

NARLabs 國家實驗研究院

國家高速網路與計算中心

National Center for High-performance Computing

Data & AI Research Platform in Taiwan

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2018.05.09

NCHC's Vision and Mission

- **Vision**
 - Become a World-Class Supercomputing and Big Data Center
- **Mission**
 - *Enabling* Scientific Discoveries & Technical Innovation through prospective computing technology and platform

NCHC's Milestones



NARLabs

National Applied Research Laboratories

National Center for High-performance Computing



Hsin Chu
Headquarters



Taichung Office



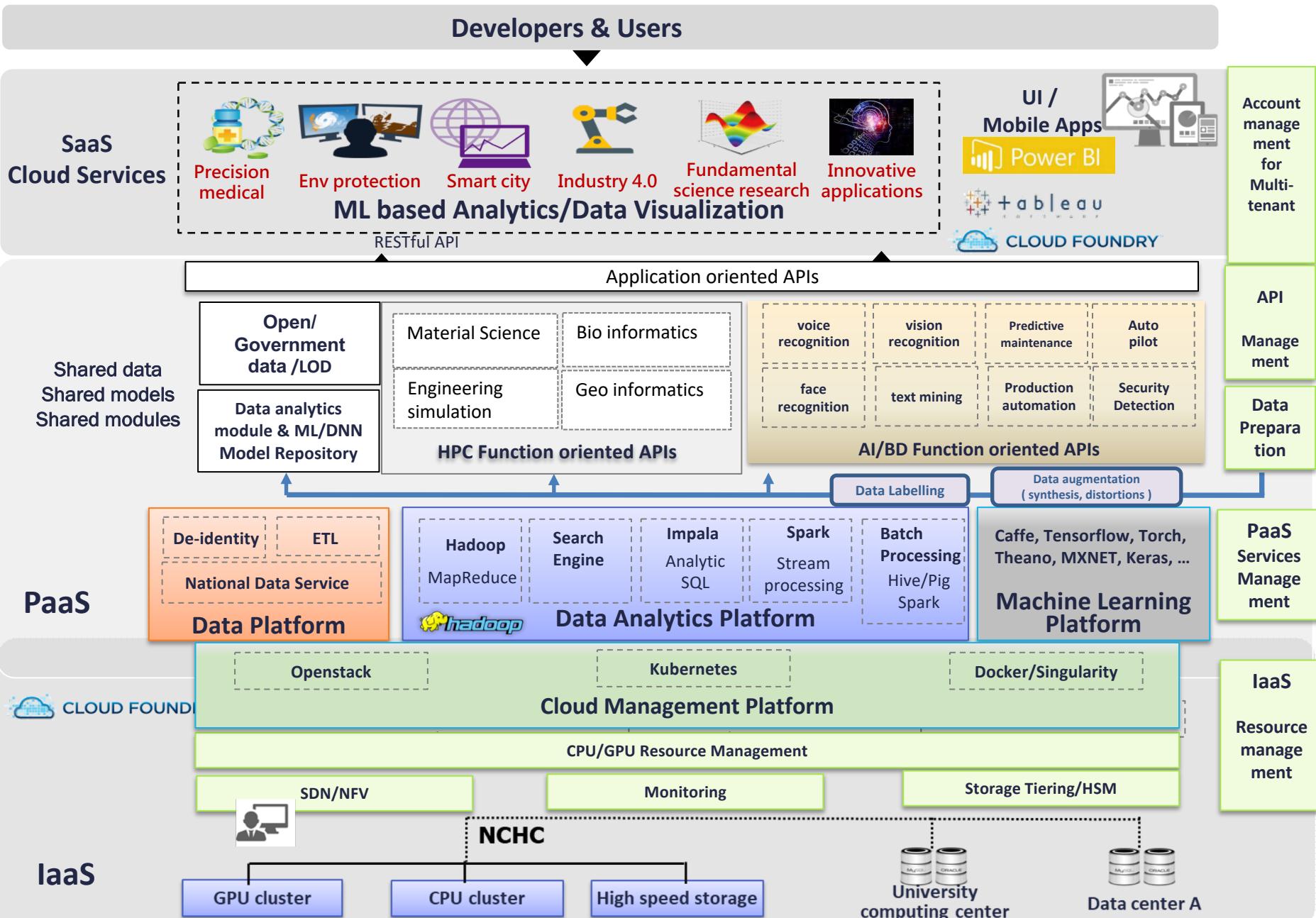
Tainan Office

Certificates:

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

HPC Services

NCHC Cloud Service



HPC Cluster- ALPS, Formosa

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



御風者

ALPS - Acer Cluster

2011, 177 TF

Cores : 25,600 , Memory : 74 TB,

Storage : 1 PB



Formosa 3 Cluster

2011, 9 TF

Virtual Machine Cloud
& First Render Farm



Formosa 5 Cluster

2012, 90 TF

Largest GPU Cluster in
Taiwan

Peta Scale HPC - Taiwania

- Ranked **95th** for Top500 in November 2017
- Launched on May 8, 2018

CPU : **1.33 PFlops**

GPU : 0.4 Pflops

Storage : 3 PB

(Supplier : Fujitsu)

Industry



Taiwania

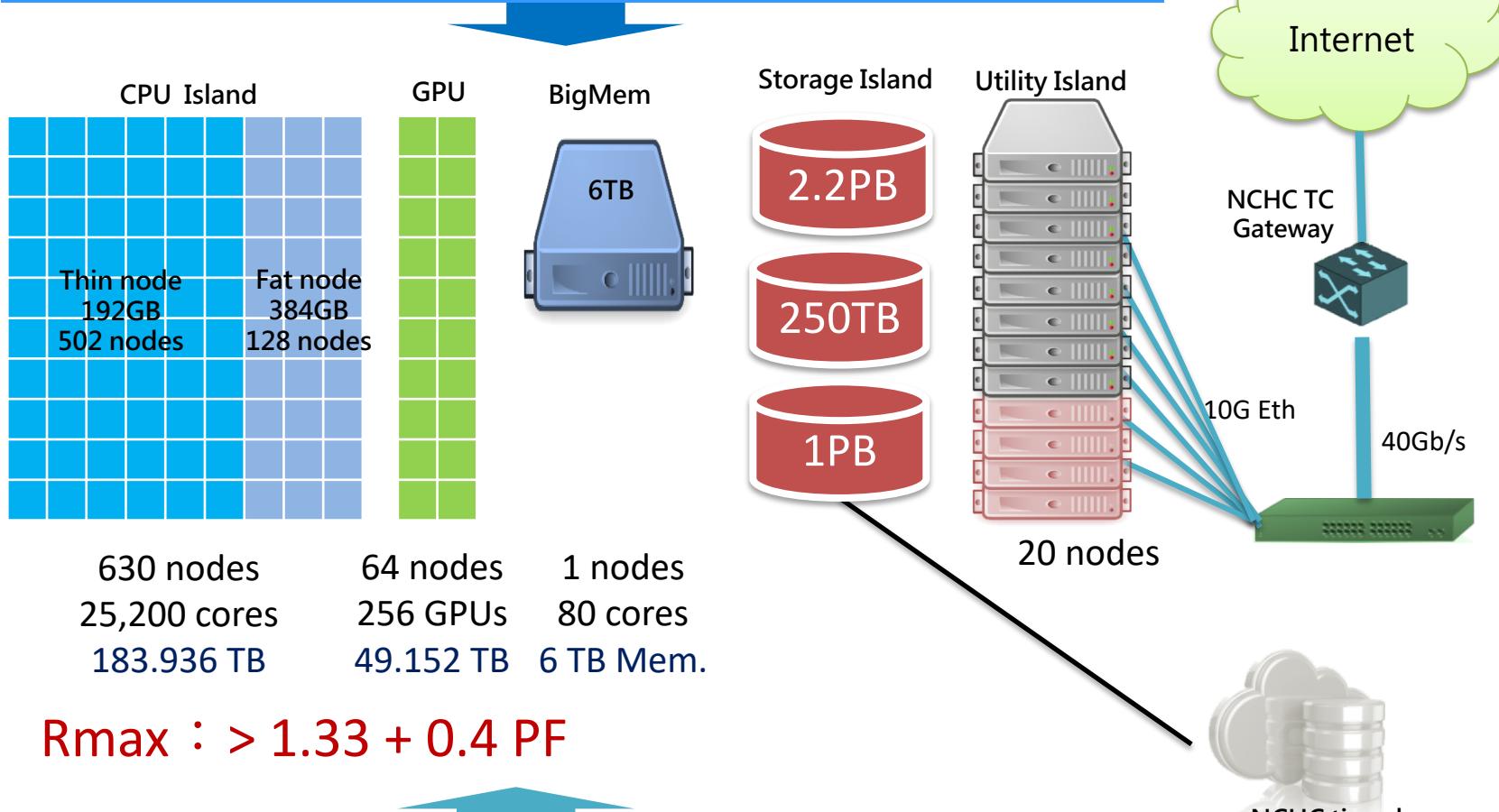
Government

Academia

- Faster
 - 1.33 PFlops
- Greener
 - 4 GFlops/Watts
- Condenser
 - 33 Square Meter
- Safer
 - 2-factor Authentication using Machine PW + OTP
- Easier to Use
 - <https://iservice.nchc.org.tw>

Peta System Architecture

Intel Omni-Path (100G/s) for both Comm/IO



$$R_{max} : > 1.33 + 0.4 \text{ PF}$$

Shared Ethernet LAN for control and Mgmt

Node configurations

| | CPU | | GPU | BigMem |
|---------------------|----------------------|----------------------|-------------------------|-----------------|
| | Thin node | Fat node | | |
| Server model | Fujitsu CX2550 | | Fujitsu CX2570 | Fujitsu RX4770 |
| CPU/node | 2 | | 2 | 4 |
| Hz | | | 2.4GHz | |
| Cores/node | 40 | | 4 | 80 |
| GB | 192 | 384 | 192 | 6000 |
| Local disk | | | 240GB SSD (for OS only) | |
| Nodes | 502 | 128 | 64 | 1 |
| Total cores | 20,080 | 5,120 | 256 | 80 |
| Rpeak(TF) | 1935 | | 1203 | 6.1 |
| Rmax(PF) | 1.33 | | 0.4 | - |
| Note: | 64 nodes: 10G NIC | 64nodes: 480G SSD | 4x P100 w/ NVLINK | For NGS project |

System Software Env

| OS | RedHat 7.3 |
|----------------------|--|
| Cluster mgmt | Bright Cluster Manager |
| Parallel File System | Intel Enterprise Edition for Lustre |
| Queuing System | PBS Pro |
| Compiler | GCC 、 Intel Parallel Studio 、 PGI Professional |
| MPI | openMPI 、 Intel MPI 、 MVAPICH |

Big Data Analysis Platform-Braavos

- Launched in January 2016 (300 nodes/2PB)

- Running Apache Hadoop

- Service Models

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

- 7 Functions in Service

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

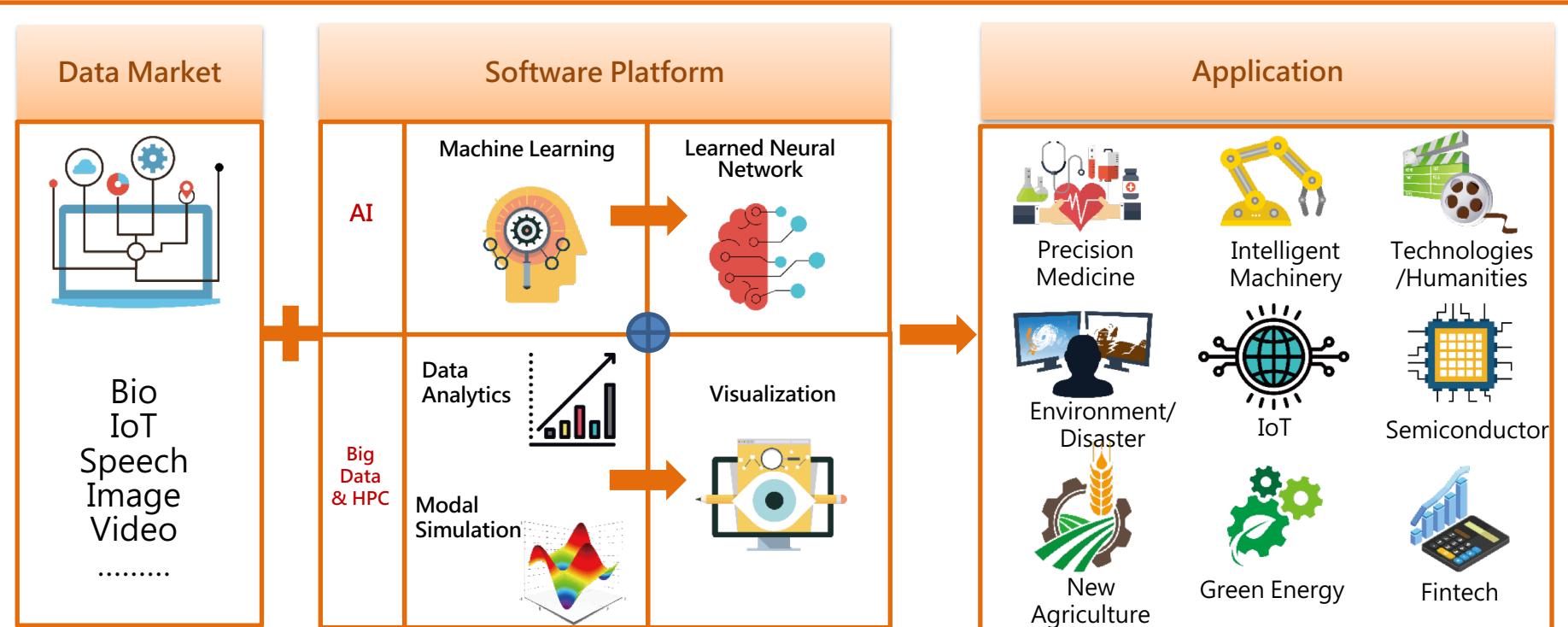


AI Services planned

Strategic Guidelines

- Provide an **elastic & sharable** computing Infrastructure for AI research.
- Develop & provide an AI technological and resource **services platform**.
- Enable a highly competitive **innovation eco-system** of AI among academia, industry and government.
- Apply advanced AI methods & tools to explore new **business opportunities**.
- Incubate AI-based research service companies through **domestically-developed software** and bridge **with industrial applications**.

National R&D Infrastructure for AI



Cloud-based resource management, software and infrastructure



TWAREN Backbone (100 Gbps)



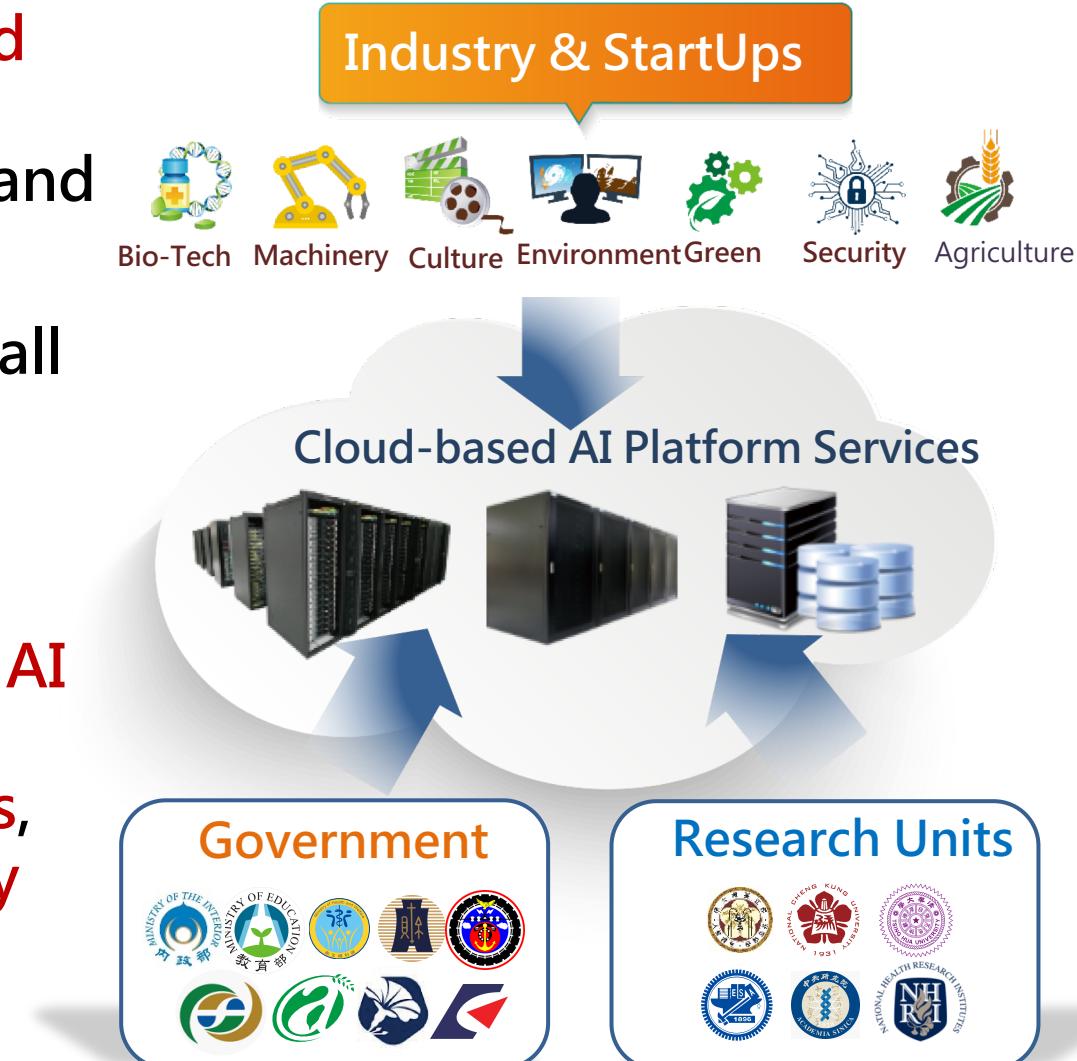
Storage (150 PB)



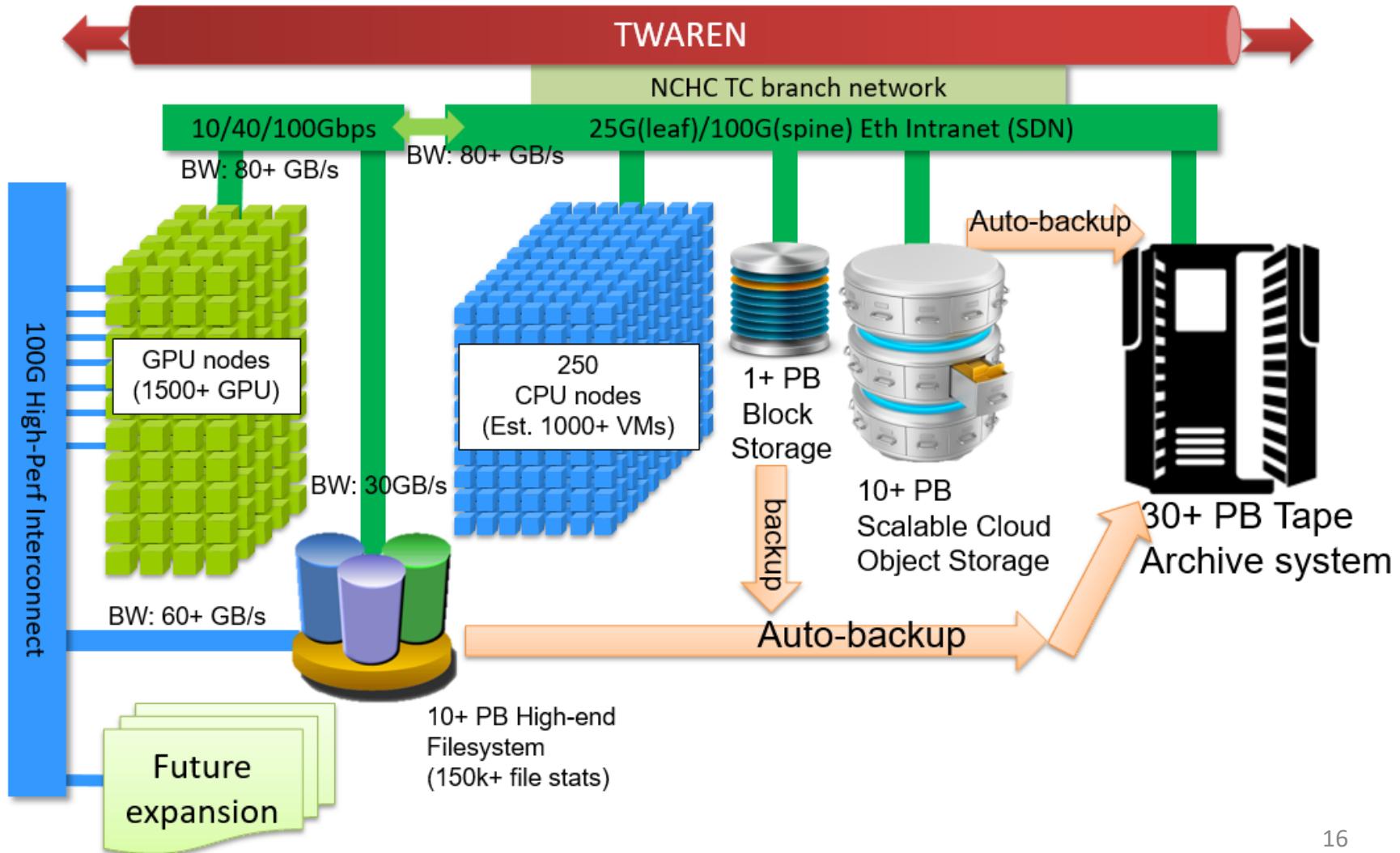
CPU+GPU(>10+ PF)

Goal

- 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



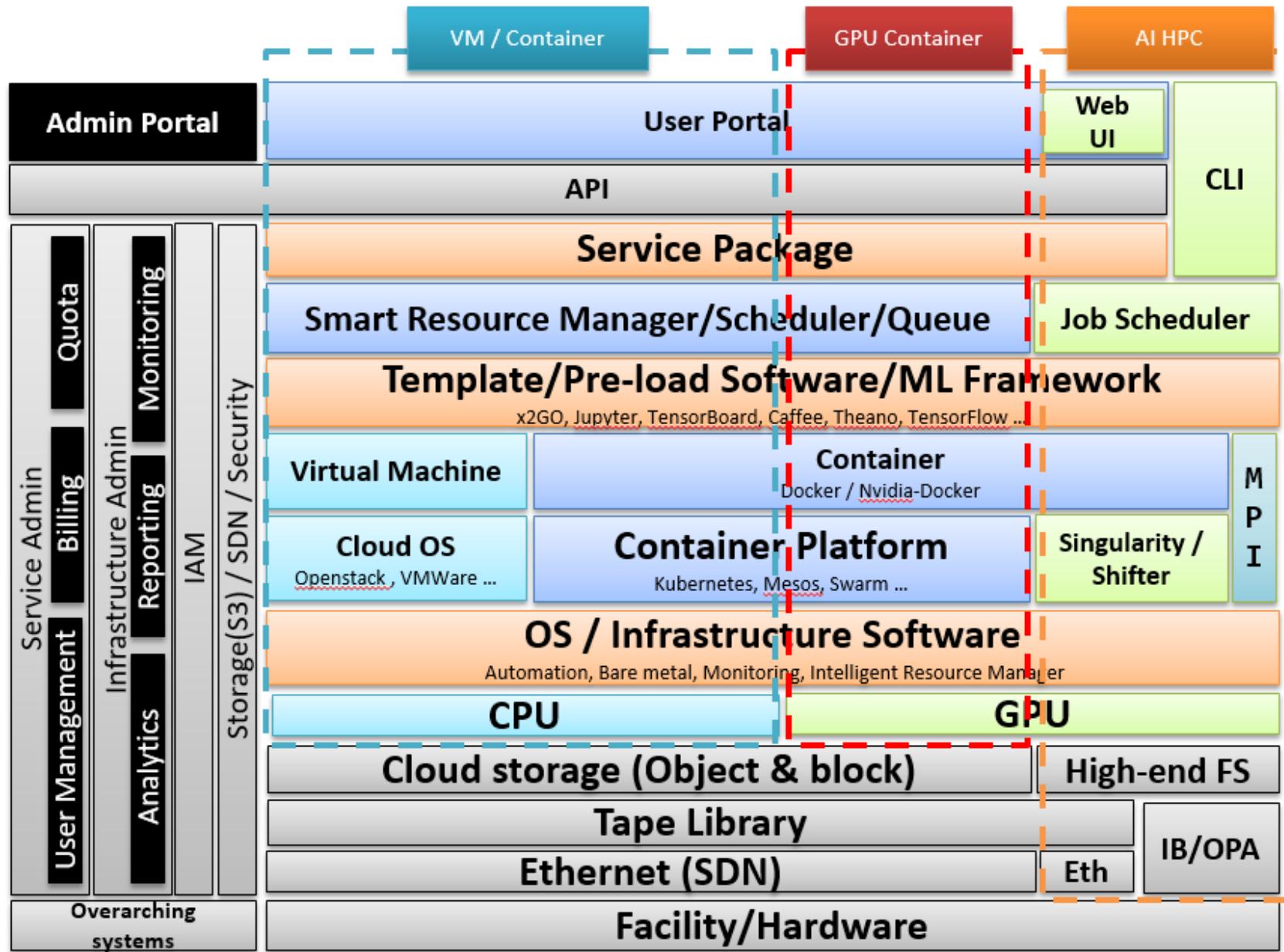
Cloud-based AI Computing Platform - 2018



Capacity 2018

- **AI supercomputer**
 - Rpeak 15.7 PF (est. Rmax:6.5PF)
 - 64-bit cluster
 - 9072 Xeon 6154 CPU cores, and 2016 NV Tesla V100(SXM2) GPUs
 - AI compute node vs. management/service nodes
 - **Compute nodes : 252 nodes**
 - 8 GPUs/node
 - 2 18-core CPUs/node
 - 768GB memory /node
 - 4TB NVMe/ node
 - **Management/service nodes: 20 nodes**
 - 100Gbps interconnect capable of connecting 1700 connections
 - 13PB IBM GPFS as parallel file system
 - Container compatible, such as NV-DOCKER, Singularity, Shifter
 - Cooling system: direct water cooling to CPU and GPU (Asetek)
 - 1.064 MegaWatt, PUE = 1.22

AI Cloud Service Platfrom



System Software

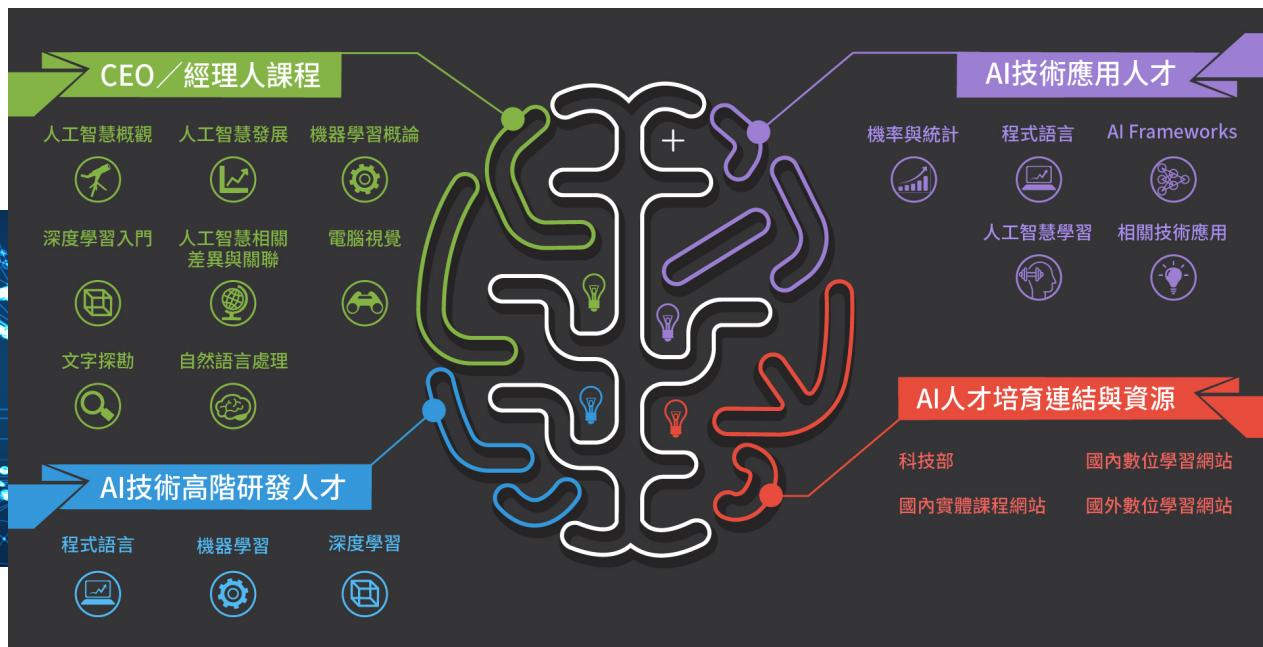
- Slurm
- Singularity/Docker/Shifter
- NV-Docker
- Kubernetes
- Openstack (Suse & Community)
- Suse Ceph
- IBM GPFS
- Monasca, Grafana, OpenATTIC

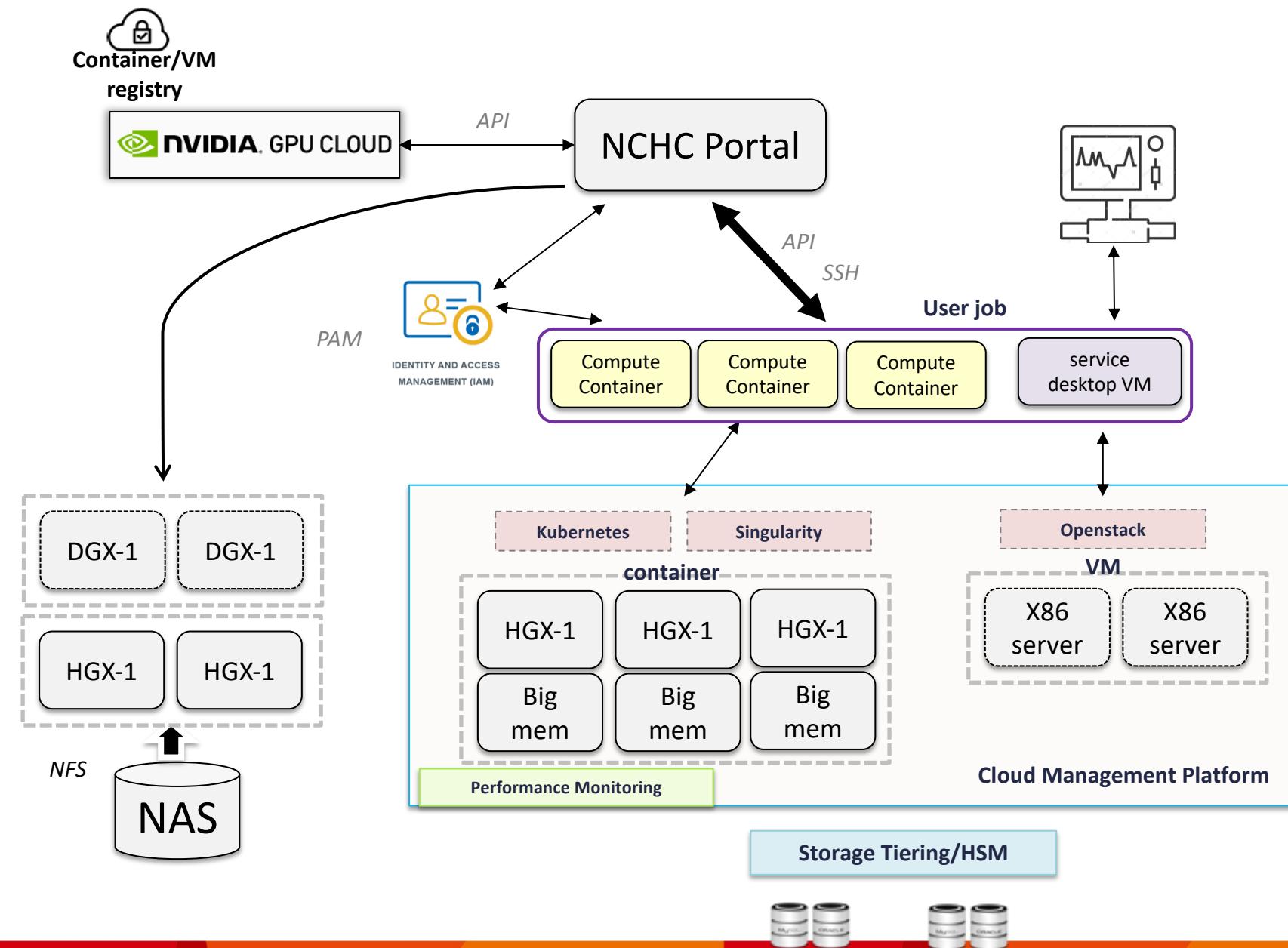
Service models

- Computing & Storage Provider
- AI Framework via Container
 - Tensorflow
 - Caffe 2
 - Torch
 - MXNET
 - ... etc.
- DataMart Service
 - Audio/text/image/medication/disaster_mitigation/Intelligent Machinery
- User communities
 - Data set, Algorithm, trained models, education & training, application examples

Education & Training

- AI Digital Learning Platform
 - One stop AI education portal
 - <http://aiel.nchc.org.tw>
 - On-line courses for
 - CEO/Manager
 - AI Researcher
 - AI Engineer
 - Learning resources
- AI training service
 - Machine Learning emphasized
 - Data preparation
 - AI model
 - Tuning
 - Deployment
- nVidia lecturer
 - nVidia DLI certified
 - Joint effort between NCHC & nVidia





Data Service

Data Market Service

Benefits

Novel data applications

Data Users



Government



Universities



Private sectors



Research institutes

Data Sets

Gov. Non-open Data

Industry Data

Taiwan Data Market
Non-open data sharing
platform for Public sectors



Big Data
Computing
Platform
(NCHC)

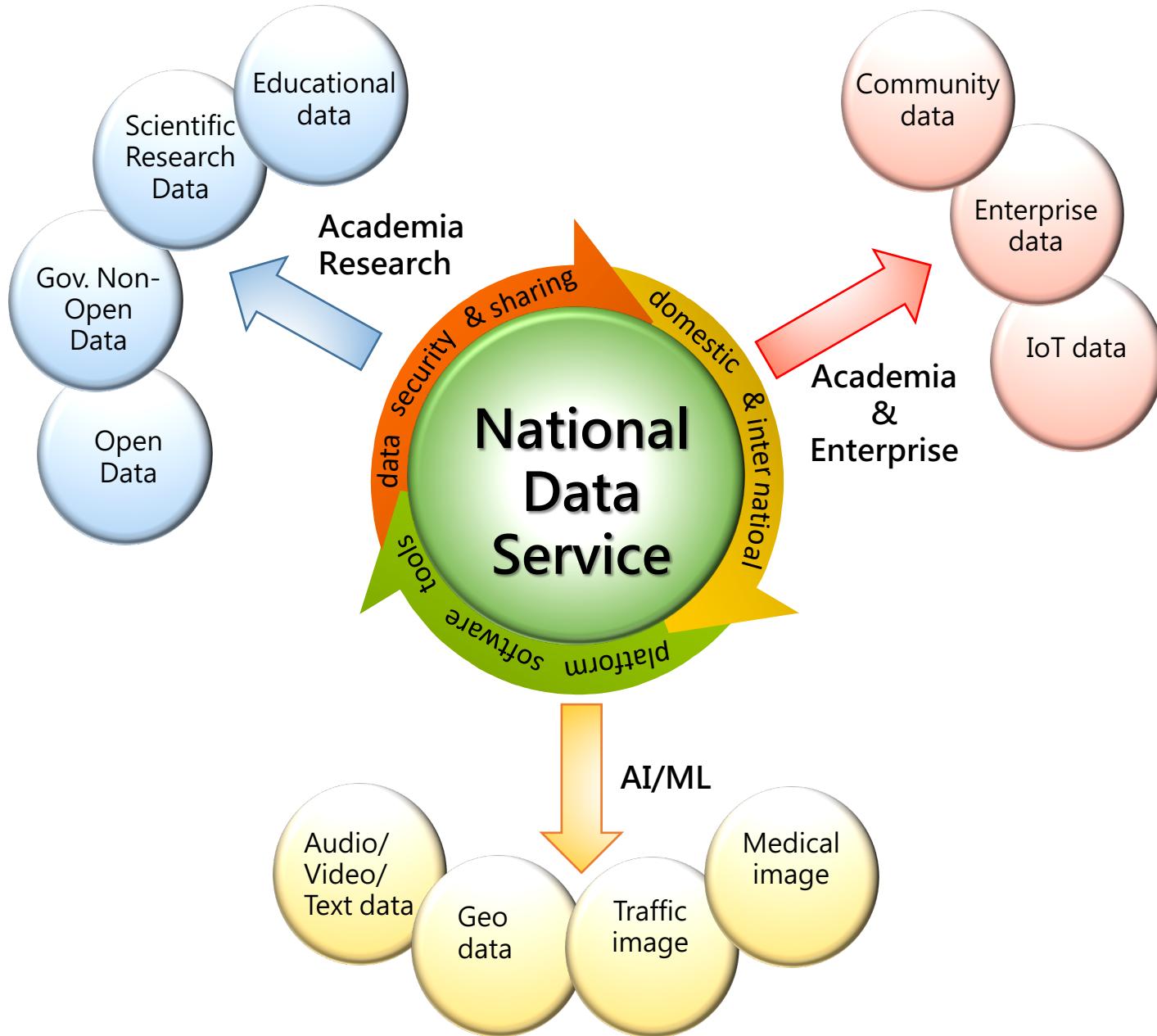
Infrastructure

Open Data
Platform
Gov Open Data
<http://www.opendata.tw>

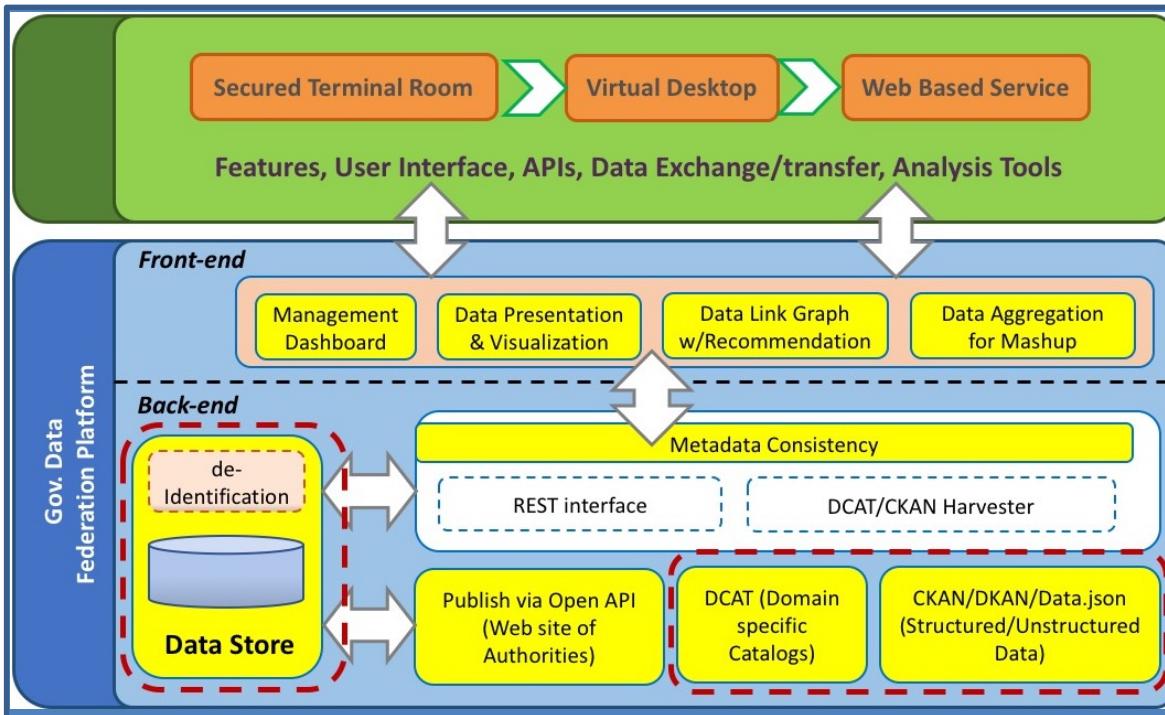


Gov Open Data Platform
(National Development Council)

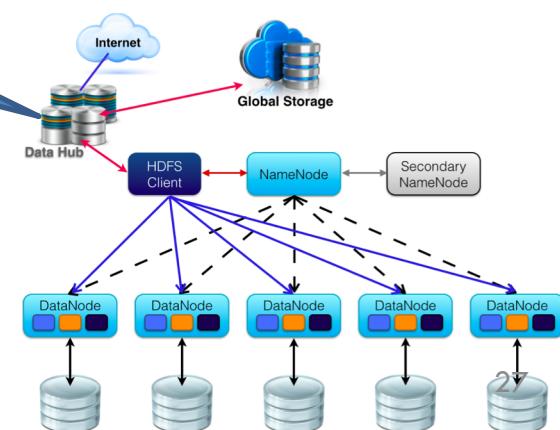
DataMart – toward the NDS



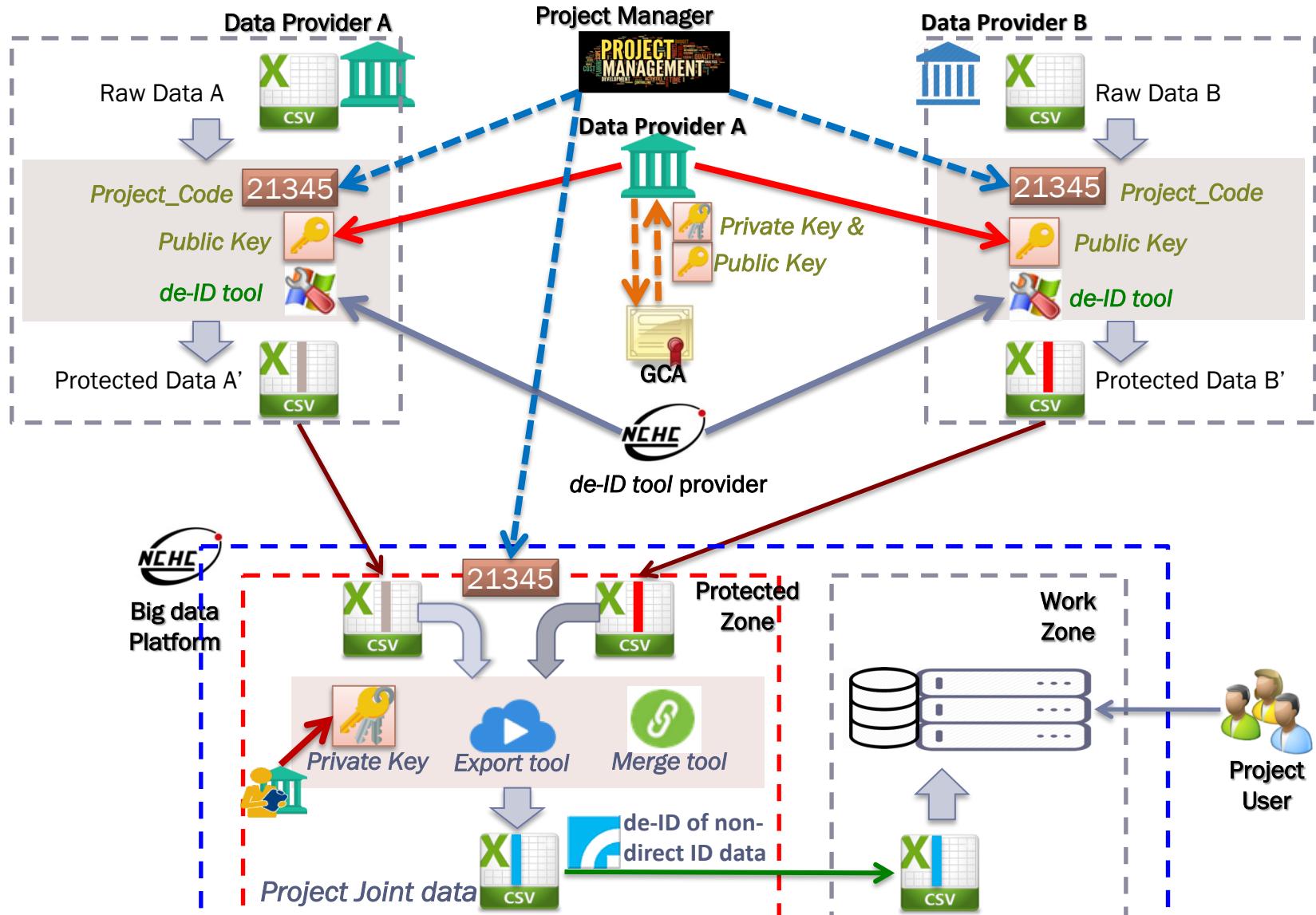
DataMart Platform



- Government Non-open data dedicated
- Certified
 - ISO27001
 - CSA Star Gold
 - BS10012



Data Integration w/de-ID



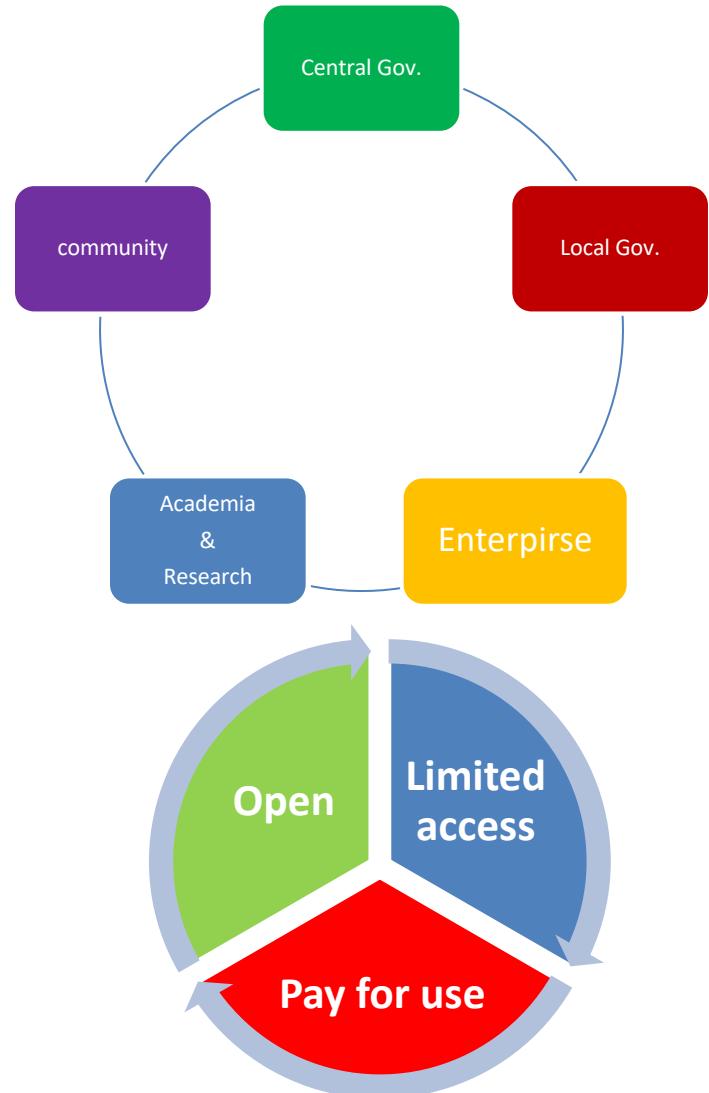
Data Portal & Collections

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

The screenshot shows the homepage of the Data Portal & Collections platform. At the top, there is a navigation bar with links for 資料集 (Datasets), 組織 (Organizations), 群組 (Groups), 關於 (About), 使用手冊 (User Manual), 連繫我們 (Contact Us), and 非公開資料集申請 (Apply for Non-public Dataset). A search bar is also present. Below the navigation bar, there is a search section with a search input field containing "例如：環境" (e.g., Environment) and a search icon. A "hot topics" section lists "主計處" (Statistics Bureau), "環保" (Environmental Protection), and "公共資訊" (Public Information). To the right, there is a banner for "big data analytics" featuring three people looking at a screen. The banner text includes "國家實驗研究院 國家高速網路與計算中心 資料集平台" and "注意事項" (Notes):

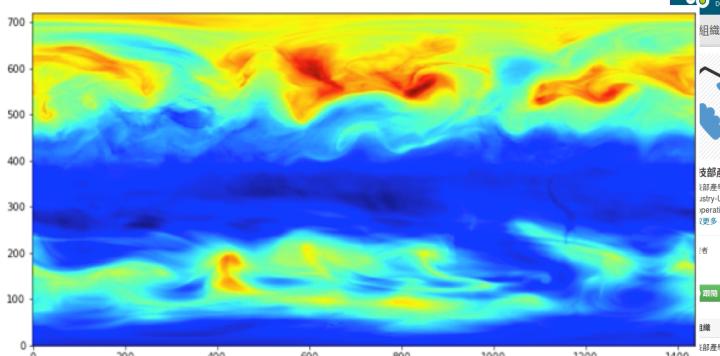
- 當檢視組織內之資料時顯示為非公開或無列表時，表示無權限所能瀏覽之資料。請 [連繫我們](#)。
- 目前本平台為測試階段，有任何建議或指教，歡迎與我們反應。
- 隱私保護及網站安全政策 [宣告](#)

- CKAN based
- Open platform
- Centralized & distributed
- Uniqueness, *hopefully!*



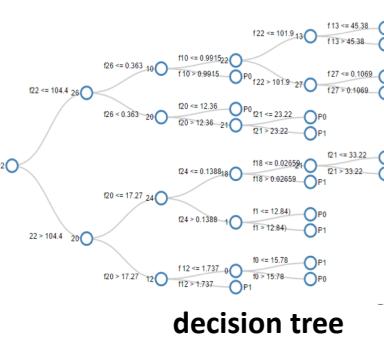
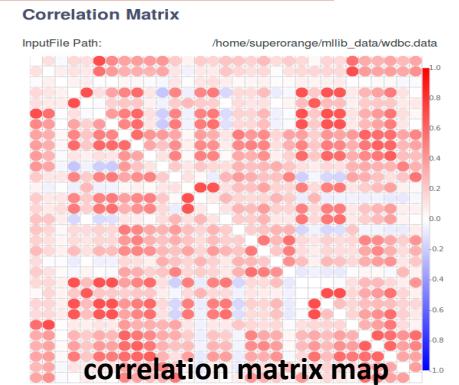
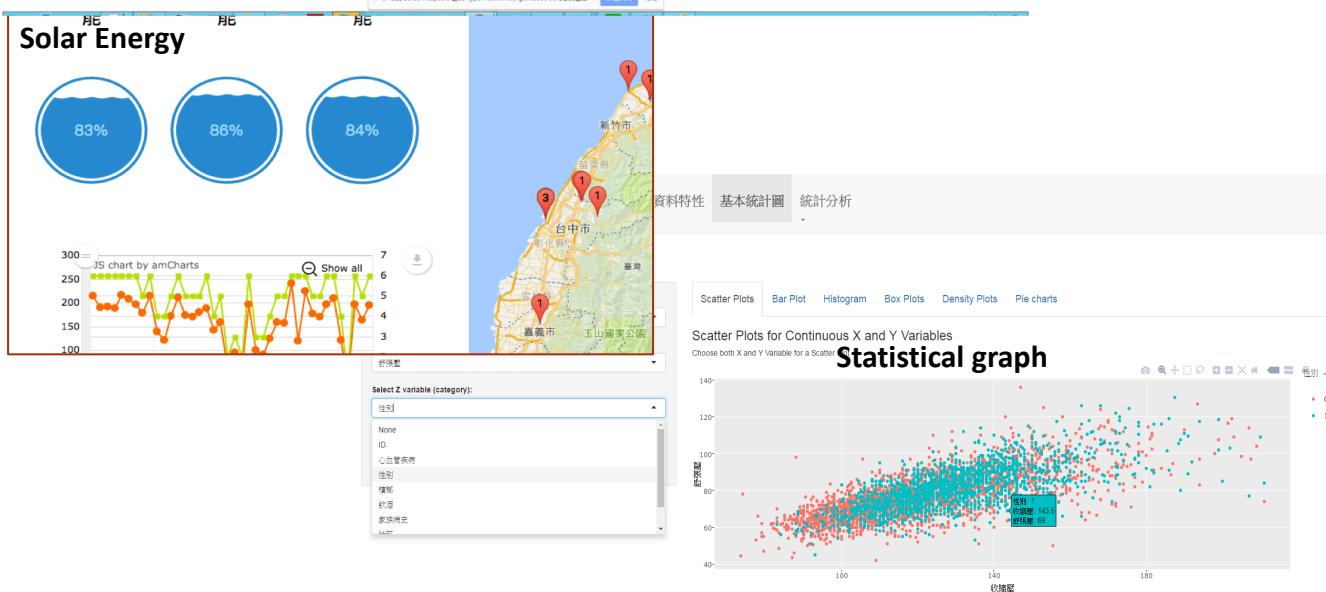
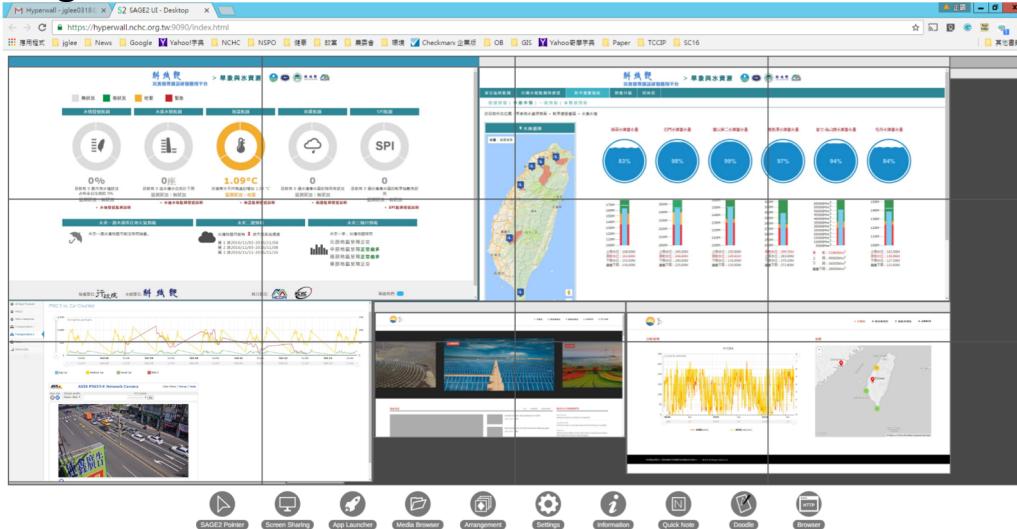
Data sets

- Open data
- Governmental Non-open data
- Environmental/Weather data
- Audio/Vocal data
- Satellite images
- Network data
- Malware sample data



Data Presentation

High Resolution TDW – SAGE2

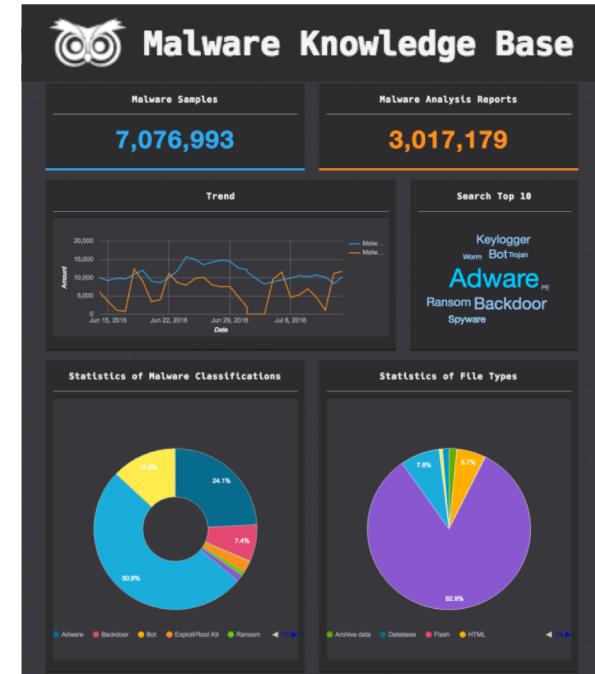


Application Cases Study

Cyber Security

Cyber security, malware behavior analysis

- Build the **Malware behavior knowledge database (13+ M malware samples)**, the only one in Taiwan
- Deploy a large-scale Honeynet platform (**6,000+ Honetpot & 65+ GB/Day**)
- Operate **TWCSIRT** (Taiwan Computer Security Incident Response Team) for Intelligence sharing and analysis in the cyberspace
- Organize the **IRCON** (Incident Response Conference) in Taiwan to connect with the other CERT/CC, CSIRT in the global



Government non-open data service

Projects

Crime Prevention by Analyzing Offending, Habitual Offenders, and.
Cross-border Crime Trend with Big Data in Taiwan

Analyzing Taiwan's wage structure and salary increase related issues
with Big-data Analytic Technology

Labor Payroll Trends Study based on Big-data Analytic Technology

Does the Taxation System Improve the Wealth Distribution of
Generations?

An Empirical Study of Taiwanese Marriage

Government non-open data service



Secured terminal room

Screenshot of a web-based booking system for a secured terminal room. The interface shows a calendar for March 2018. The days are color-coded: grey for Saturday and Sunday, light blue for Monday through Friday. Specific timeslots are highlighted in green for reserved rooms. The top navigation bar includes links for '国家高速網路與計算中心' and '獨立作業空間預約系統'. The bottom of the screen displays a detailed list of reserved dates and times.

| 當日預約: | 3月 25 3月 26 3月 27 3月 28 3月 29 3月 30 3月 31 4月 01 4月 02 4月 03 4月 04 4月 05 4月 06 |
|-------|---|
| 隔日預約: | 3月 24 3月 25 3月 26 3月 27 3月 28 3月 29 3月 30 3月 31 4月 01 4月 02 4月 03 4月 04 4月 05 4月 06 |
| 月顯示: | 1月 2018 2月 2018 3月 2018 4月 2018 5月 2018 6月 2018 7月 2018 8月 2018 9月 2018 |

