



National Applied Research Laboratories  
National Center for  
High-performance Computing

# NCHC & it's AI Adventure

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HPC

Cloud

Big Data

Network

Commitment • Passion • Innovation

# NCHC Milestones



A Member of **NARLabs**  
**National Center for  
High-performance Computing**

**1991**

Taiwan's first  
National level  
supercomputer  
Center



**2003**

NPO  
under NARLabs



**2005**

Tainan  
Office



**2011**

177 TF  
Windrider super-  
computer



**2017**

1.33 PF  
Peta scale HPC  
台灣杉  
TAIWANIA



**1993**

Hsinchu  
Headquarters



Hsin Chu  
Headquarters

**2004**

TWAREN  
Services 10G



Taichung Office

**2008**

Taichung  
Office



Tainan Office

**2016**

100G Network  
Backbone



## Certifications

- ✓ ISO 9001:2015
- ✓ ISO 27001:2013
- ✓ CSA STAR Level 2 Gold Award
- ✓ BS 10012

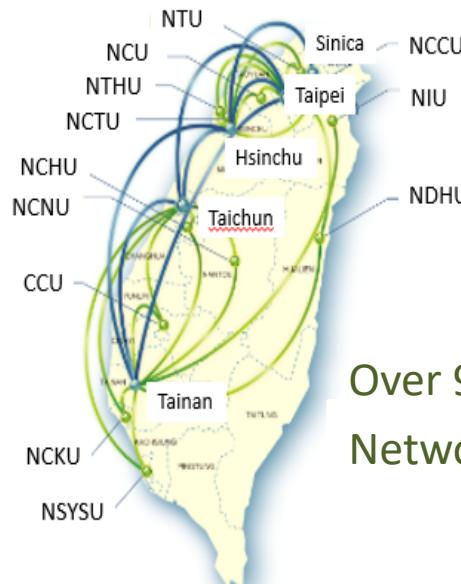
# Research and Education Network



Taiwan Advanced Research and Education Network

- **TWAREN** (Optical, dedicated bandwidth)

- ✓ 100Gbps backbone
- ✓ 12 GigaPOPs
- ✓ 94 universities & research institutes
- ✓ 500K users



Over 99.99%  
Network Availability

**TWAREN Domestic Backbone**

- ✓ Sharing underlying optical network with **TANet** (4000 schools, 4.5 M. users)
- ✓ Network Availability: 99.99% ↑
- ✓ 20G International Bandwidth w/30 int'l research networks



**TWAREN International Connection**

# HPC Cluster



CPU : 1.33 PF  
GPU : 0.4 PF  
Storage : 3 PB

台灣杉

TAIWANIA  
Service launched in July 2018

Efficiency : 4 GF/W  
PUE < 1.3

<https://iservice.nchc.org.tw>

- 700+ projects/year
- 3000+ accounts/year

2007  
IBM Cluster 1350, 1350A  
25 TF  
Cluster

2011  
Formosa 3 Cluster  
9 TF  
Virtual Machine Cloud  
& First Render Farm



2011  
ALPS - Acer Cluster  
177 TF  
Cores : 25,600 ,  
Memory : 74 TB,  
Storage : 1 PB

2012  
Formosa 5 Cluster  
90 TF  
GPU Cluster

# Big Data Analysis Platform-Braavos



- Launched in January 2016
- 300 nodes, 2PB
- Apache Hadoop

IaaS: VM (SUSE OpenStack Cloud 7)

PaaS: MRS big data analysis and processing service

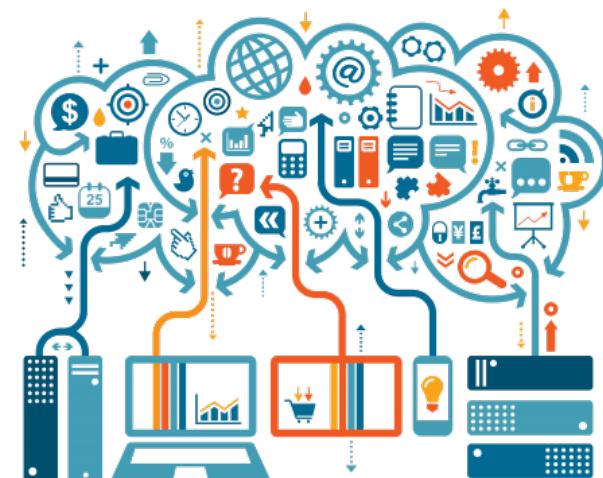
OSS: Object Storages (Amazon S3 compatible)

## Service Models

- Time sharing for research and academia
- Dedicated platform for governmental data
  - providing de-identification tools for governmental departments

## Services

- MapReduce
- Spark
- Hive
- Hbase
- R-hadoop
- Mahout
- Flume



# National AI Initiative

- Elastic & sharable infra.
- AI tech. & resource service platform
- AI eco-system (academia, industry, government)
- AI for business opportunities
- AI based Research Service Company

## 5 Strategies

Computation/Storage  
Infrastructures and  
Platforms

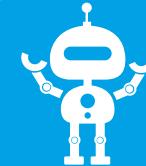


Research Center

(NTU, NCKU, NCTU, NTHU)

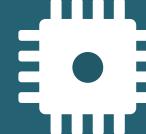


Robot Makerspace



AI chip

Moonshot Program

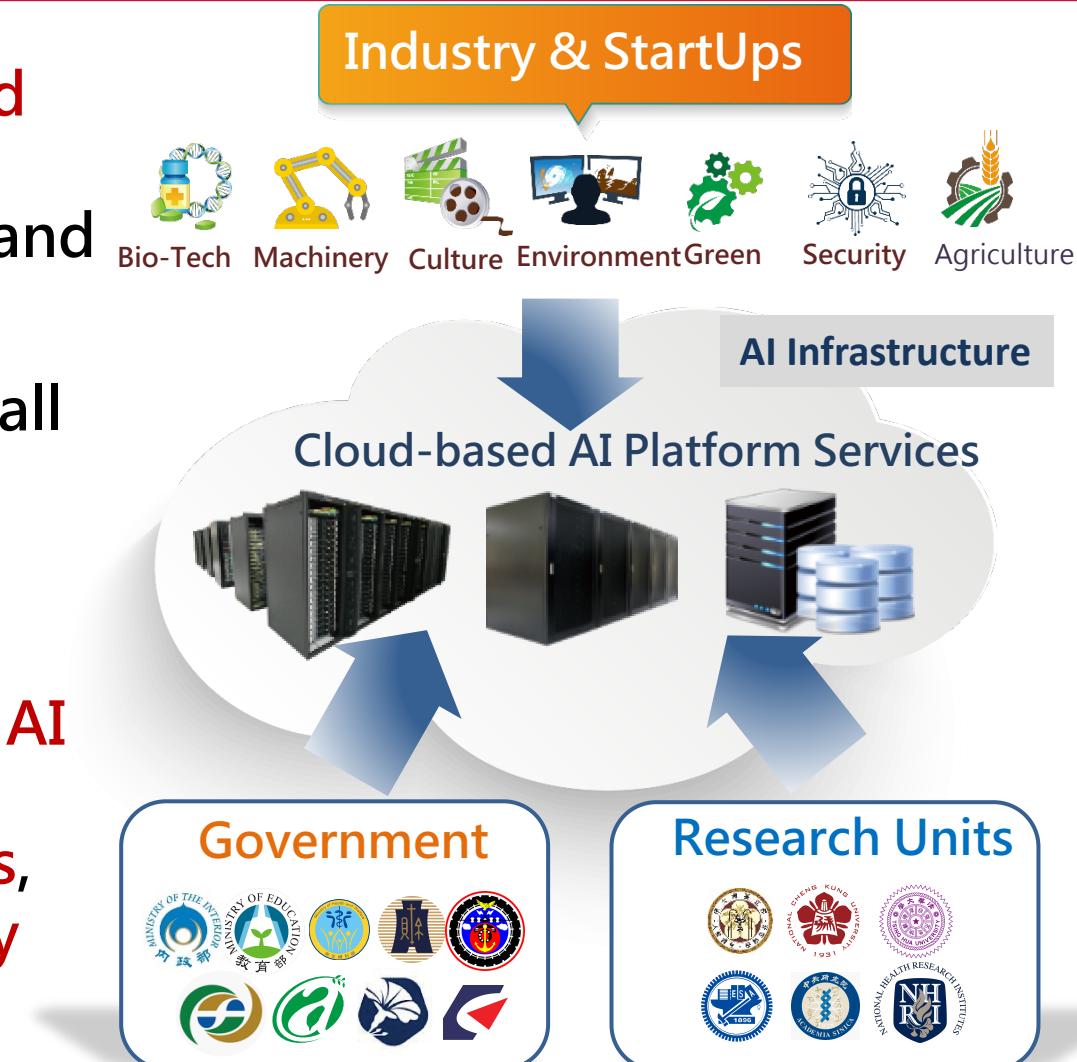


AI Infrastructure + AI centers (4) + industrial focuses,  $n$  AI research projects

# Goal of Infra. & Platform

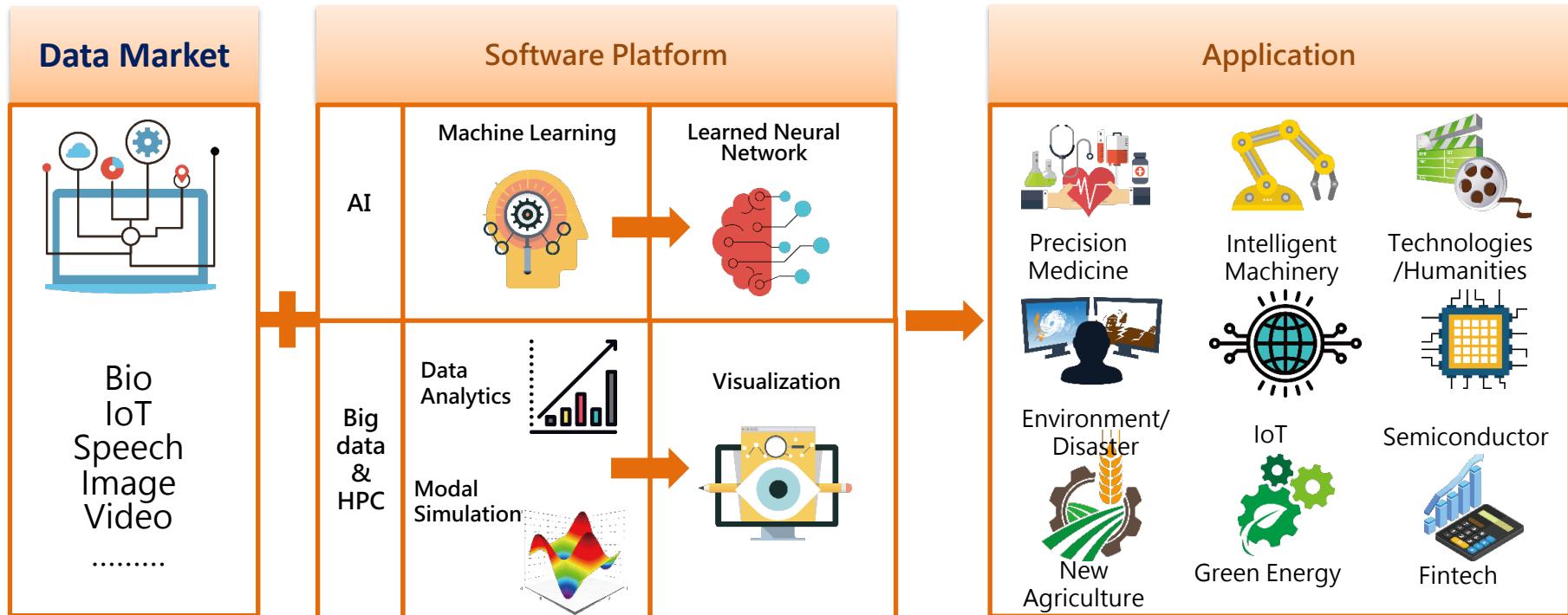
AI Research Projects

- Provide **computing and storage resources** for industry, government and university
- Synergize **R&D** across all sectors & support the advancement of **key industry technologies**
- Enable **self-developed AI products**, enhance technology capabilities, and accelerate **industry innovation**



1.4 billions X 3

# National R&D Infrastructure for AI



Cloud-based resource management, software and infrastructure



# AI Cloud – 2018

4-year national project

## Target

- Support AI Open Innovation Ecosystem
- Accelerate AI research & industry development
- Leverage ICT superiority of Taiwan
- Take advantage of open communities, such as AI frameworks, AI models and data

## Approach



Research &  
Development

NCHC AI Cloud  
TWCC  
Taiwan Computing Cloud

BigData

250 Servers

APIs,  
Containers,  
Datasets,  
Pre-trained models



AI-HPC

9 PFLOPS w/2016 V100 GPU

Storage  
50PB

Government

MOST 科技部  
Ministry of Science and Technology



Academy

台灣杉二號

TAIWANIA 2

ASUS  
IN SEARCH OF INCREDIBLE

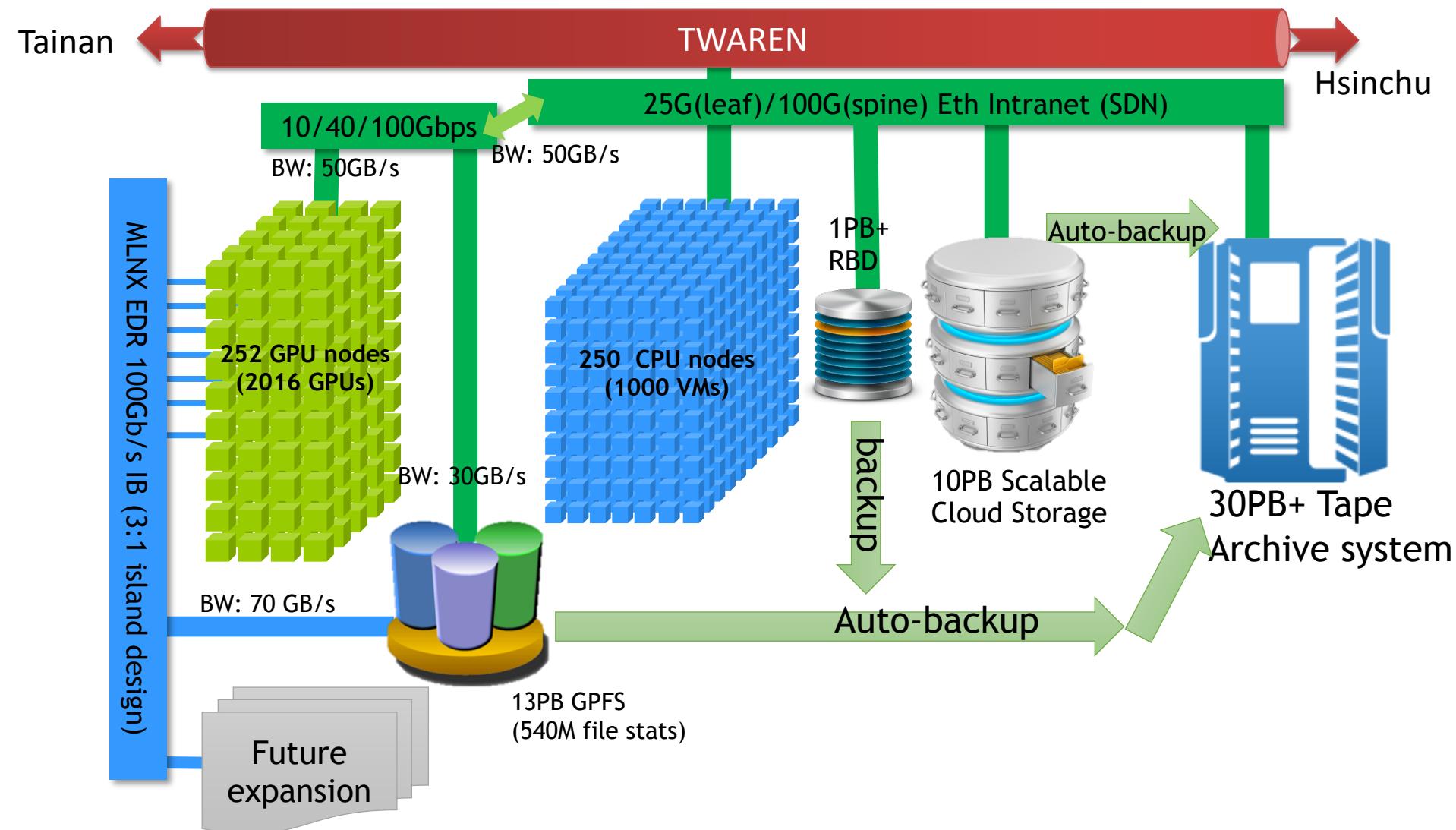


Taiwan Mobile



Quanta Computer

# AI Cloud Platform Architecture



# TAIWANIA 2

## Hardware - whole system

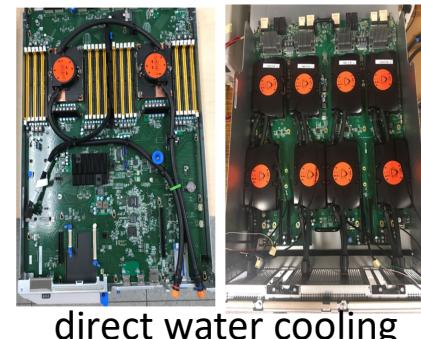
- 252 nodes / 9072 CPU cores / 2016 GPUs
- 193.5 TB memory
- 10 PB storage
- EDR InfiniBand 100 Gbps
- 797.54 KW, 11.28 GF/W
- 1.25 PUE (Warm Water Cooling)

## Software Environment

- Slurm / Kubernetes
- Nvidia NGC Docker
- Ceph
- Spectrum Scale (GPFS)
- CentOS

## Hardware - single node

- Intel Xeon Gold CPU x 2
- Nvidia Tesla V100 w/32GB x 8
- 768 GB memory
- 240 GB SSD + 4TB NVMe

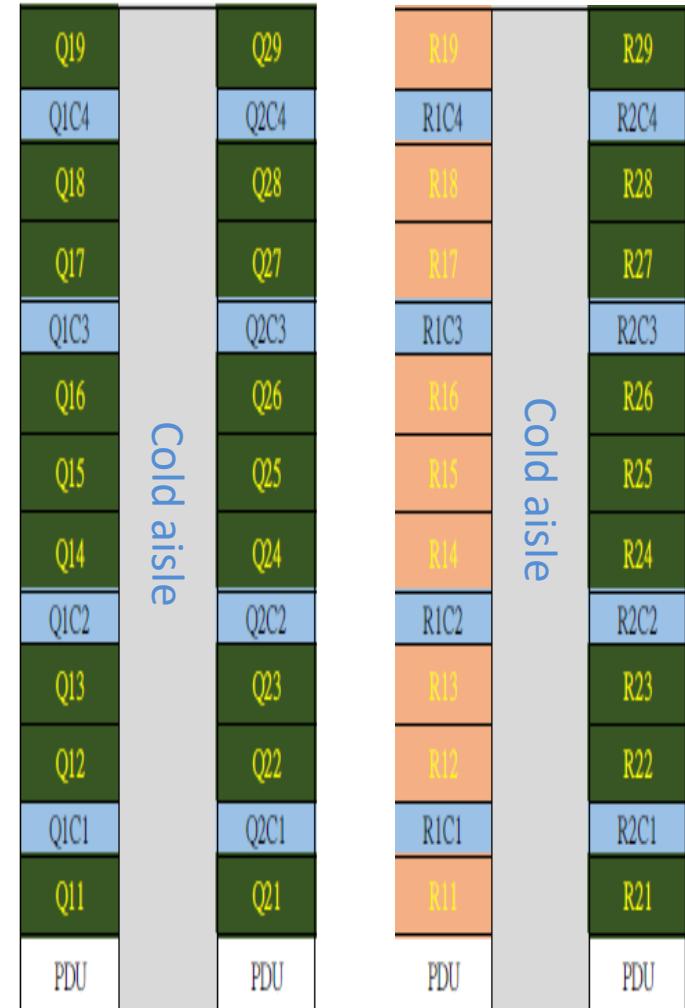


## AI Framework

- Tensorflow
- Caffé / Caffé 2
- PyTorch / Torch
- .....and more

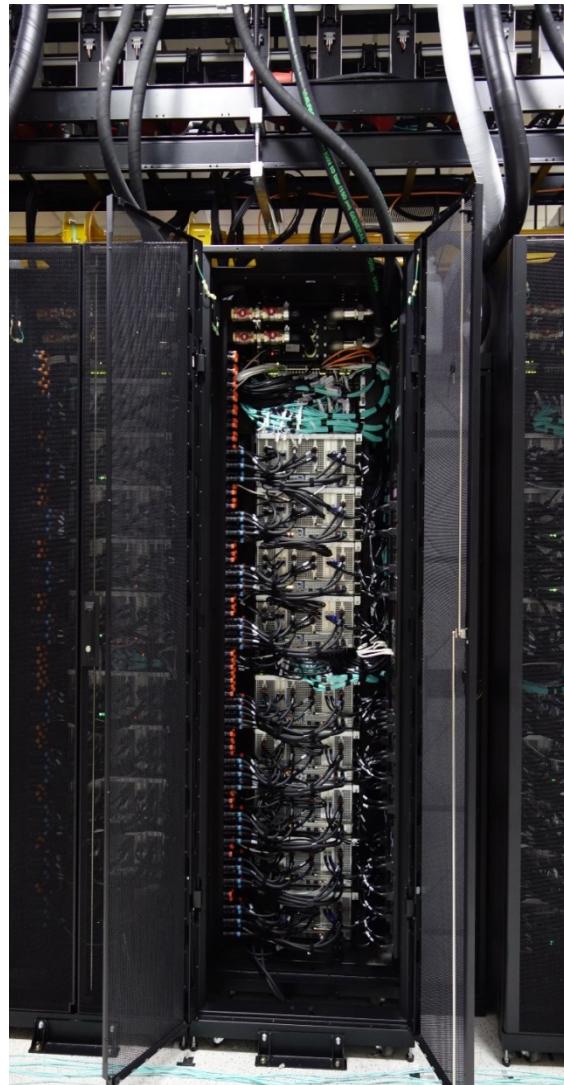


# Machine Layout



# AI Machine

48	Asetek
47	4U InRackCDU
46	
44	Mellanox AS4610-54T
43	
42	Mellanox SB7890
40	Mellanox SB7890
39	Mellanox SB7890
38	
37	QCT
36	QuantaGrid D52G-4U
35	
33	QCT
32	QuantaGrid D52G-4U
31	
29	QCT
28	QuantaGrid D52G-4U
27	
25	QCT
24	QuantaGrid D52G-4U
23	
22	Mellanox SB7890
21	Mellanox SB7890
20	
19	QCT
18	QuantaGrid D52G-4U
17	
16	QCT
15	QuantaGrid D52G-4U
14	
11	QCT
10	QuantaGrid D52G-4U
9	
7	QCT
6	QuantaGrid D52G-4U
5	
4	QCT
3	QuantaGrid D52G-4U
2	
1	QCT
	QuantaGrid D52G-4U



Located in F1 machine room

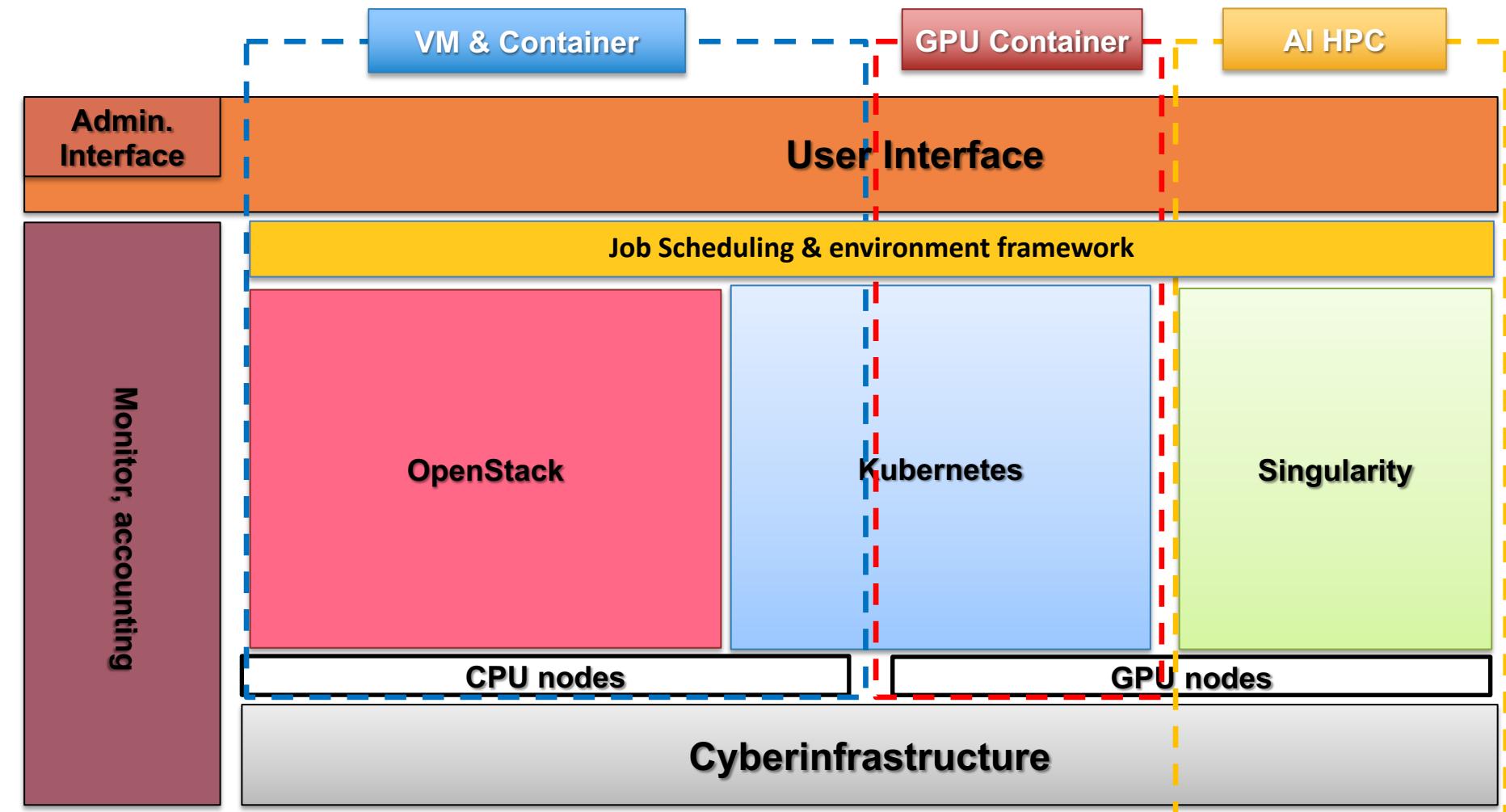
# AI Machine

Cloud CPU Node	
42	MPO Fiber Panel
41	Mellanox SN2410
40	Mellanox SN2410
39	Mellanox SN2410
38	Mellanox SN2410
37	Mellanox SN2410
36	Mellanox AS4610-54T
35	Mellanox AS4610-54T
34	Mellanox AS4610-54T
33	Mellanox AS4610-54T
32	Cable Manager
31	ASUS
30	RS720Q-B9-RS24-S
29	ASUS
28	RS720Q-B9-RS24-S
27	ASUS
26	RS720Q-B9-RS24-S
25	ASUS
24	RS720Q-B9-RS24-S
23	ASUS
22	RS720Q-B9-RS24-S
21	ASUS
20	RS720Q-B9-RS24-S
19	ASUS
18	RS720Q-B9-RS24-S
17	ASUS
16	RS720Q-B9-RS24-S
15	ASUS
14	RS720Q-B9-RS24-S
13	ASUS
12	RS720Q-B9-RS24-S
11	ASUS
10	RS720Q-B9-RS24-S
9	ASUS
8	RS720Q-B9-RS24-S
7	ASUS
6	RS720Q-B9-RS24-S
5	ASUS
4	RS720Q-B9-RS24-S
3	ASUS
2	RS720Q-B9-RS24-S
1	Cable Manager



Located in F3 machine room, Obj./Tape storage + container service

# TWCC Software Architecture



# TWCC User Portal

The screenshot displays the TWCC User Portal interface, featuring three main service management sections:

- Bucket 管理**: Manages S3 buckets. It includes a search bar for "建立日期" (Creation Date) and a table view with columns: ID ↑, Bucket 名稱 (Bucket Name), 建立日期 (Creation Date), 虛擬主機名稱 (Virtual Machine Name), 虛擬主機狀態 (Virtual Machine Status), and 建立日期 (Creation Date). The table lists several entries, such as inference01, inference02, highavailability, hadoop01, hadoop02, and hadoop03, all in a Ready state.
- 虛擬主機管理**: Manages virtual machines. It includes a search bar for "建立日期" (Creation Date) and a table view with columns: ID ↑, 虛擬主機名稱 (Virtual Machine Name), 對外 IP (External IP), 平台 (Platform), 虛擬主機狀態 (Virtual Machine Status), and 建立日期 (Creation Date). The table lists several entries, such as inference01, inference02, highavailability, hadoop01, hadoop02, and hadoop03, all in a Ready state.
- GPGPU 容器管理**: Manages GPGPU containers. It includes a search bar for "建立日期" (Creation Date) and a table view with columns: ID ↑, GPGPU 容器名稱 (GPGPU Container Name), 類型 (Type), 狀態 (Status), and 建立日期 (Creation Date). The table lists two entries: tr116 and tr119, both in an Active state.

# TWCC Admin Portal

Hi ! Admin 11:42:31 AM

雲端後台管理平台

Solutions Management

Images Management

Monitor Management

User Management

Servers Management

登出

Slurm GPU Dashboard

Panel Title

Time	_name_	host	instance	job	Value
2018-10-04 11:45:51	nvidia_gpu_num_devices	inference02-100-iaas	140.110.10.213:9445	slurm-gpu-exporter	1.00
2018-10-04 11:45:51	nvidia_gpu_num_devices	inference01-84-iaas	140.110.10.208:9445	slurm-gpu-exporter	1.00
2018-10-04 11:45:51	nvidia_gpu_num_devices	hsbagnr425	172.22.2.50:9445	slurm-gpu-exporter	4.00
2018-10-04 11:45:51	nvidia_gpu_num_devices	hsbagnr420	172.22.2.51:9445	slurm-gpu-exporter	4.00
2018-10-04 11:45:51	nvidia_gpu_num_devices	hsbagnr416	172.22.2.52:9445	slurm-gpu-exporter	4.00

GPU Temperature

GPU Memory Used

GPU MilliWatts

Legend:

- hsbagnr416 No.0 Tesla V100-SXM2-16GB
- hsbagnr416 No.1 Tesla V100-SXM2-16GB
- hsbagnr416 No.2 Tesla V100-SXM2-16GB
- hsbagnr416 No.3 Tesla V100-SXM2-16GB
- hsbagnr420 No.0 Tesla V100-SXM2-16GB
- hsbagnr420 No.1 Tesla V100-SXM2-16GB
- hsbagnr420 No.2 Tesla V100-SXM2-16GB
- hsbagnr420 No.3 Tesla V100-SXM2-16GB
- hsbagnr425 No.0 Tesla V100-SXM2-16GB
- hsbagnr425 No.1 Tesla V100-SXM2-16GB
- hsbagnr425 No.2 Tesla V100-SXM2-16GB
- hsbagnr425 No.3 Tesla V100-SXM2-16GB
- inference01-84-iaas No.0 Tesla P40
- inference02-100-iaas No.0 Tesla P40

## Targeted Applications



Smart City



Disaster Mitigation



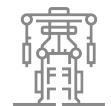
Industry 4.0



Autonomous Car



Biomedical Science



Robotics

## Targeted Services



Image Recognition



Text Mining



Natural Language Processing



Vehicle Speed Estimation



Bioinformatics Analysis

# $\beta$ testers

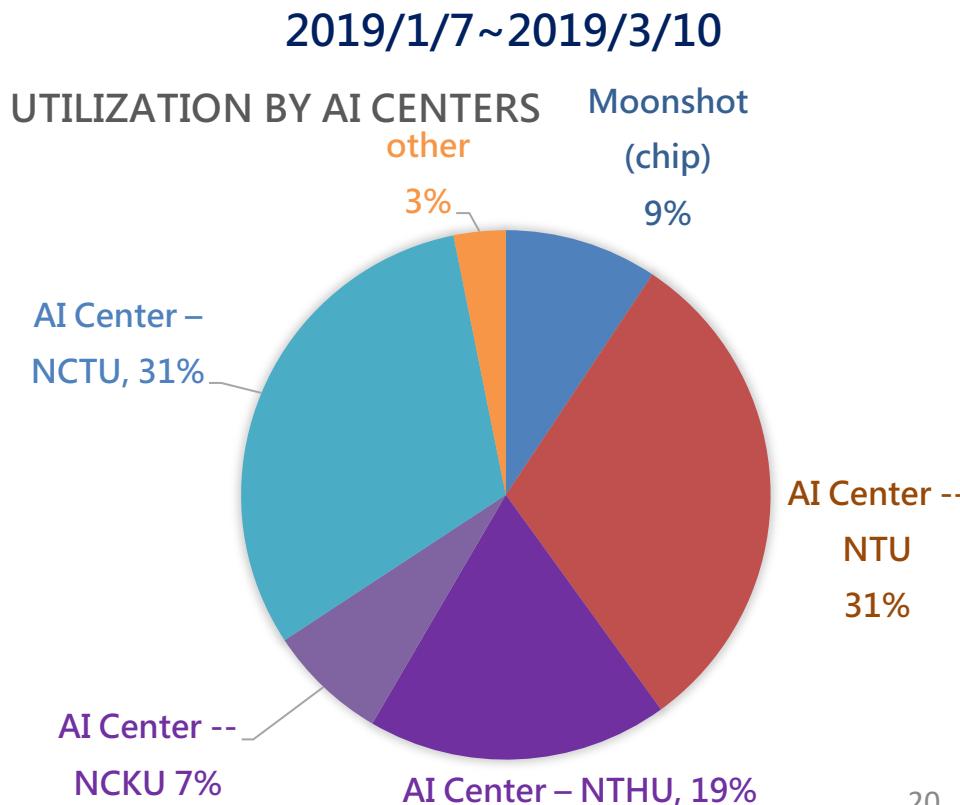
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- Entity sector
  - Telcom
  - surveillance
  - manufacture
  - hospital
  - digital media
  - academia
  - ...
- Application domain
  - intelligent medicine
  - disease diagnosis
  - retail
  - green energy
  - pattern recognition
  - face recognition
  - image clustering
  - moonshot – chip design
  - disaster mitigation
  - smart city
  - traffic management
  - long term health care
  - intelligent manufacture
  - reinforced DL
  - ...

# Utilization of AI Platform

- Application Development via TWGC

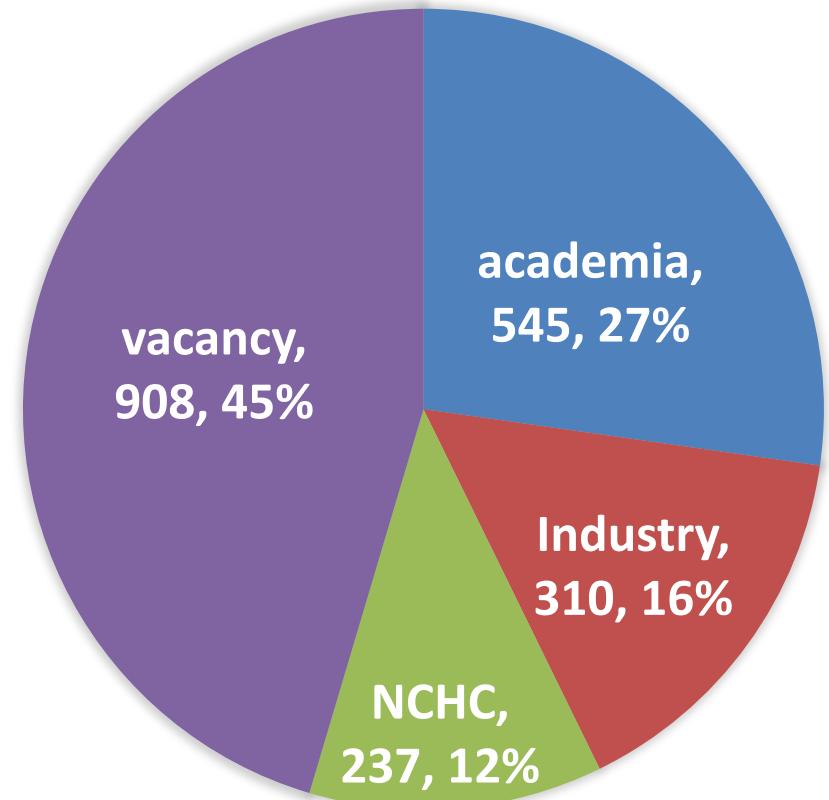
- TWGC : testbed prior to TWCC
- # of nodes : 17
- Project # : 64
- # of Containers : 390
- Users : 323
- GPU-hours
  - ✓ allocated: 205,632
  - ✓ utilized : 132,382
  - ✓ utilization : 64.38%



# Utilization of AI Platform

- Taiwania II via TWCC
  - currently under  $\beta$  test
  - Project # : 218
  - GPUs: 1,092
  - Containers : 390
  - Users : 971

GPU UTILIZATION, 2019.03.01 ~ 2019.03.22



# Thank you

<http://www.nchc.narlabs.org.tw>

