台灣自來水公司
TAIWAN WATER CORPORATION

A new ICT architecture of smart water network platform for improving management performance: maintenance, security, and deployment cost

Lee Chien-Hsing

Taiwan Water Corporation /Department of Information Management

30,10, 2024

Oral Presenter:

Lee Chien-Hsing

・Section Position

Chief, Department of Information Management, TWC

•Education:

Ph.D., E. E., National Yunlin University of Science & Technology, Taiwan

・Certification ＆ License：

▪Professional Electrical Engineer, MOEA, Taiwan

▪Waste Disposal Technician（Class A）, MOE, Taiwan

▪Dedicated Wastewater And Sewage Treatment Specialists（Class A ）, MOE, Taiwan

- **Experience: Chief of a Water Purification Plant for 10 Years**

- **Teacher Education : 20 Credits of Teacher Education**

➢ **Educational Psychology**

➢ **Curriculum Design**

➢ **Adult Education**

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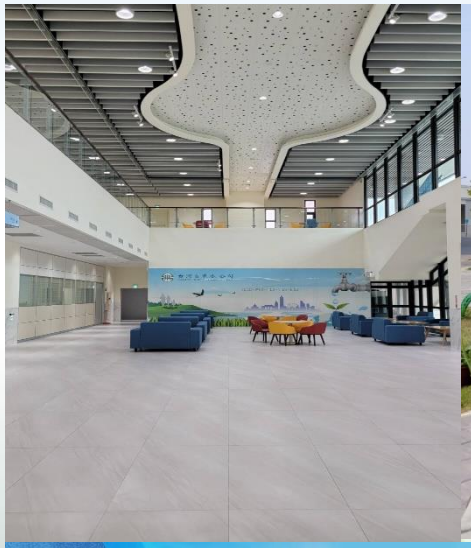
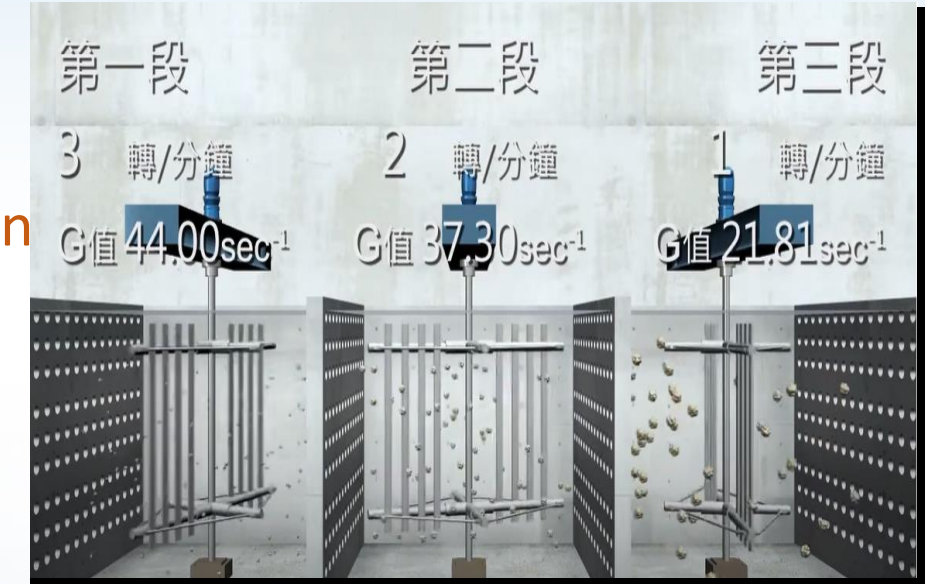


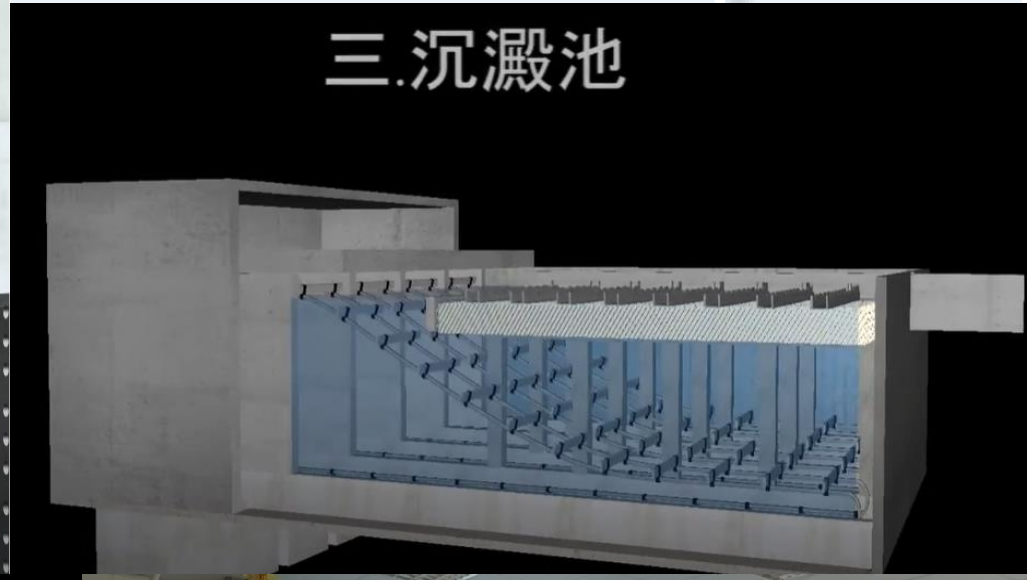
- **Developed a Digital Twin System for Water Purification in 2019**

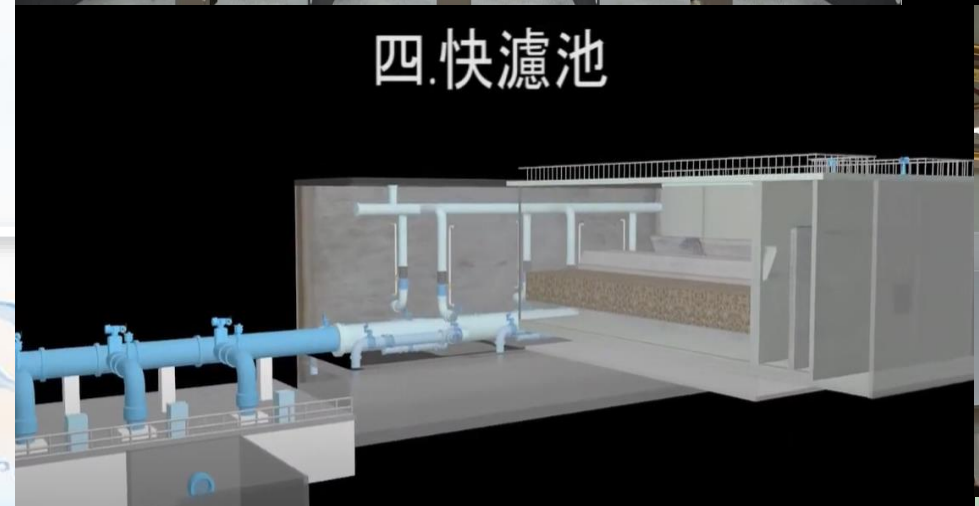
Environmental Education

Guidance

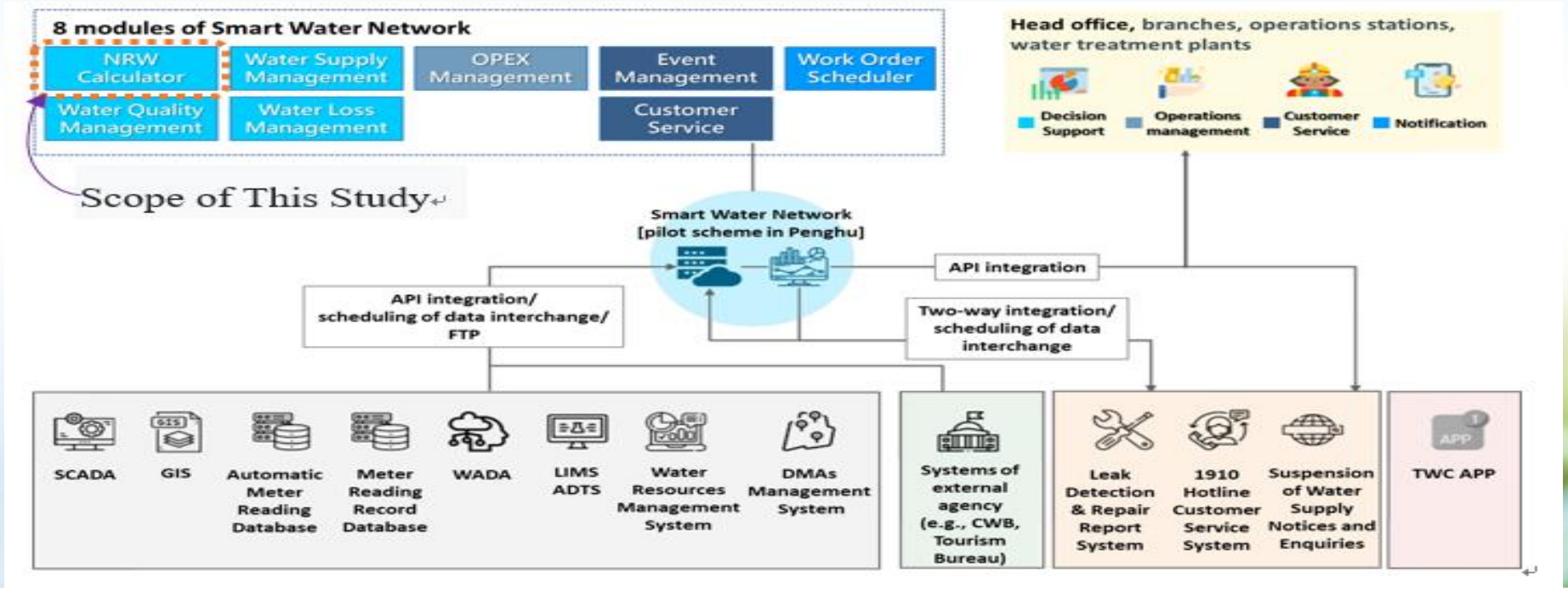
Explanation







·Developed a Smart Water Management Platform for Improving the Accuracy of Leakage Detection in Water Distribution Networks in 2023



·Winner Award 1
e-Newsletter of IWA-Aspire in 2023

Government Service Award of Taiwan in 2024.

政府服務獎
Government Service Award

IWA-ASPIRE 2023
22-26 OCT@KAOHSIUNG MARRIOTT HOTEL
#1 | OCT 2023

2023 KAOHSIUNG

EXHIBITION HIGHLIGHT

Taiwan Water Corporation (TWC)

Taiwan Water Corporation (TWC) was established in 1974 and has been dedicated to improving the quality of tap water supply for nearly half a century, making remarkable contributions to the progress of Taiwanese society and industrial development. In recent years, as living standards have improved and high-tech industries have thrived, the impact of extreme weather events and frequent droughts have increased the urgent need for stable water supply. In addition to ongoing investment in water supply infrastructure construction, TWC actively introduces new technologies, innovative methods, and strengthens the application of technology to enhance water supply resilience. The highlights of our participation in this exhibition are as follows:

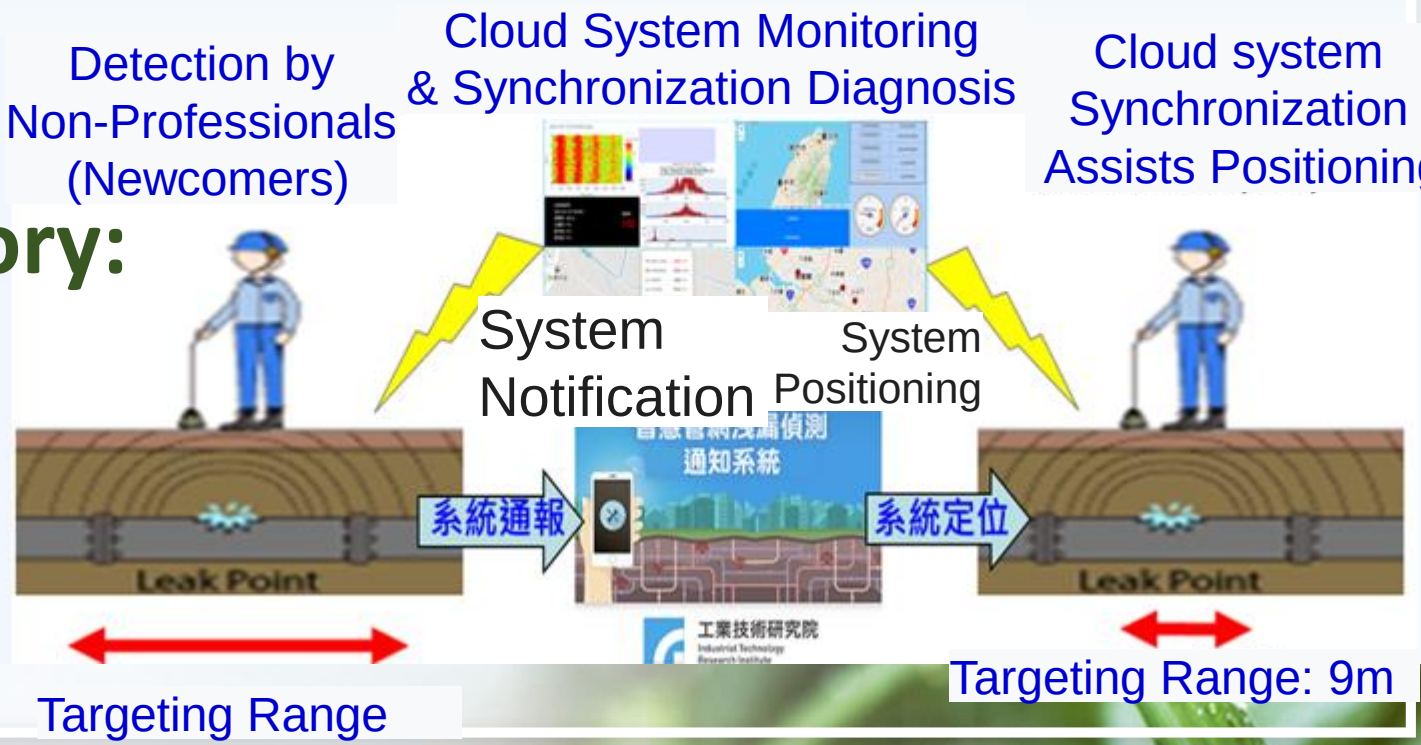
AI-assisted water leakage detection technology
Taiwan Water Corporation establish Artificial Intelligence leak detection system, developed and used a localized AI water leakage diagnosis instrument to capture live dynamic audio, and integrated the Internet of Things technology to simultaneously perform leakage event identification and water leakage location.

Subsurface Flow Development Project
Subterranean flow exists in the shallow gravel layers beneath riverbeds. It has advantages such as fast replenishment, ample water volume, and low turbidity. All operations are conducted underground, without disrupting surface water patterns and landforms. This helps reduce the risk of water shortage during periods of high turbidity and ensures stable regional water supply to meet water demands

Smart Water Network in Penghu
Taiwan Water Corporation initiated a pilot scheme in Penghu to develop a Smart Water Network (SWN) and install smart water meters. The SWN provides information such as alarms, assessment of pipe leakage, and decision-making support by analyzing the real-time data of flow and pressure. With installation of smart water meters, SWN also enhances service quality to customers by analyzing daily consumption and internal pipe

·AI diagnostic water leak detection technology

Accuracy Field/Laboratory: 82%/96%



·Winner Award 2

e-Newsletter of IWA-Aspire in 2023 and PIA Awards, IWA in 2024.

IWA-ASPIRE 2023
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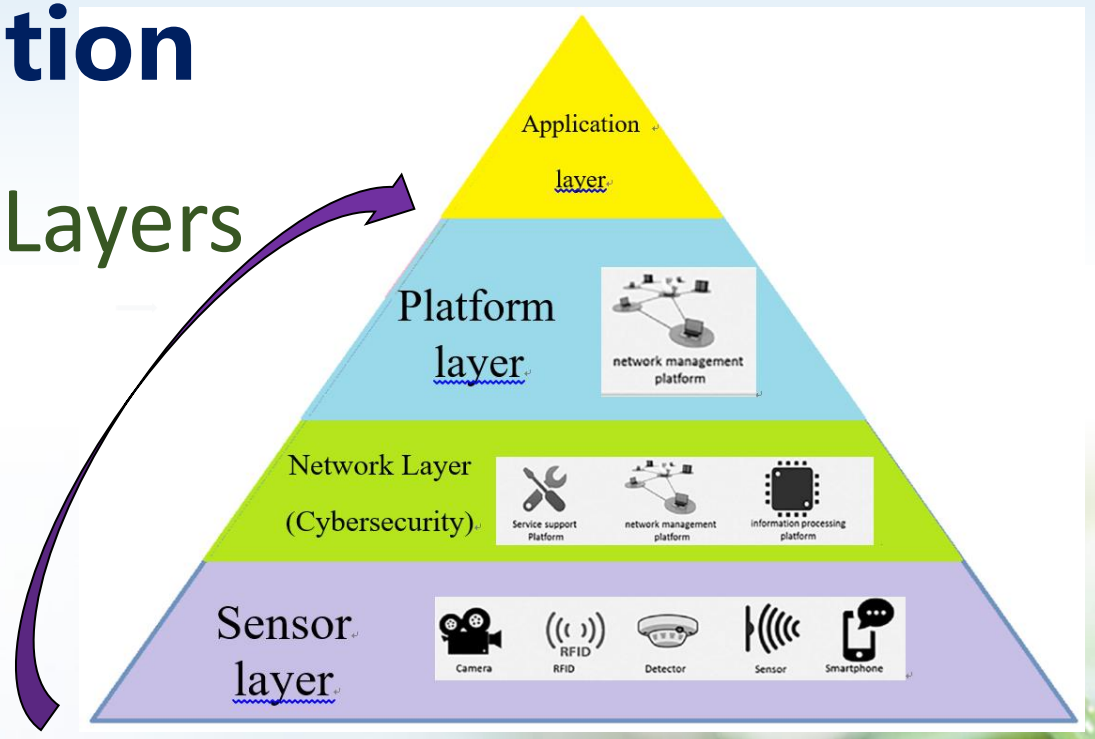
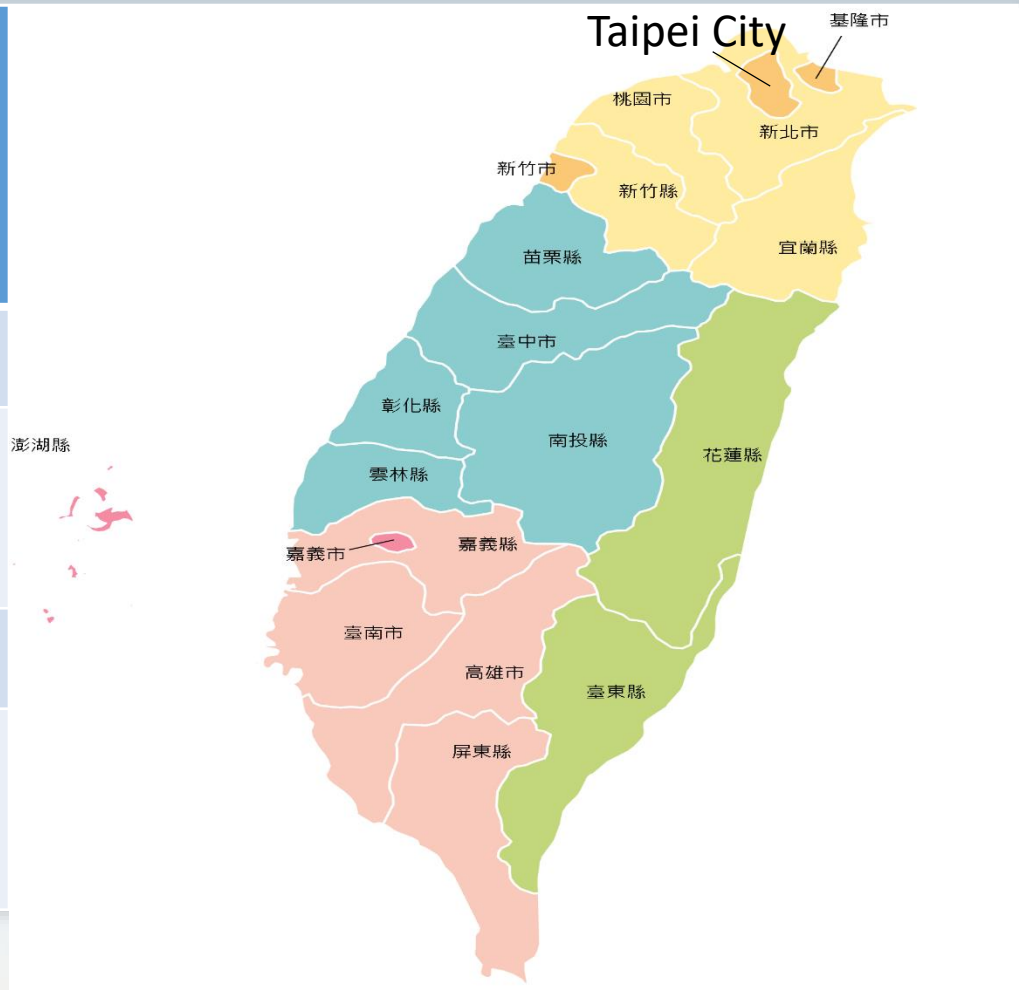
01 Introduction

A Smart ICT's 4 Layers



01 Introduction - TWC Outline

Item	Operating Performances
Number of Water Users	18,520,943
Numbers of Connected Households	7,708,910
Number of Employees	5,779
Households Served Per Employee	1,334



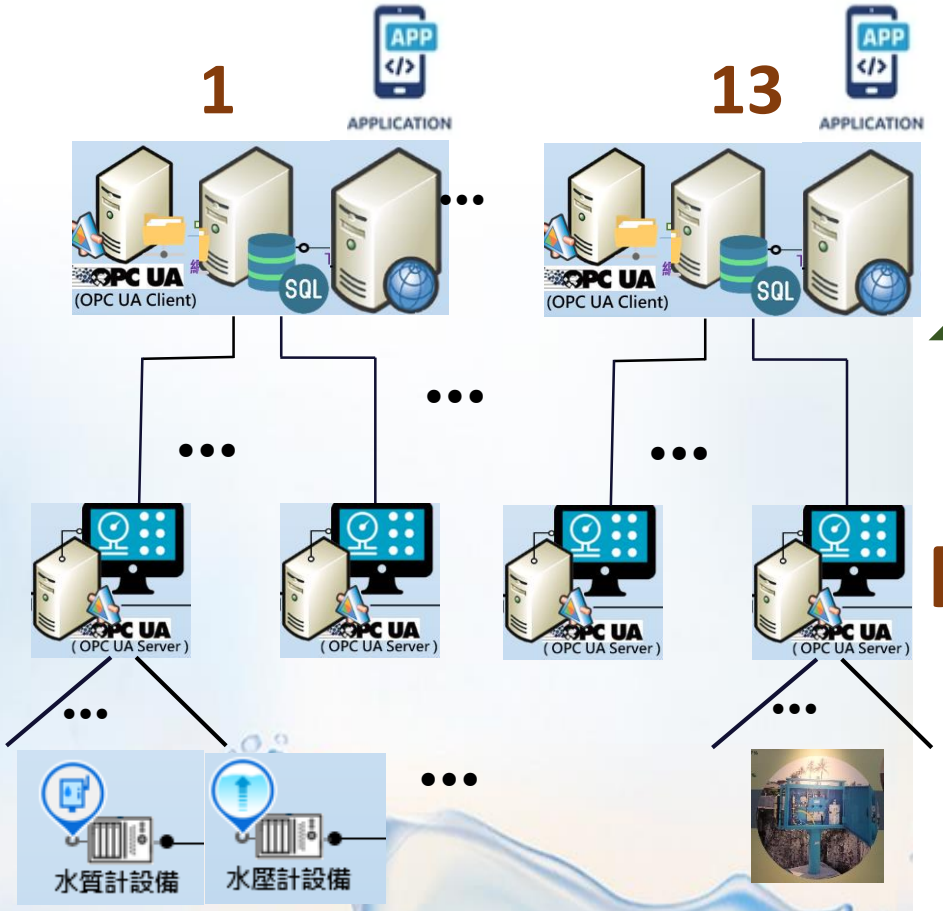
01 Introduction - TWC Outline

Item	Operating Performances
Distributed Water Per Day (CMD)	8,711,633
Water Sold Per Day (CMD)	6,913,591
Percentage of Revenue Water (%)	79.36
Unit Revenue of Water Sold (USD/m^3)	0.36

The Shengou Water Resources Ecological Park

01 Introduction

Distributed Hosts

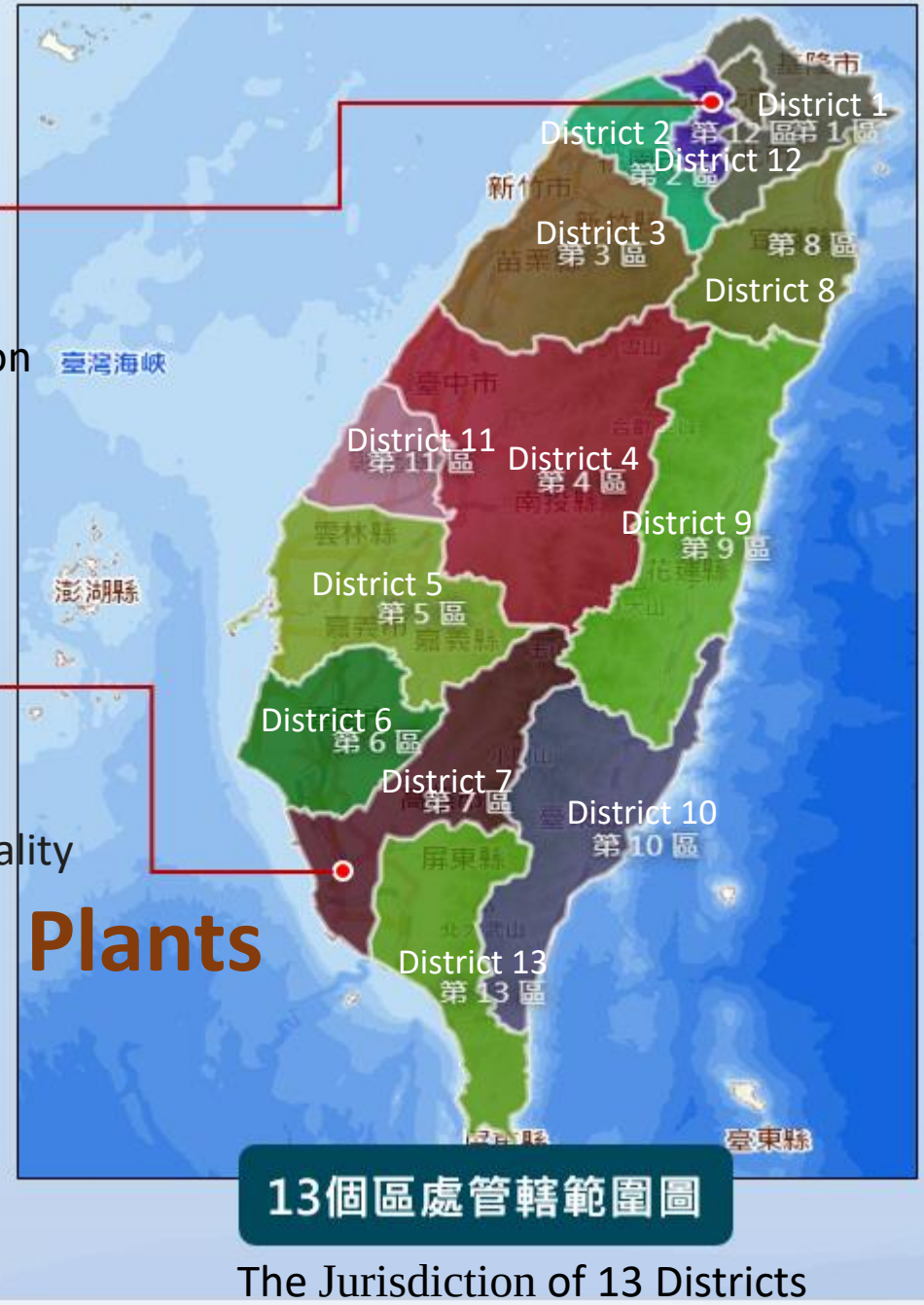


Water Quality Instrument

OPC disconnection abnormality

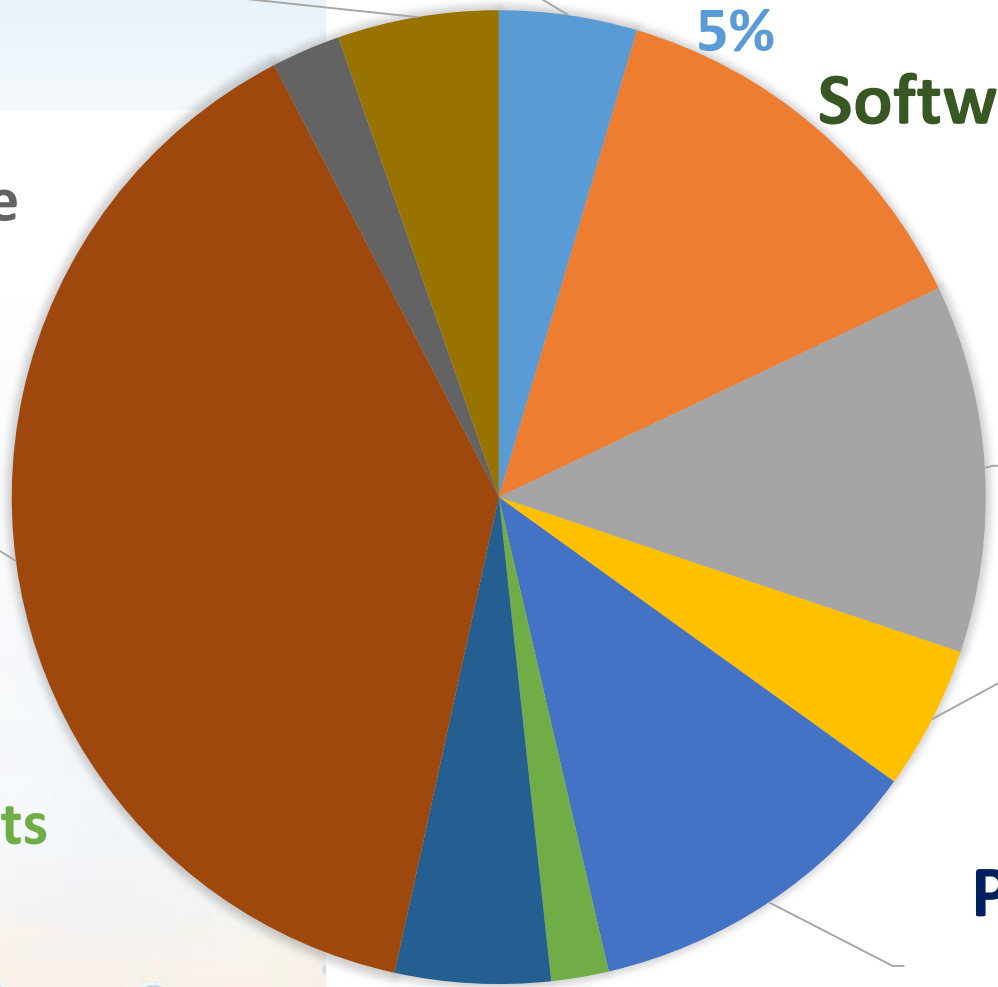
Network abnormality

Purification Plants



The Jurisdiction of 13 Districts

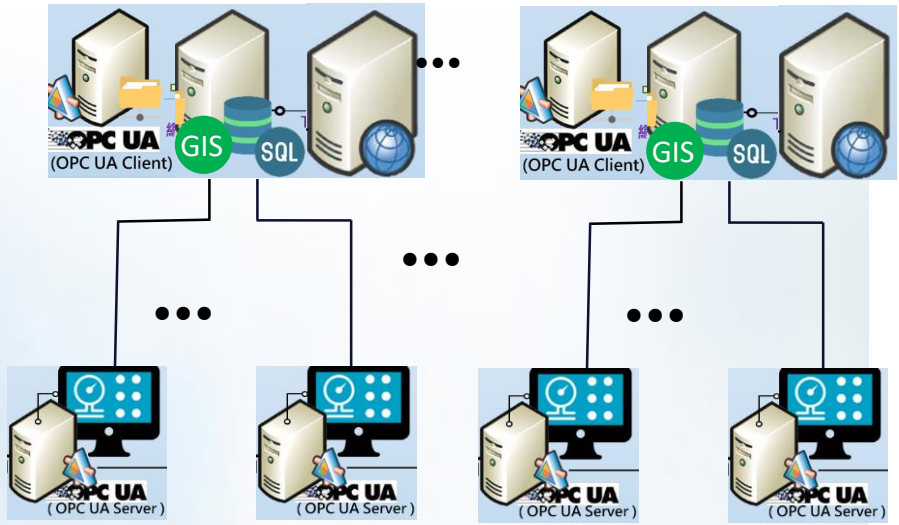
02 Problem Analysis and Improvement Approaches



02 Problem Analysis and Improvement Approaches

13 Distributed Hosts

13 (600wx3 Hyper Converged)

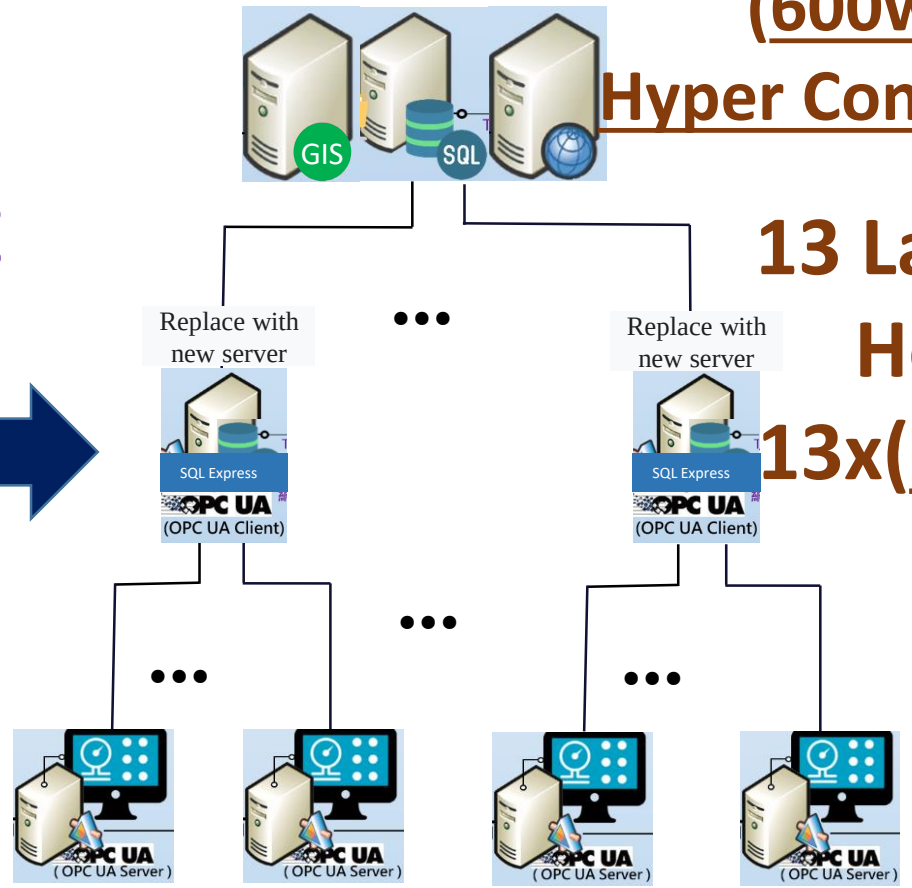


OPC API

1 Centralized Host

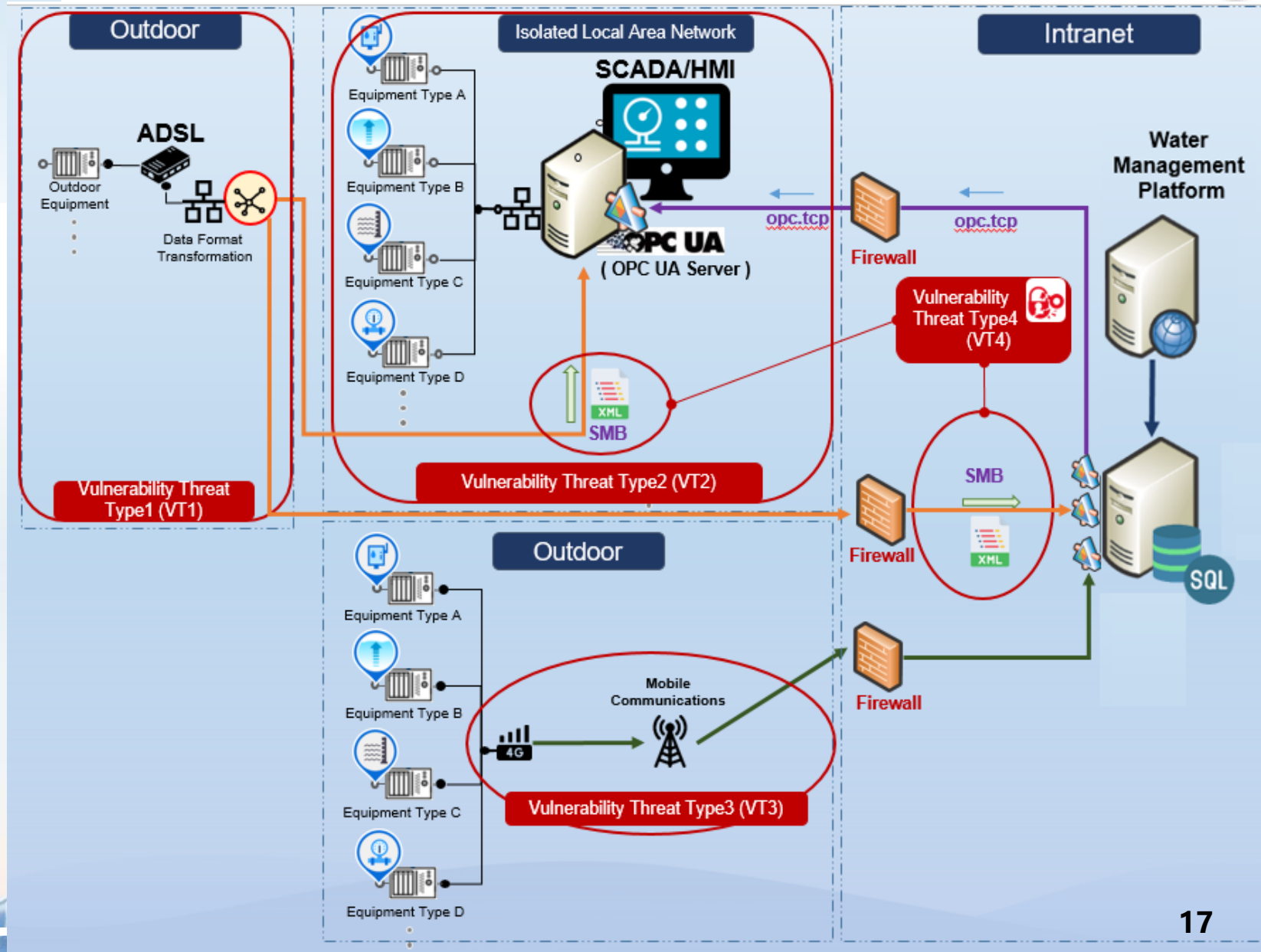
(600wx3 Hyper Converged)

13 Laptop Hosts 13x(500w)



02 A. Vulnerability Threats:

- *Internet Entrances-IOTs、Query Platforms*
- *Samba Propagations*
- *ICT architectures*
- *OPC Versions*



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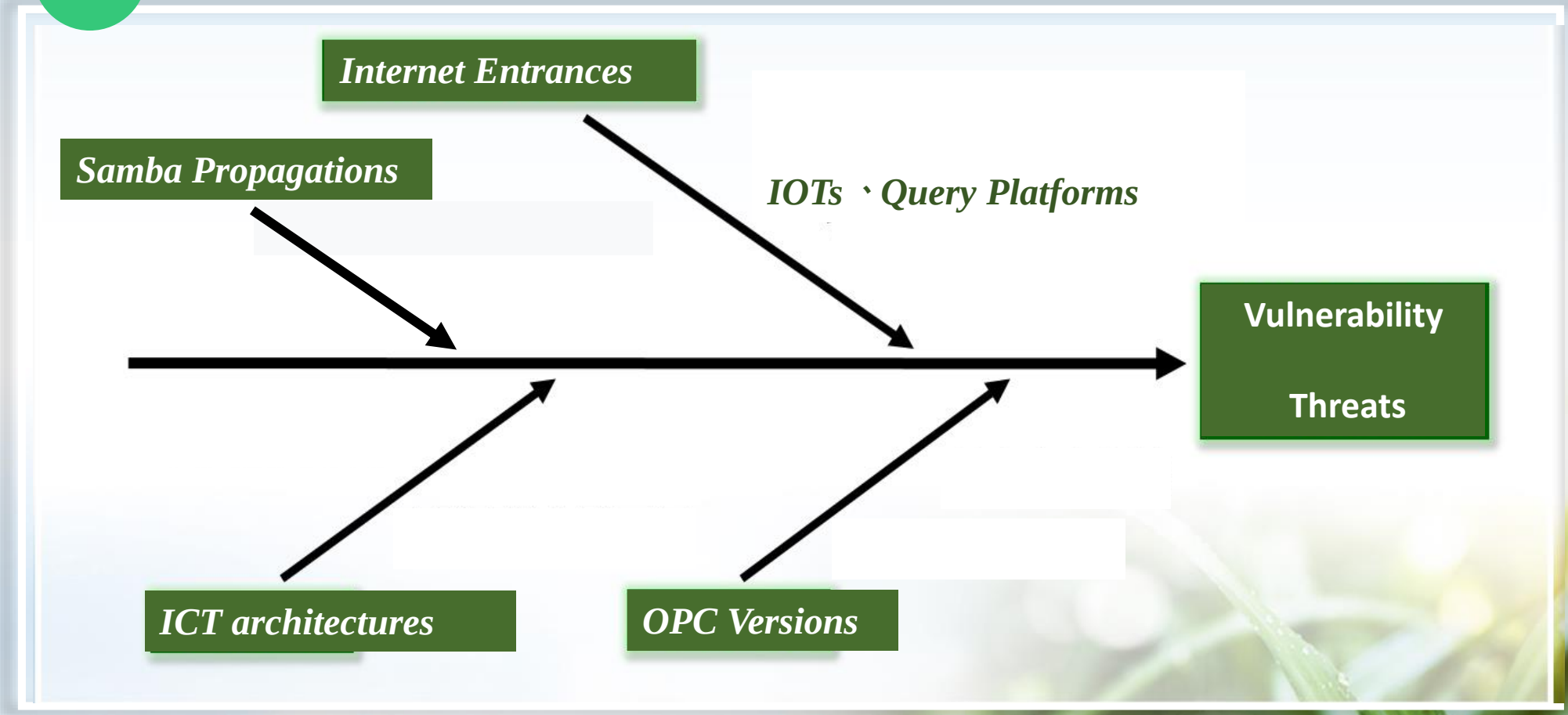


02 B. Deployment Costs and Carbon Footprints

Server Architecture		Hardware		Software			Carbon Footprint Ratio (%)	Deploy Cost Ratio (%)
		Infrastructure Host (500w)	Hyper Converged Infrastructure x3 (600wx3)	Virtual Machine (VM)	Database	SQL Express		
				1.VM Platform 2. VM Server 3. OS Licensing 4 cpu	SQL			
Deploy Cost (x10,000 USD)		0.3	4.69	4.8	4.3			
Improved	Centralized	N	1	1	1	N	(Nx500+1800)/Nx1800 =35.47%, where N=13	(Nx0.3+4.69+4.8+4.3) /[Nx(4.69+4.8+4.3)] =9.86%, where N=13
Before Improvement	N Distribute		N					

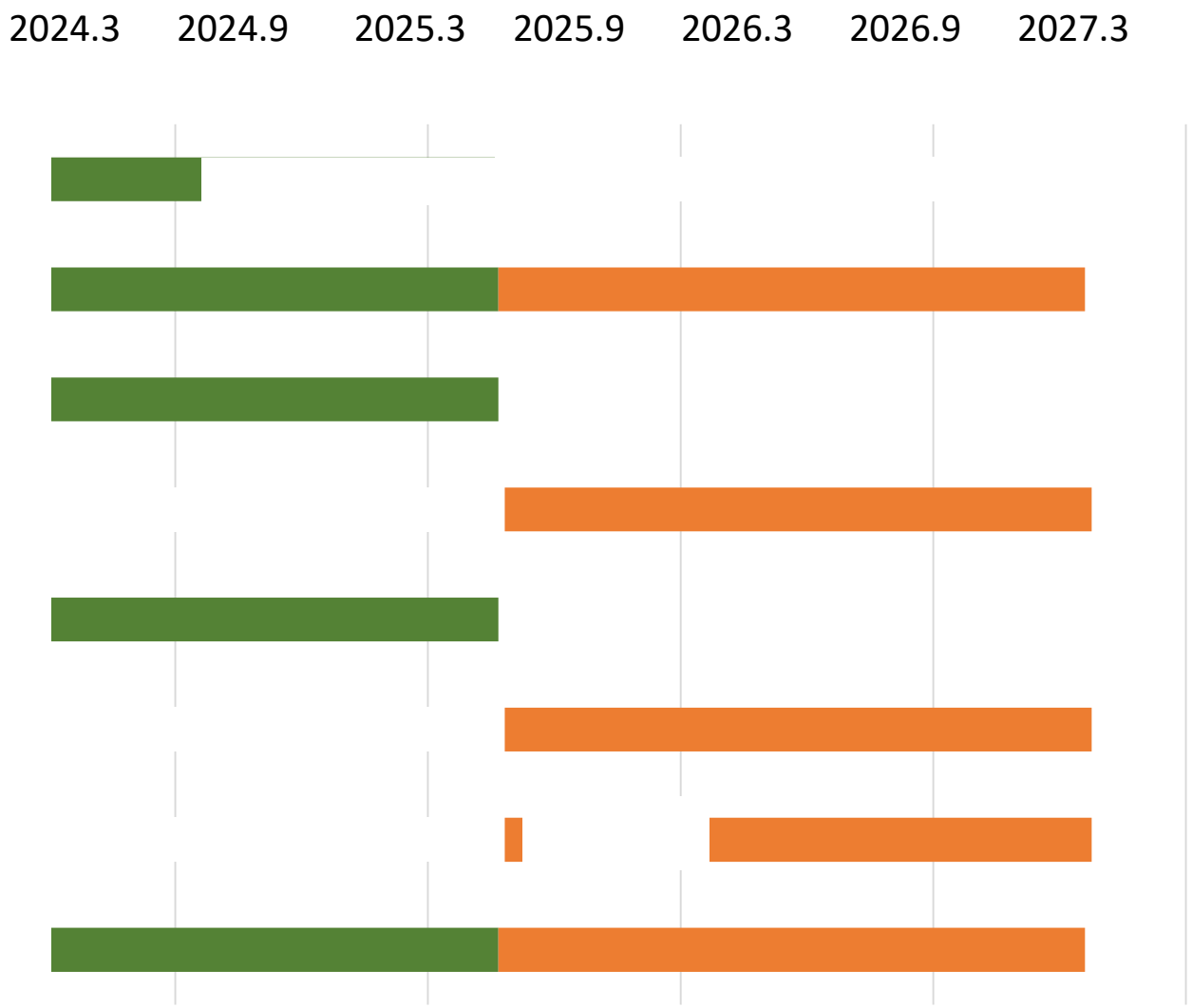
02 B. Deployment Costs and Carbon Footprints

$$\text{Carbon footprint } ratio = \frac{\text{Nx500+1800}}{\text{Nx1800}} x100 \quad (1)$$

$$Deploy\ cost\ ratio = \frac{\text{N+0.3+4.69+4.8+4.3}}{N(4.69+4.8+4.3)} x100 \quad (2)$$

02 C. Improvement Schedule

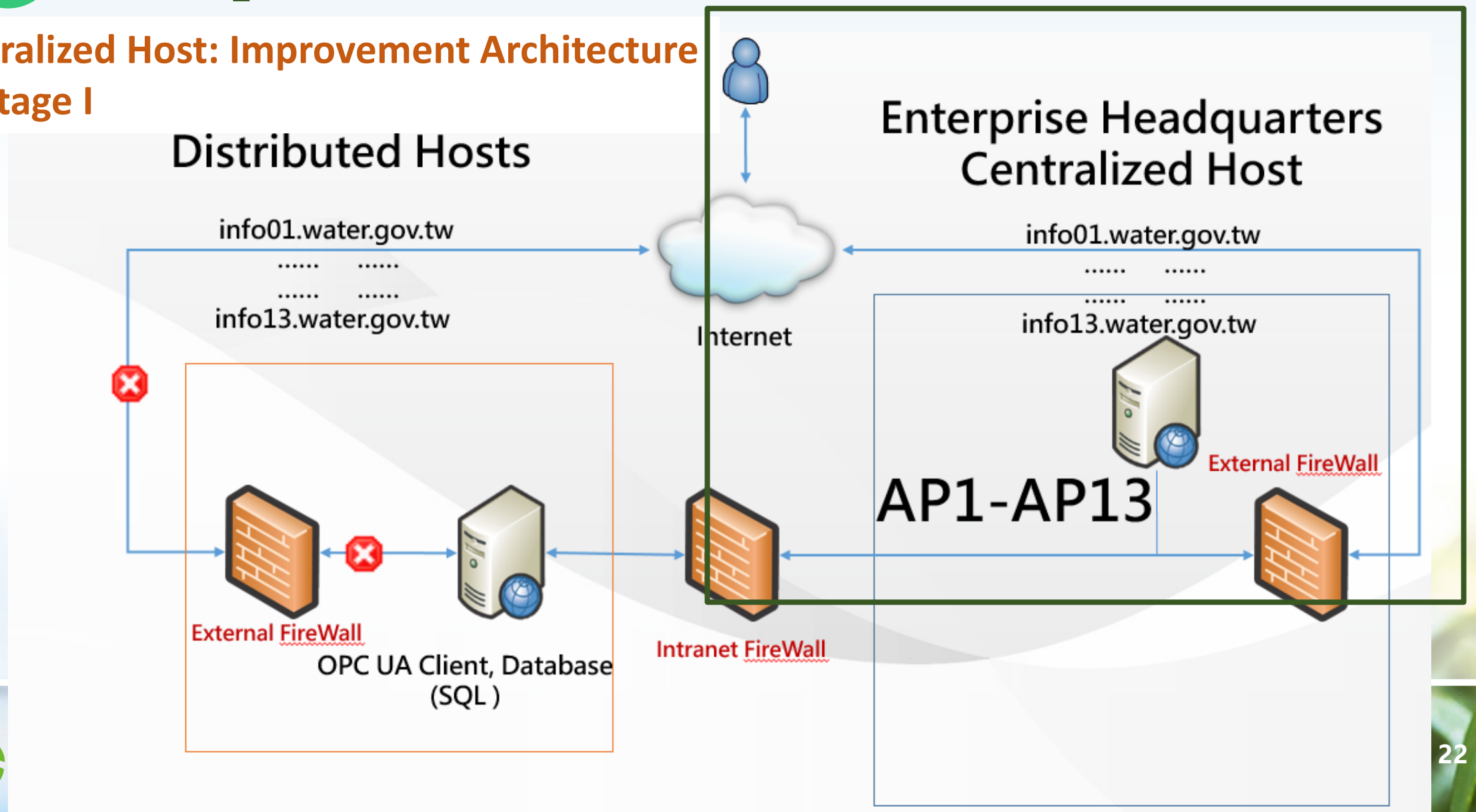
- ✓ Modify 13 Internet Entrances of Query Platform to enterprise Headquarters
- ➢ Organize IOT Internet Entrances to MDVPN
- ➢ Update OPC Versions
- ➢ Remove Windows Samba Architecture
- ➢ Centralized Host
- ➢ Smart Health diagnosis Module of Information Flow



02 D. Improvement Schedule

Centralized Host: Improvement Architecture

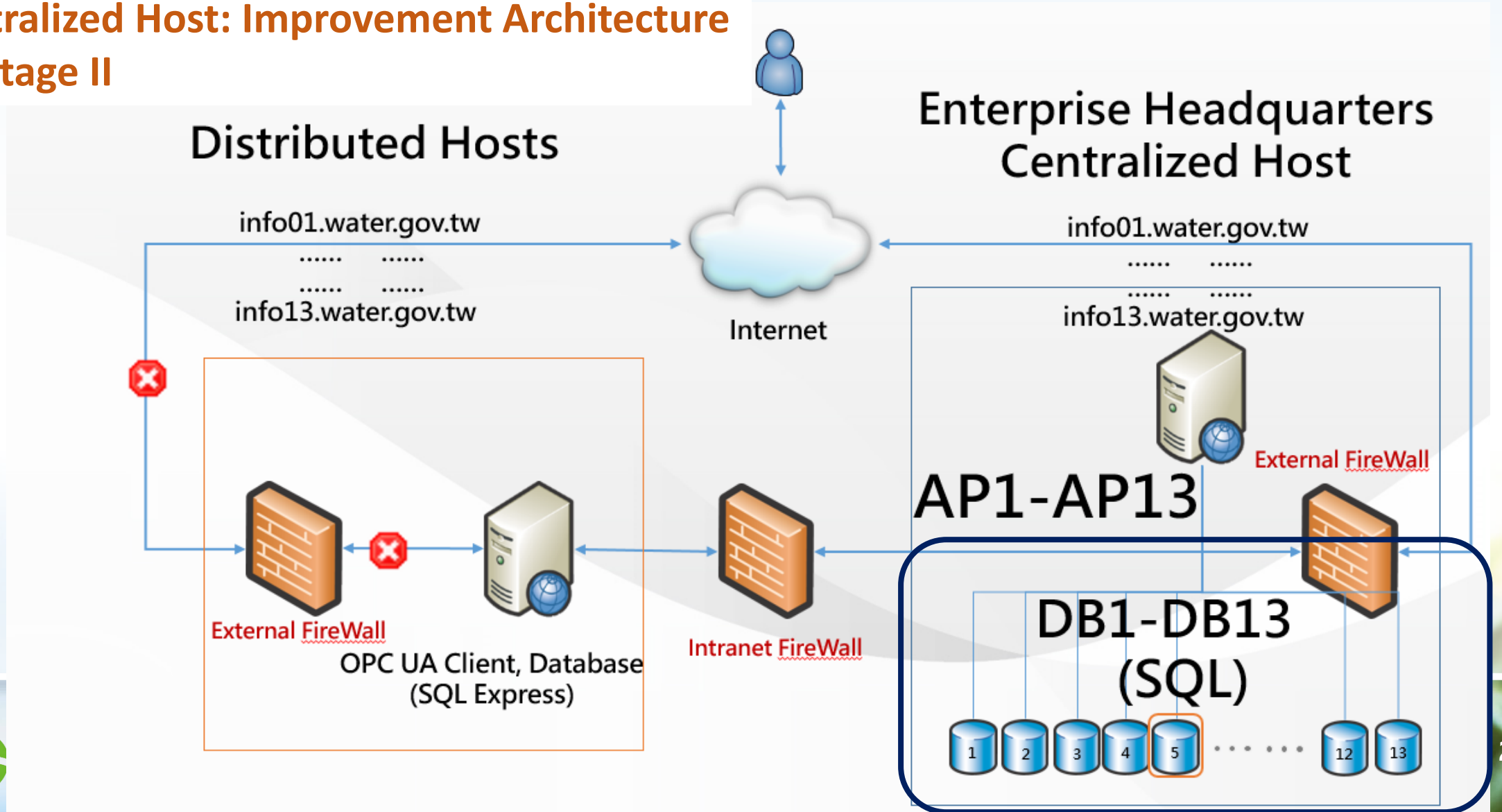
Stage I



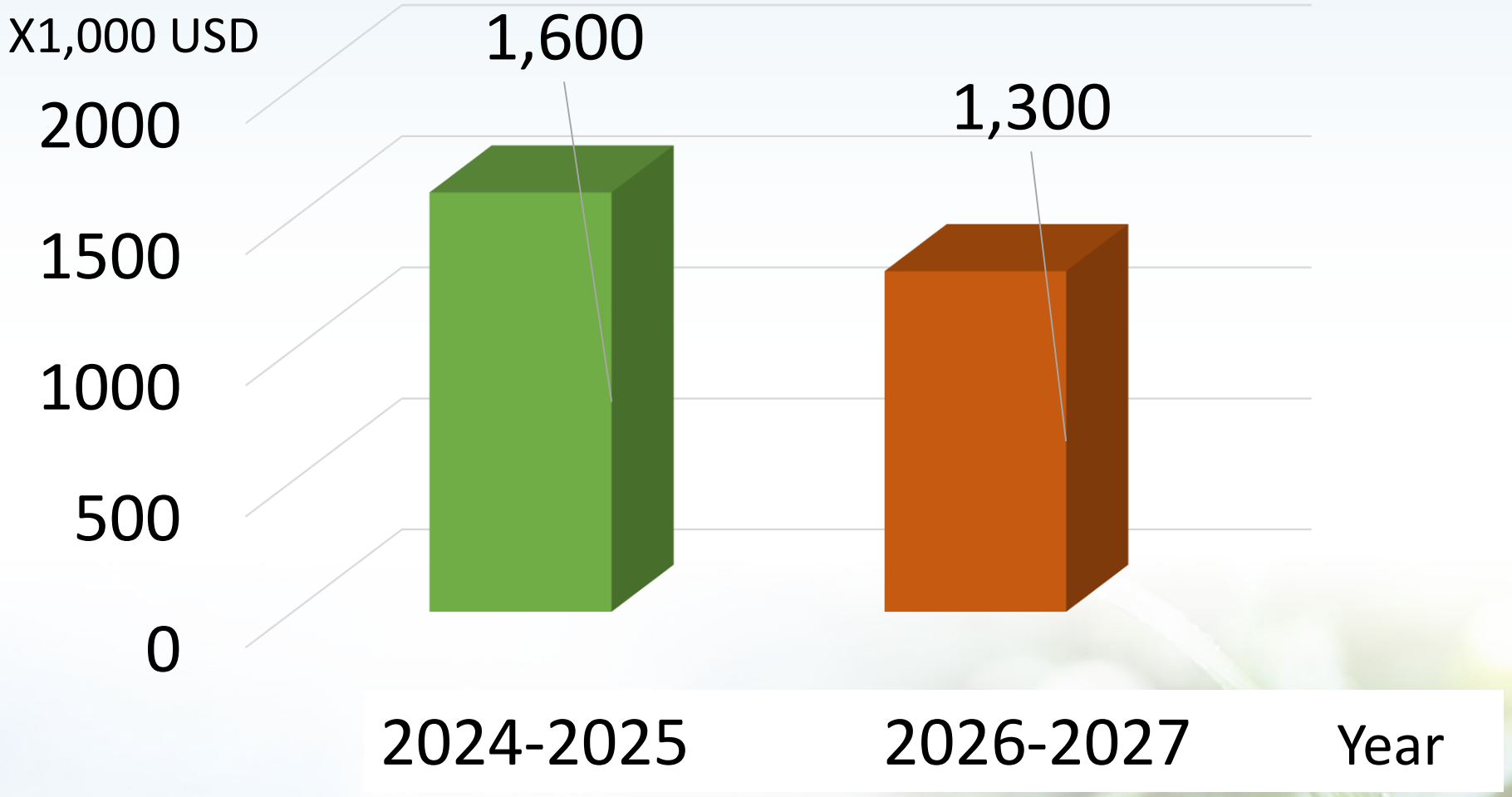
02 D. Improvement Schedule

Centralized Host: Improvement Architecture

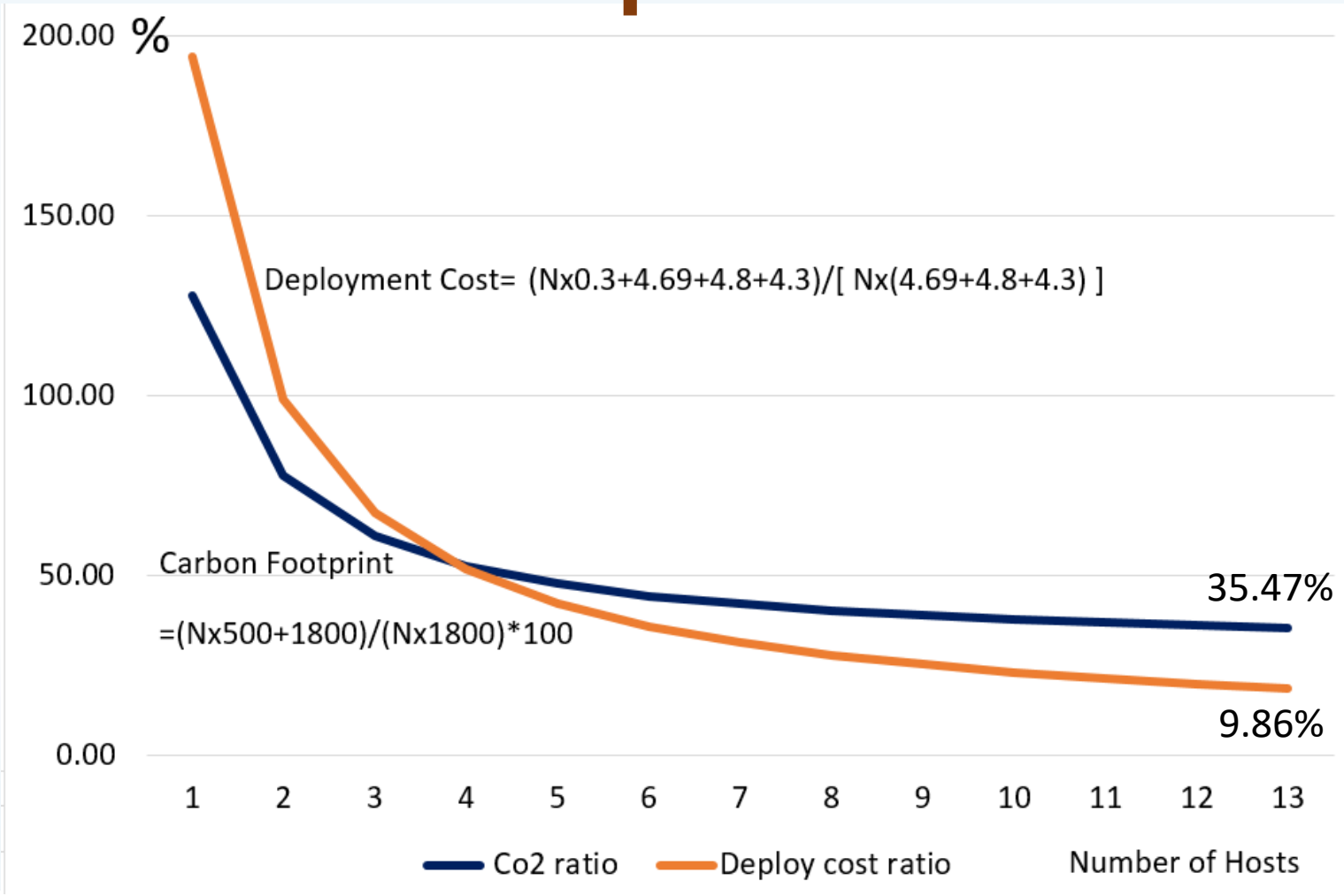
Stage II



02 E. Investment Cost



03 Simulation and Improvement Results



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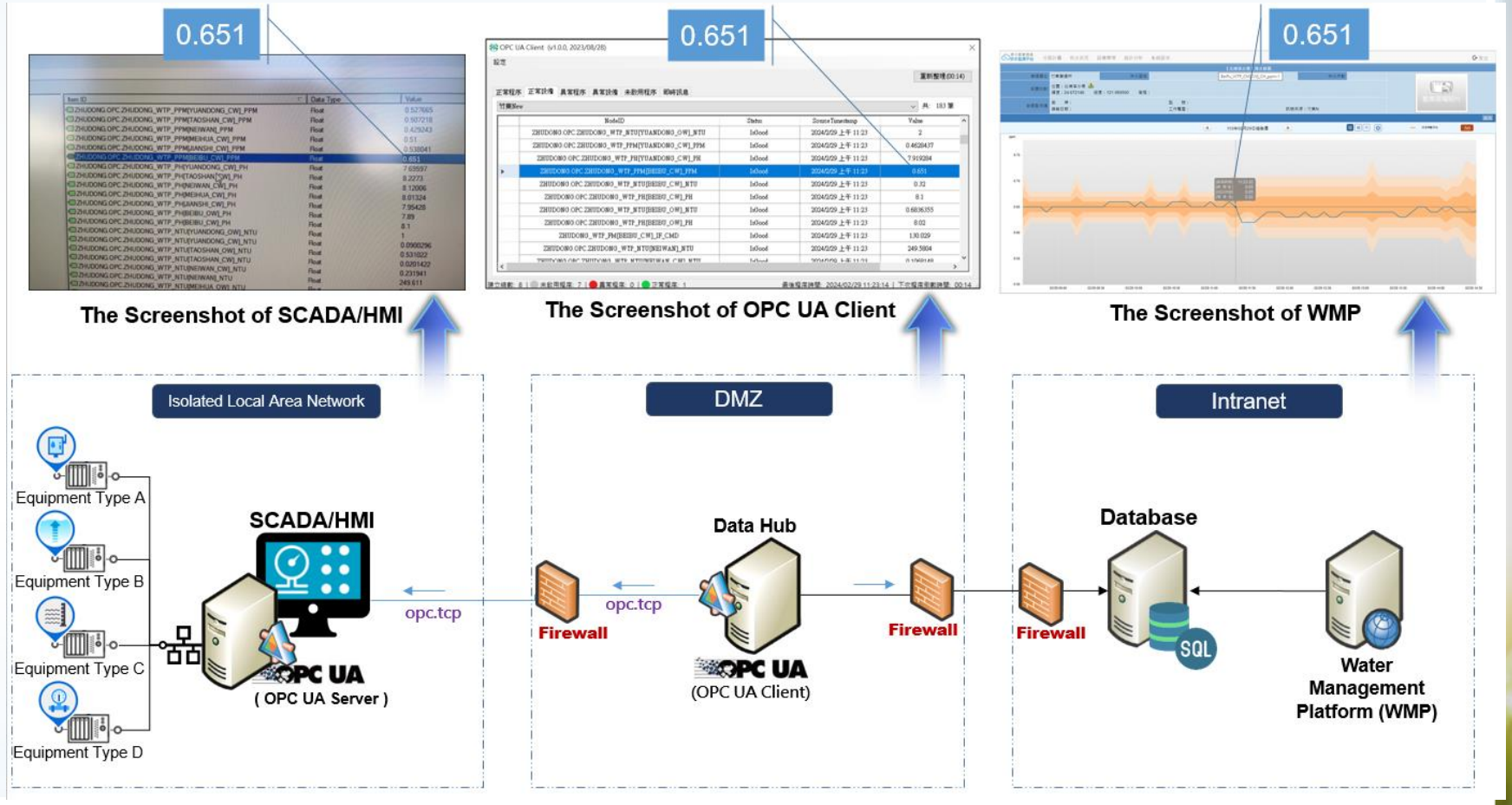

04 Conclusion

- The results show that the improved centralized information system is better than the traditional distributed architecture:
  - ✓ Information efficiency
  - ✓ Convenient maintenance
  - ✓ Low update cost

04 Conclusion

- Carbon footprint and information deployment cost after the improvement of centralized host are only 35.47% and 9.86% of those before the improvement of distributed hosts, respectively
- The unification of OPC versions will improve the stability of information flow.
- The smart health diagnosis module of the information system will quickly detect and locate fault points, saving a lot of query time and manpower.

Thank You for Listening

들어주셔서 감사합니다