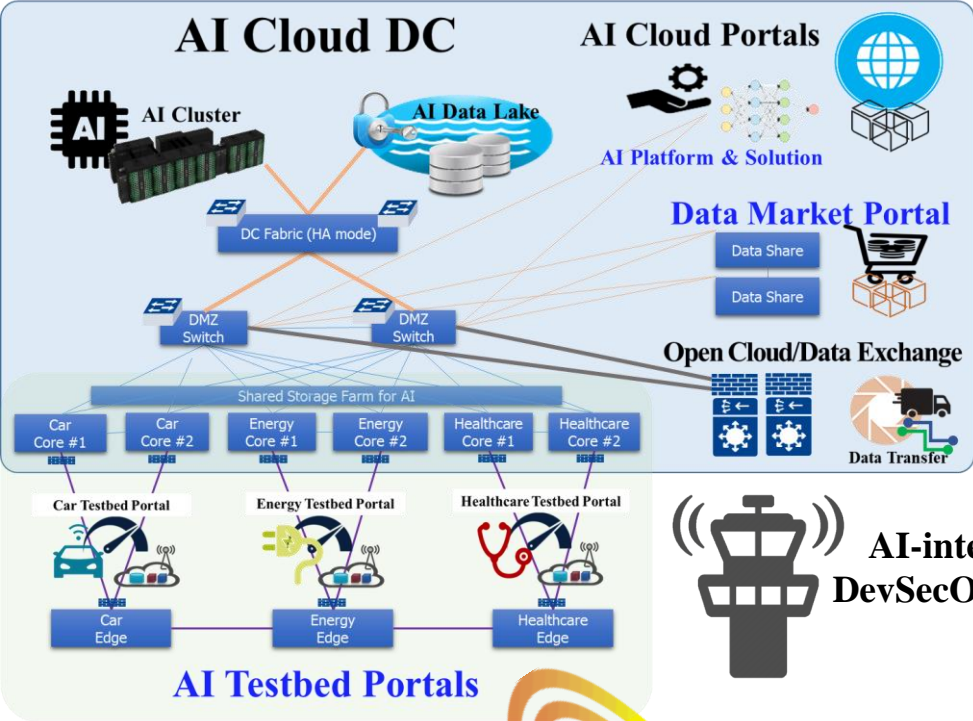


# Twin-based Live! City-scale Massive X+AI Realization

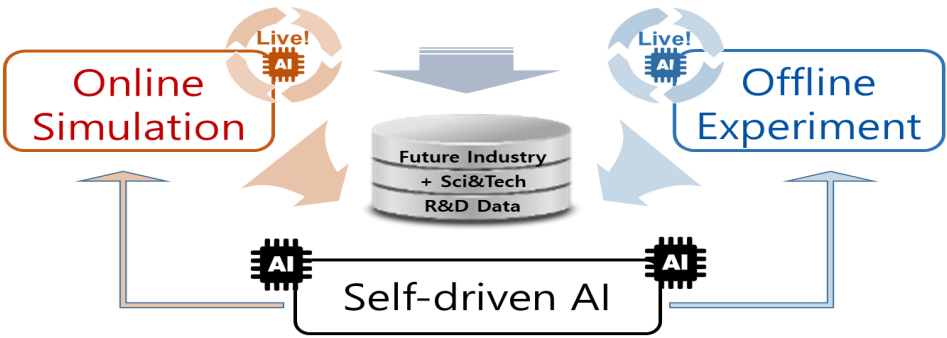
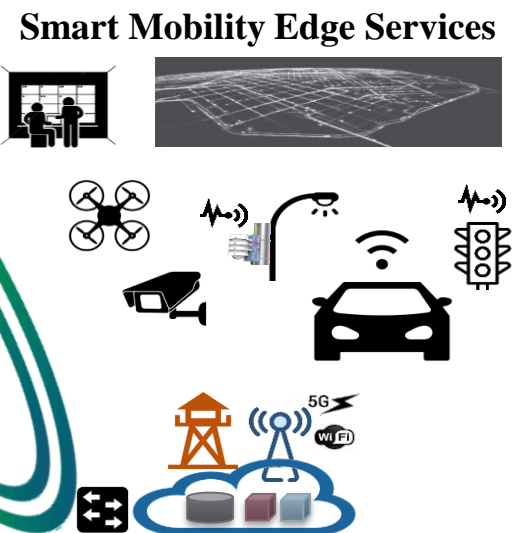




# Live! X+AI R&D Ecosystem over AI Complex Area



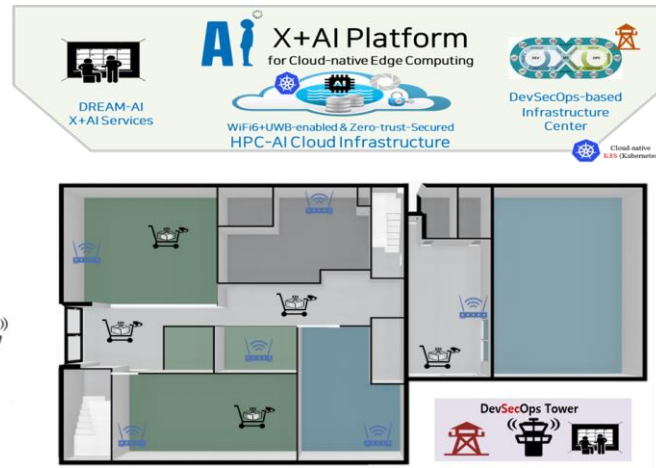
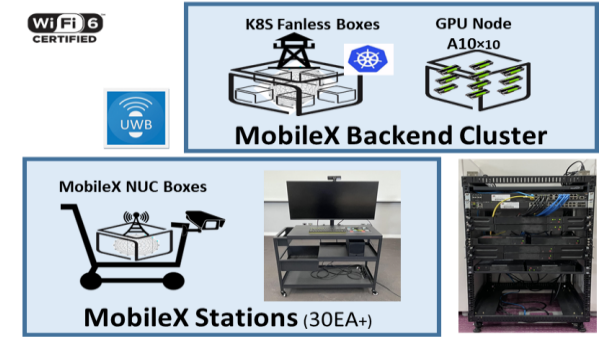
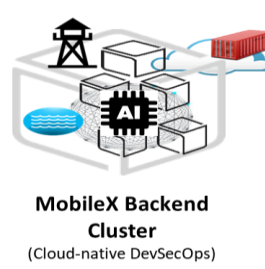
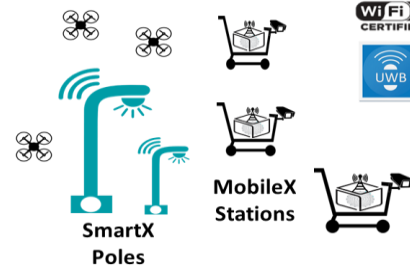
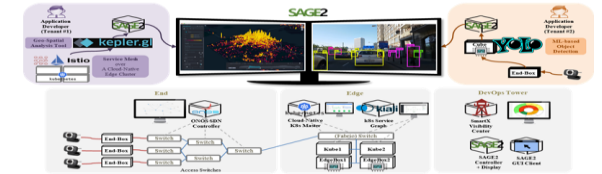
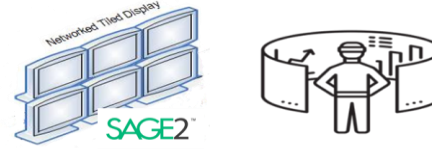
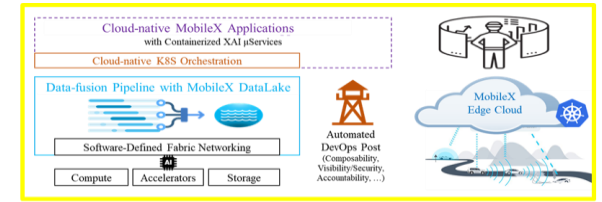
**5G+ Rainbow Regional Network**



# DREAM-AI Playground: Digital Twin & MobileX



Cloud-native MobileX Platform for X+AI Service Realization









# HPC-AI Open Infrastructure: Operation Plan



User Group Category: Single, Multi, Sandbox, ...



1-Stage Verification

HPC-AI Service Portal

Web/VM Login Nodes

KAFE Service Provider

SSH Login Cluster (K8S)

2-Stage Verification



Dedicated Operators

Provisioning and Visibility

DevSecOps Portal

Scheduling Request

Sandbox-POD Schedulers

Workload Scheduling & Deployment

SandBox-POD

(DGX-1Vx3, Ceph Storage HCIx2, OpenStack Cloud HCIx1)

Software Inst./Conf.

LMA Reporting

Software Inst./Conf.

R&D Direct Access

Scheduling Request

DataSet Service (MetaData + DataCache)

Data Transfer Node (\*Separate build)

Workload Scheduling & Deployment

Data Read/Write (200G IB)

Data Transfer (200G IB)

A-POD

(HGX A100x8 20 Nodes)

B-POD

(HGX A100x8 20 Nodes)

Data-POD

(Weka 10PB DataPond)



Web (VM) Login Nodes / Sandbox-POD Scheduler (Cheetah, ...)

Multi-Purpose Nodes



Identity Provider (KAFE-ready OpenHPC.kr IdP)



DevSecOps Portal (Inst./Conf., LogMonAcct, ...)



Login (K8S) Cluster

Multi-Purpose Nodes



HPC-AI Service Portal (KAFE SP + Solution Service (Container/Model Repository))



Platform Service (A/B-POD Schedulers: SLURM, K8S, Cheetah, ...)



DataSet Service (MetaData + DataCache Nodes)

Open Data Sharing (100GE)

Data Transfer Node (\*Separate build)



Open Data Sharing (100GE)

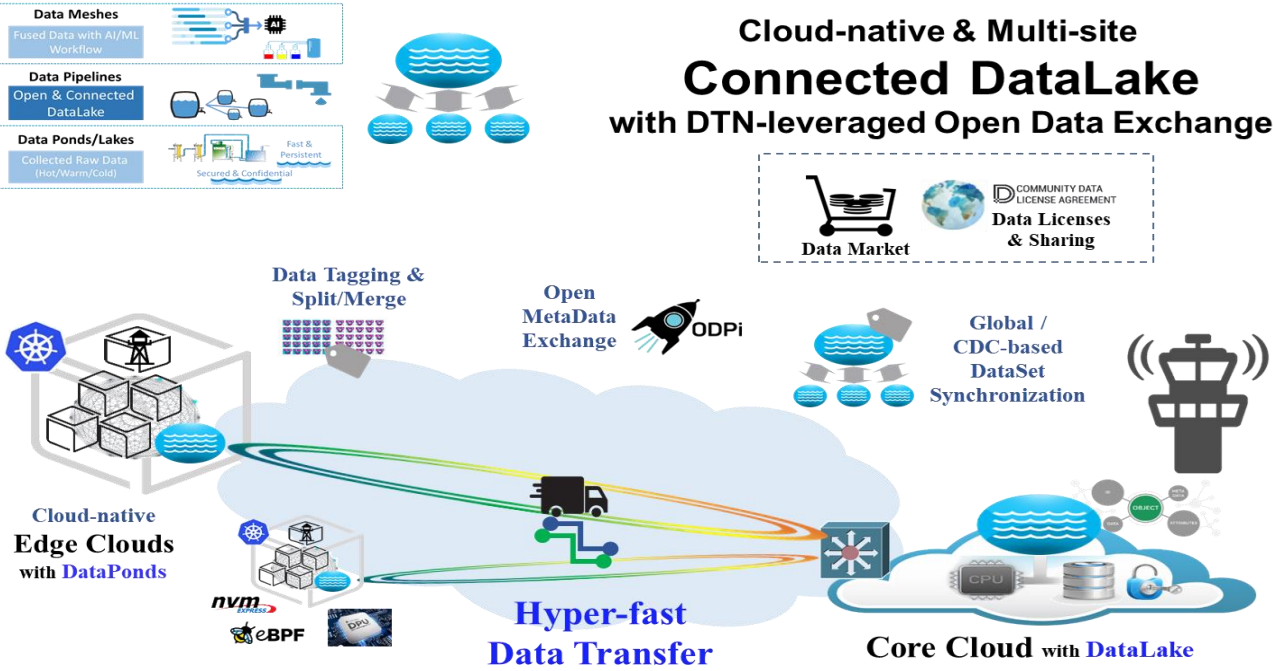
Data Transfer Node (\*Separate build)

DataSet Service (MetaData + DataCache)

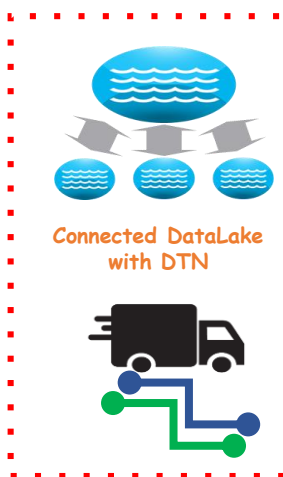
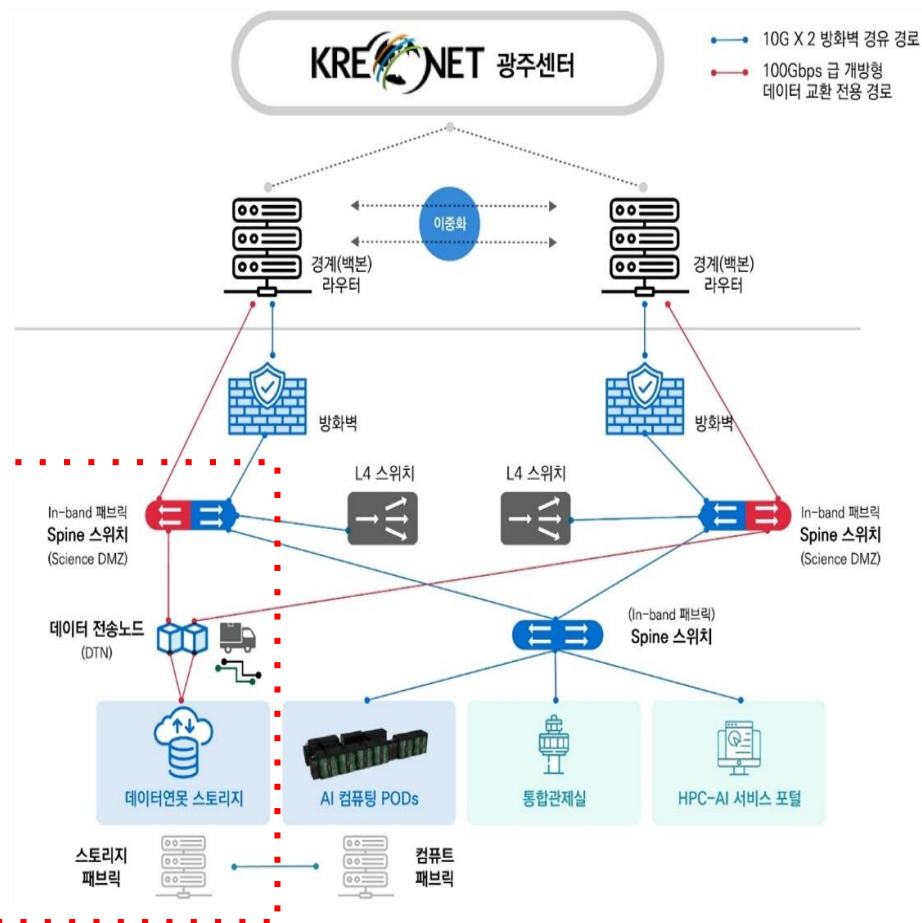
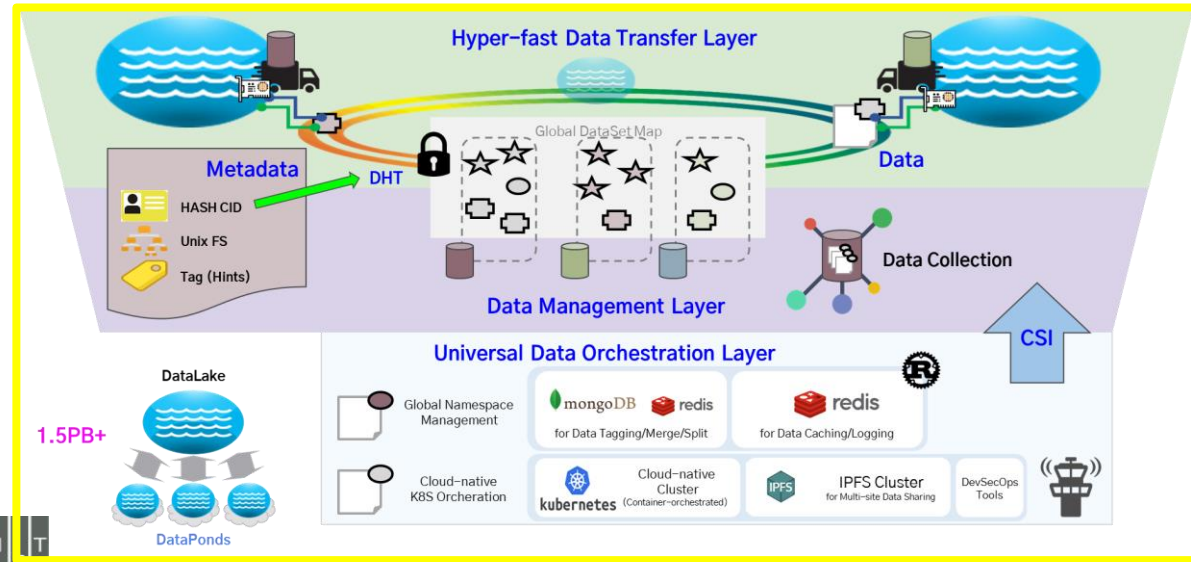
Data Read/Write (200G IB)

Data Transfer (200G IB)

# HPC-AI Open Infrastructure: Connected DataLake Plan



NVIDIA BlueField2 DPU (Data Processing Unit) 노드



# Autonomous Driving Specialized HPC Center

자율주행 HPC 전문센터



Iterative Validation & Digital-Twin-linked  
Cyber-Real Driving Capability

Data-centric & Cloud-native  
Autonomous Driving / Mobility /  
Digital-Twin Specialized  
Super Computing Services



**DREAM-AI**  
Top500 178th  
(2022.11)



Computing PODs



Data Pond

200Gbps Computing/Storage  
InfiniBand Fabric



~ 2025  
Proposed

**50.1PF Compute**

CPU-POD
 GPU/NPU-PODs

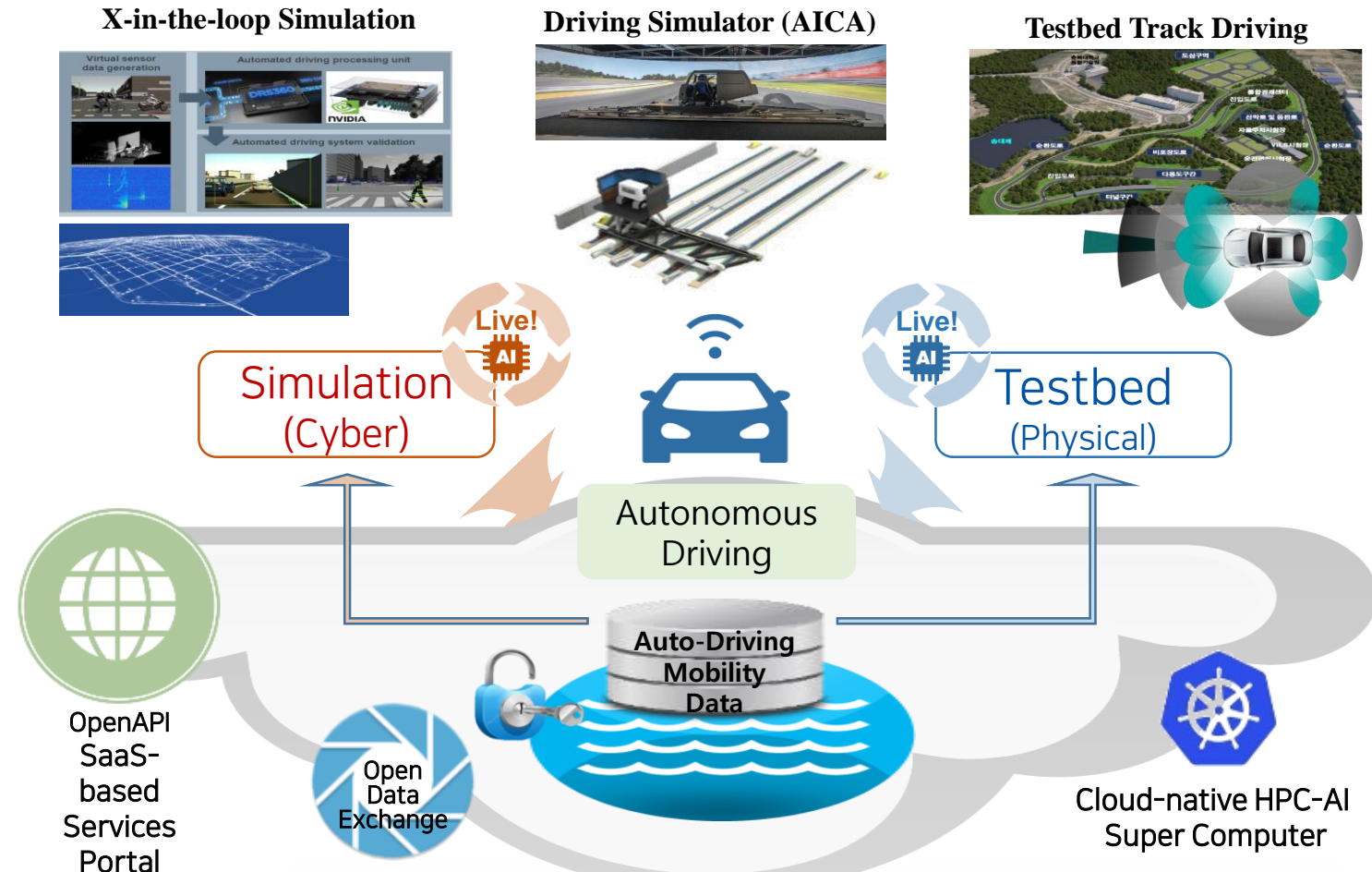
400Gbps InfiniBand Fabric

**30PB Storage**

Flash 10PB+  
**OBJECT + BLOCK**
 DPU

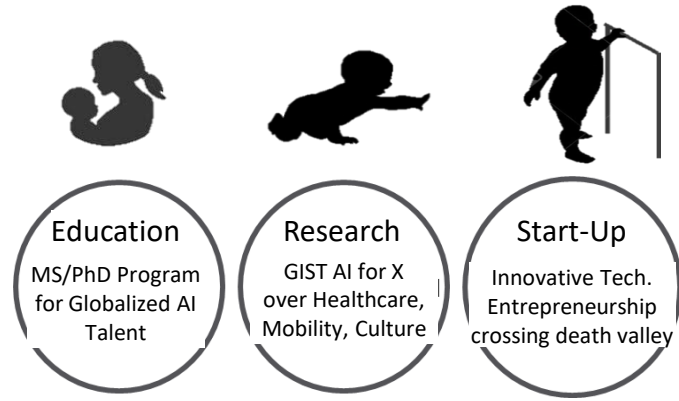
Data Pond Data Mover

200Gbps Ethernet

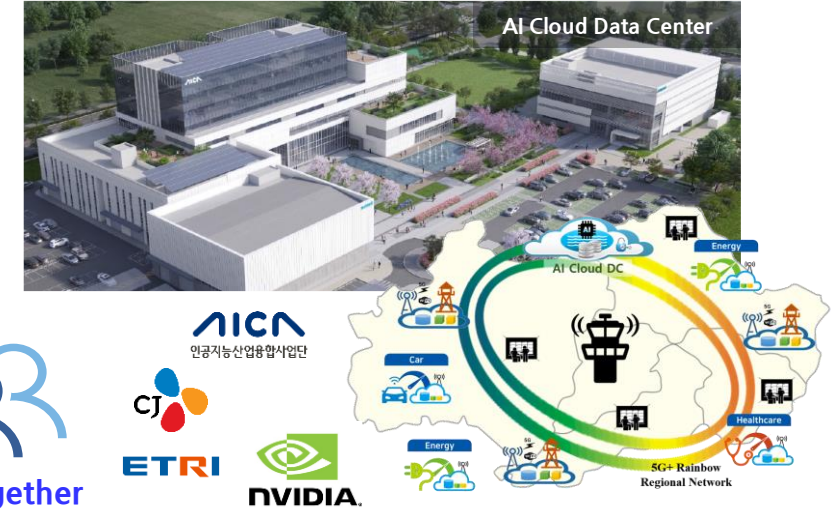
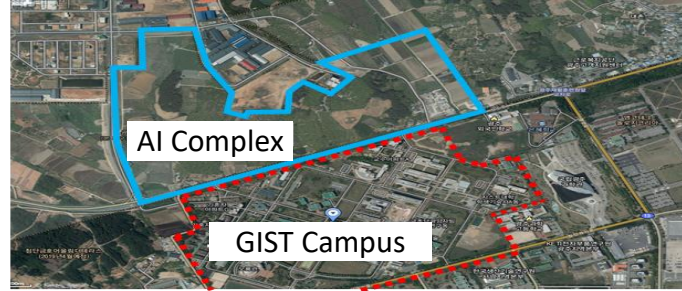




# GIST AI Graduate School and Gwangju AI Complex for Open X+AI Collaboration



2020.03 Open (2019.10 Established)



GIST AI Policy/Strategy Graduate School (2024~)

GIST AI Conv. UnderGrad Program Sub-major (2021~) → AI/SW Major (2024~)

GIST attached AI Talent School (2027~)

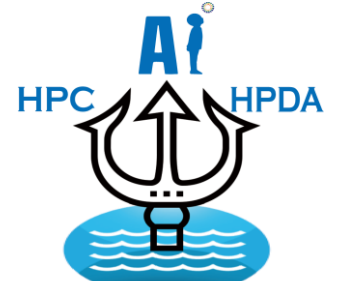


누구나, 언제나, 어디서나  
K-DIGITAL PLATFORM

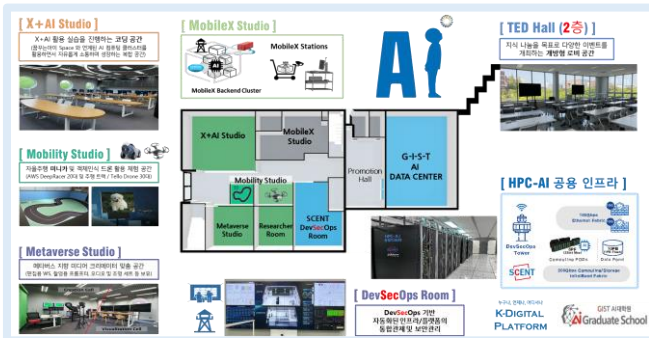
AXEL Together PPP Collaboration



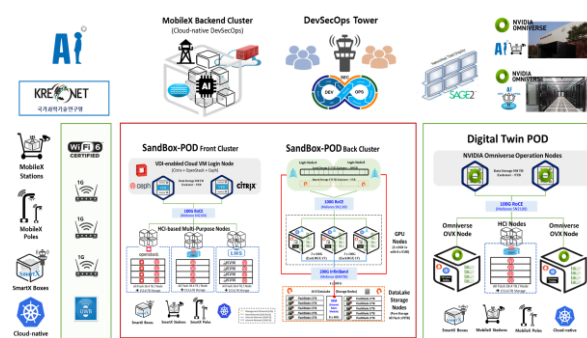
AXEL Camp & Education Collaboration



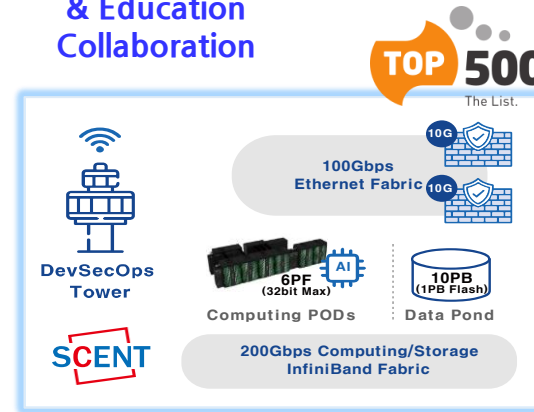
Data Sharing Collaboration



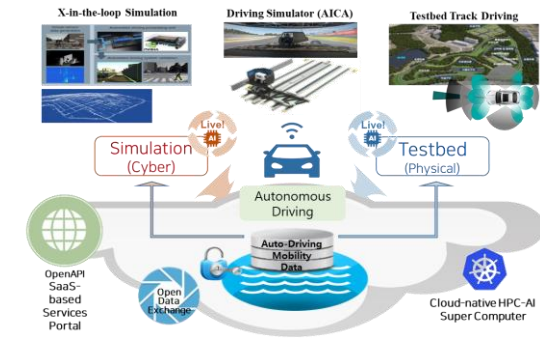
DREAM-AI Playground



Digital Twin with MobileX



HPC-AI Open Infra



X+AI Common Platform (Mobility)

New Technology  
Global Frontier **GIST**

 **GIST AI대학원**  
**AI Graduate School**

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