An Implementation of Smart Water in Taipei

臺北智慧水務推展與實踐

—智慧水表篇

Huang Chin-Ling | Executive Engineer
(黃欽稜 一級工程師)

2020.9.24

臺北自來水事業處
TAIPEI WATER DEPARTMENT

Outlines

- Why Smart Water ?

  Demands & Requirements of Taipei

- How & What To Do ?

  Proof of Concept & Pilots Before a Rollout

- Who Can Benefit From This ?

  Effects & Results

Ductile Iron Pipe with Valves

Smart water management (臺北的需求)

AMR

SCADA
GIS, MIS

Forecast
Optimization

Decision
Prediction

Water Supply	Household Management	Energy Conservation	Leakage Control
Quantity Quality	Bulk customers Metering error	Pumping eff. Electricity mgt.	Pressure mgt. Pipeline replacement

Transformation of Manual Reading (臺北的需求)

10 million readings for Billing per year, collected by 87 meter readers.

Labor intensive jobs that pay poor, some contractors & most young men quit.

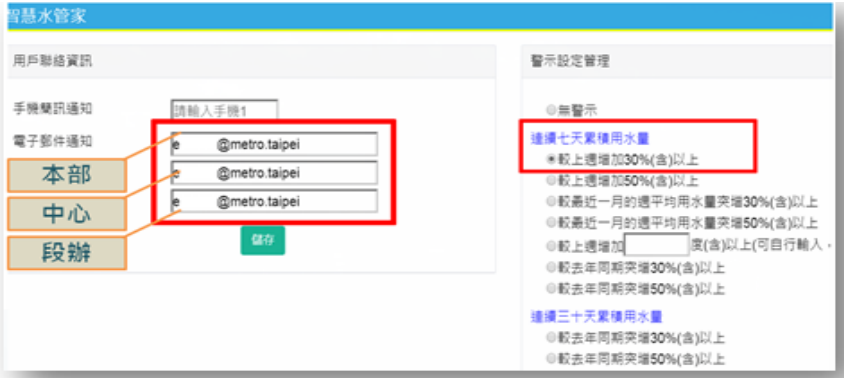
To enhance domestic service & mgt. (臺北的需求)

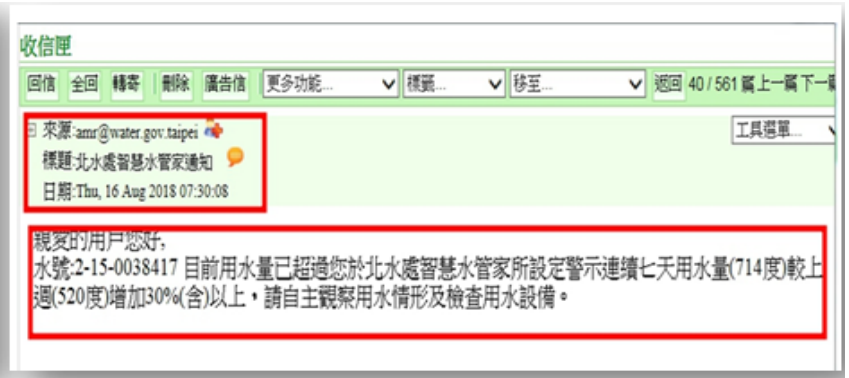
30,000 suspected cases of abnormal water consumption & billing per year, only 10,000 of them been confirmed as true.

→ Mechanical meters are not suitable for service & management jobs

On site "Print & Post" by handheld devices :

Notification of abnormalities by the Smart Metering system :





日期	估算用水量(度)
107/08/10	80
107/08/11	71
107/08/12	63
107/08/13	111
107/08/14	151
107/08/15	156
107/08/16	155
107/08/17	119
107/08/18	61
107/08/19	63

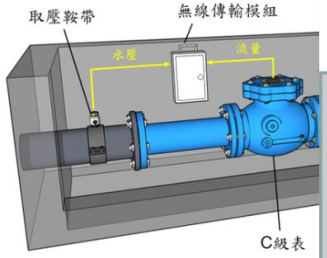
勘查發現為空調冷卻水塔故障

Smart Water in Taipei（臺北的智慧水務計畫）

Pilot projects during
2015～2018
(4,000 households)

Since 2019 a long term plan has been initiated (1.68 million households)

All newly constructed buildings will install AMR from 2020



回傳部分水壓值，增加水壓監視點密度

5處均由本處免費設置，未來13處自費

至107年累計完成1800只大戶表

Bulk Customers

至107年累計於5處公宅安裝2282戶

Public Housings

Applications

至107年完成應用分析加值軟體

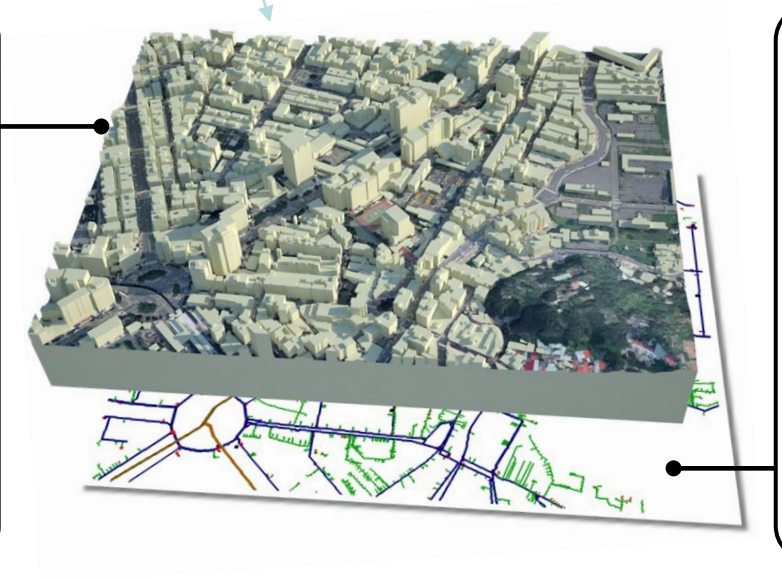
Households

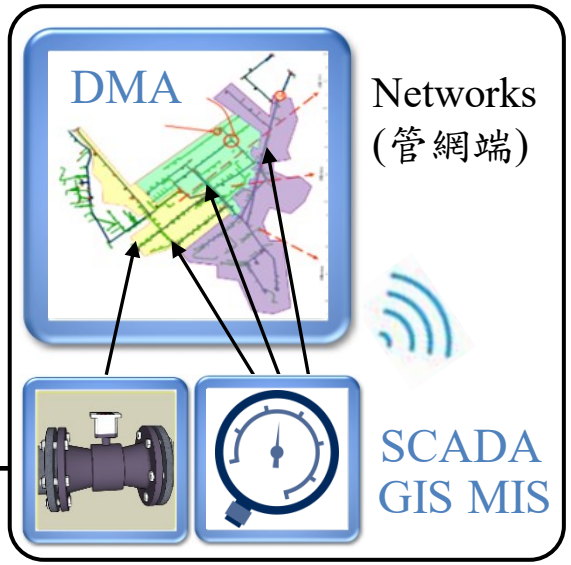
106年完成法令與收費標準修改

提升分處監管分析能力與用戶服務性

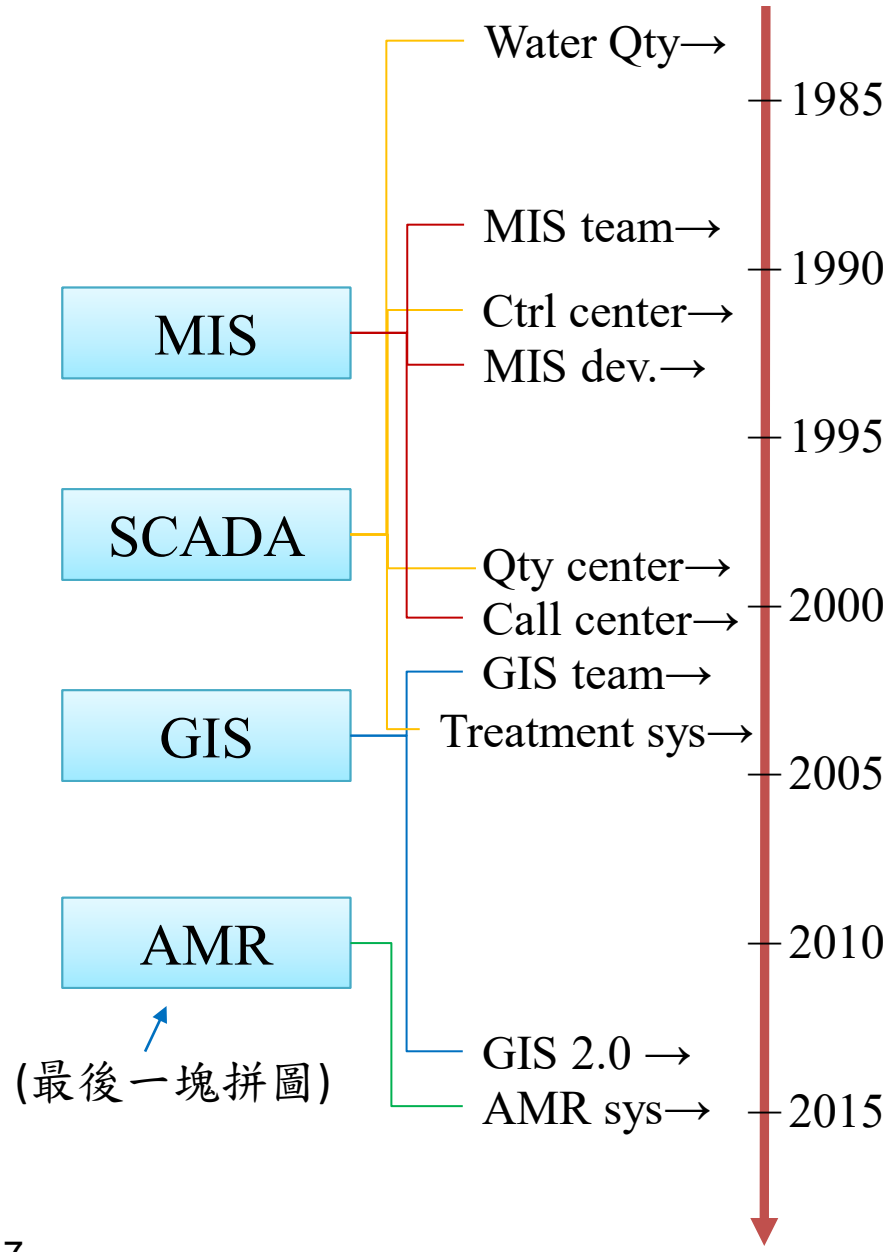
高樓層新建物分層設置AMR為強制性

Smart Metering + Smart Water Supply (北水規劃12年計畫「智慧計量」+「智慧供水」)





History of development (發展歷程)



System development : step by step

From 1982, a first water quality monitoring sys being set up, to present day the whole system is still evolving

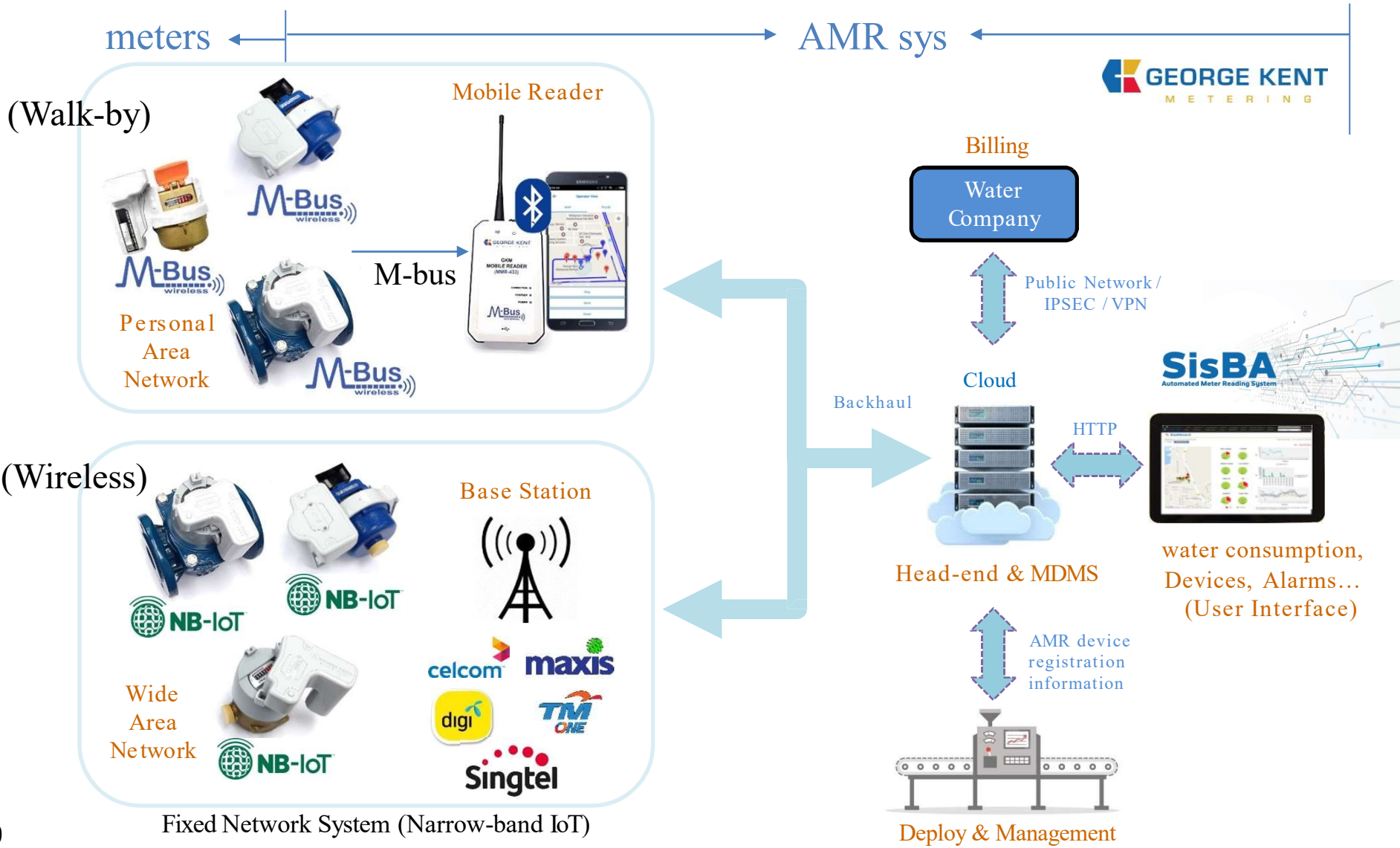
Outlines

- Why Smart Water ?
  - Demands & Requirements of Taipei
- How & What To Do ?
  - Proof of Concept & Pilots Before a Rollout
- Who Can Benefit From This ?
  - Effects & Results

Ductile Iron Pipe with Valves

What is AMR ? (自動讀表系統 Automatic Meter Reading)

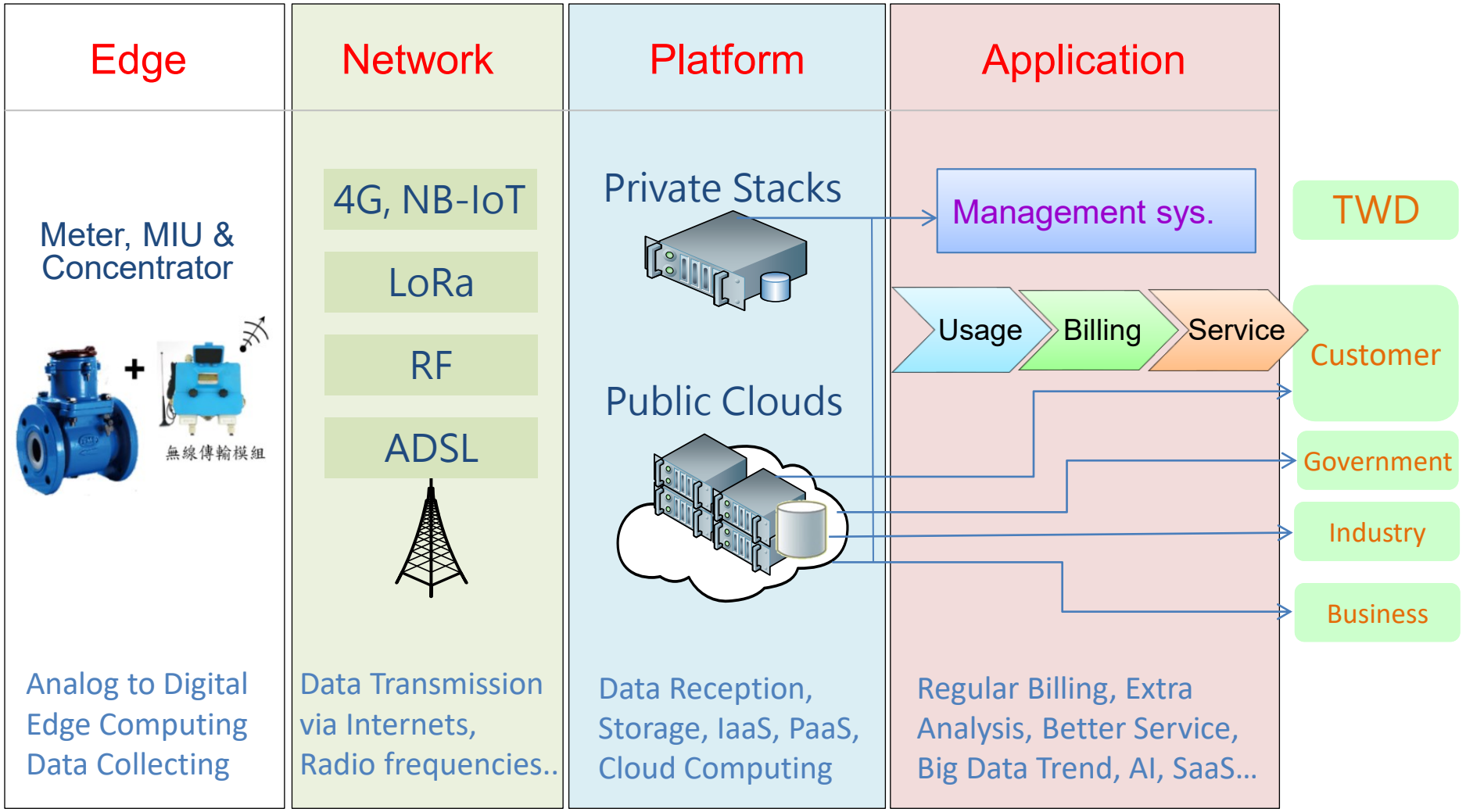
Smart meters generate lots data, therefore AMR sys is essential to collect, process & demonstrate data. Without AMR, smart meters will be useless as mechanical meters



Fixed Network System (Narrow-band IoT)

Integration of Services (一條龍的服務)

The chain of AMR system should be integrated into one package, otherwise, a broken chain will provide poor services



Assembling the Chain (政策說明會，宣告計畫)

3 seminars & forums announcing the AMR project & budget of Taipei to assemble the Chain, to form collaborative teams for Taiwan smart water industry

2019/1/29、4/26 TWD held seminars for AMR project with Department of Information Technology & TPMO

2018/12/26 “Forum of AMR supply chain” held in TWD

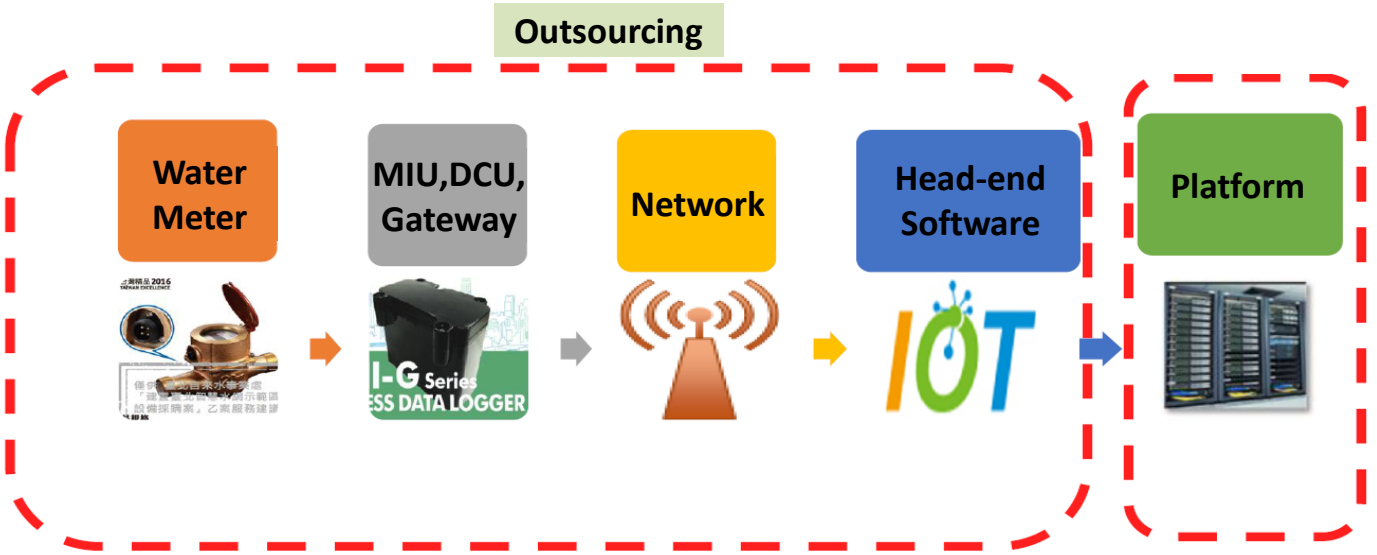
Integrated AMR sys (買服務的模式)

An integrated AMR system will provide seamless connection of each service, also help supply chain reduce cost of manufacture & maintenance

Tendering:

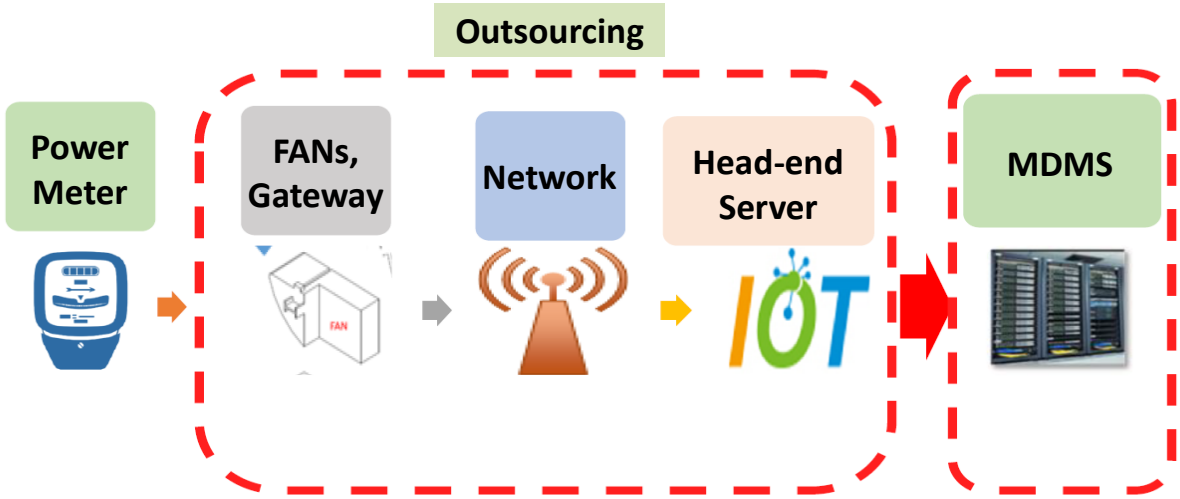
Taipei Water

AMR



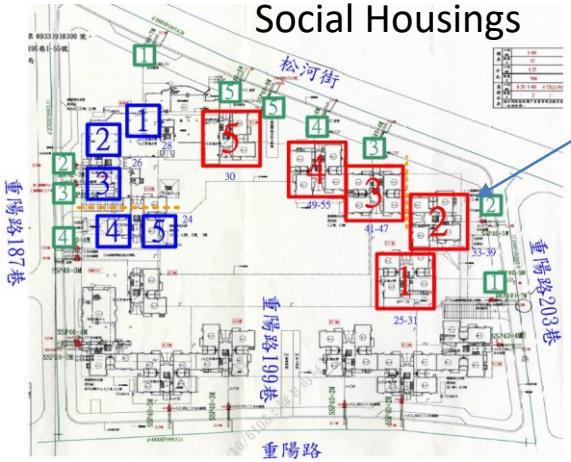
Taipower Co.

AMI



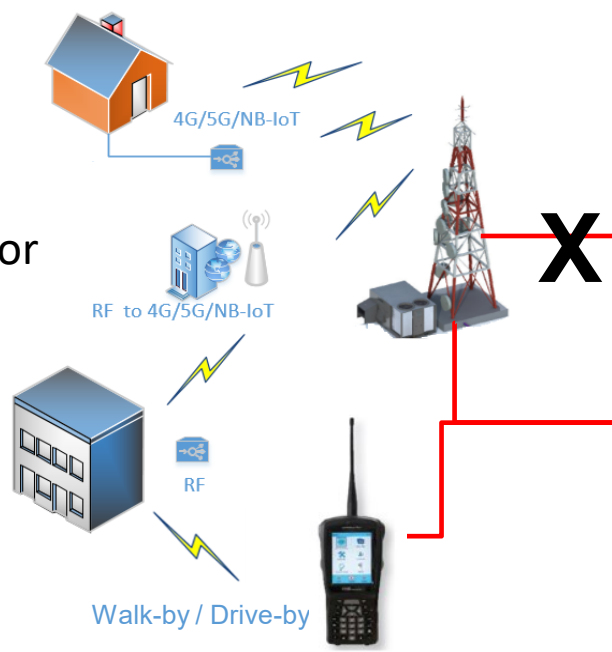
Proof of Concept (POC) (廠商組團測試)

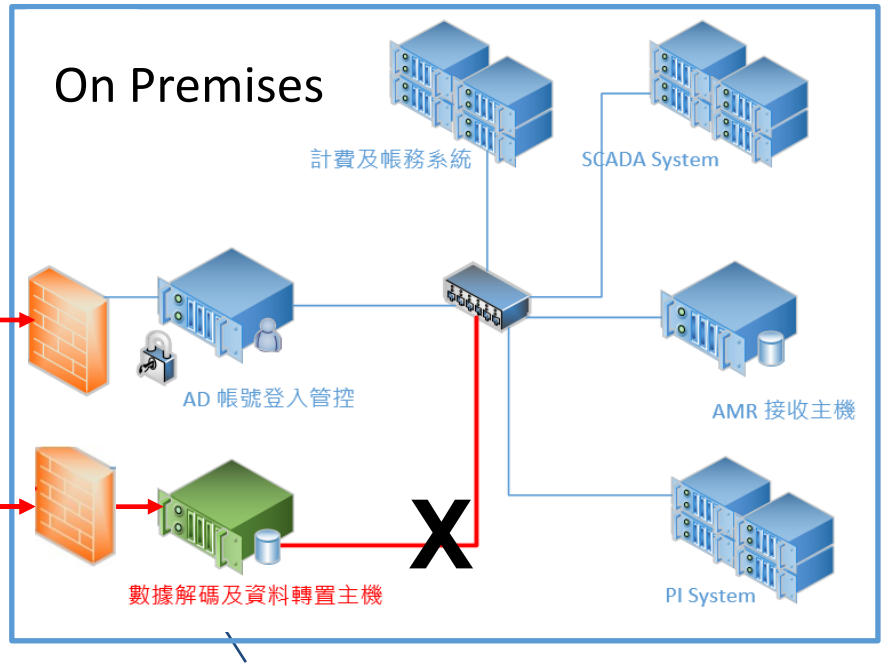
TWD initiated a POC project in 2019



On Sites

60 meters for each team





Head-end server receiving data for evaluation

POC Teams (組團概況)

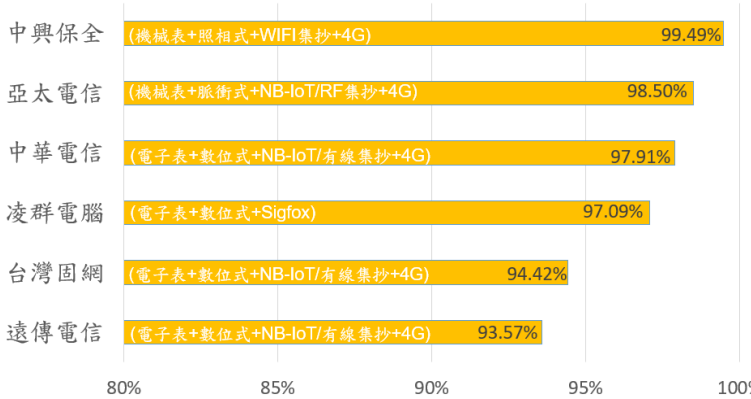
2 turns of POC involved 11 teams :

Team no.	Leader	Partners		1st	2nd
1.	中興保全 SECOM	源泰	ARBOR 磐儀科技 ARBOR Technology Corp.	✓	
2.	中華電信 Chunghwa Telecom	銓準	EMS 弓弦企業股份有限公司 ENERGY MANAGEMENT SYSTEM CO., LTD	✓	
3.	FAREASTONE 遠傳	銓準	EMS 弓弦企業股份有限公司 ENERGY MANAGEMENT SYSTEM CO., LTD	✓	
4.	台灣固網 TAIWAN FIXED NETWORK	銓準	EMS 弓弦企業股份有限公司 ENERGY MANAGEMENT SYSTEM CO., LTD	✓	
5.	亞太電信 Gt 智慧生活	宇泰豐	DELTA 台達	✓	
6.	凌羣電腦 THE SYSCOM GROUP	銓準	UnaBiz Global Hive of Living Things	✓	
7.	FAREASTONE 遠傳	宇泰豐	Freestyle technology connecting your world		✓
8.	亞太電信 Gt 智慧生活	宇泰豐	宇泰豐 YU TAI FENG TECHNO		Quit
9.	中華電信 Chunghwa Telecom	儀鎮	acer		✓
10.	華新儀錶	宇泰豐	Itron		✓
11.	斯其大科技 DAS Technology CO.,LTD	源泰	斯其大科技 DAS Technology CO.,LTD		✓

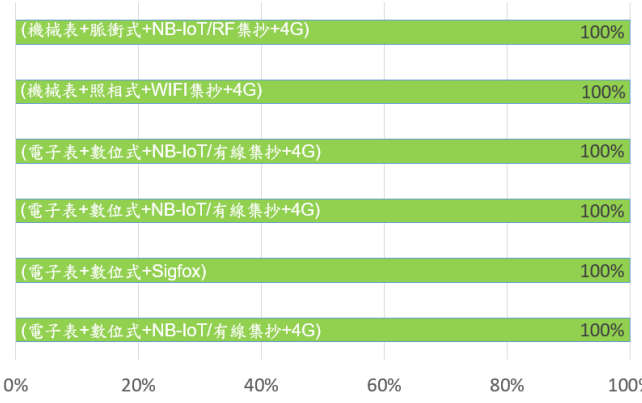
Outcomes of POC (試煉結果)

1st turn is better than 2nd one

Receiving Rate (%)：



Accuracy Rate (%)：



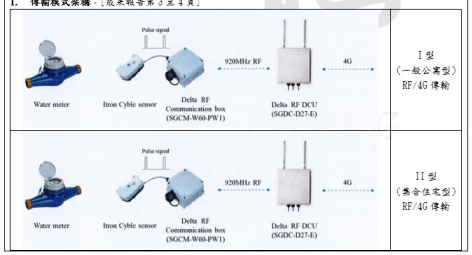
City Government： IT department & TPMO participated the evaluation

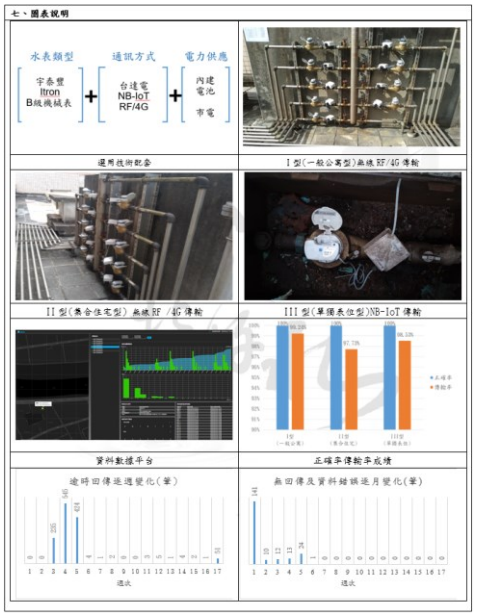
Evaluation Report：

- Receiving Rate
- Accuracy Rate
- AMR Structure
- Water Meter
- Transmission Device
- Head-end application
- Troubleshooting

技術試煉成果評分項目計分表(稿)

申請編號	108-01-008	評分日期：　年　月　日	
一、整合團隊代表	亞太電信股份有限公司		
二、整合團隊成員	宇泰塑料技實業股份有限公司(水表針)、台建電子股份有限公司(傳輸模組)		
母數/類型	I 型 (一般公寓)	II 型 (集合住宅)	III 型 (單獨表位)
水表數	每 6 栓 1 組，共 2 組	每 20 栓 1 組，共 2 組	每 1 栓 1 組，共 8 組
紀錄頻率	每日 1 筆	每日 1 筆	每 15 分鐘 1 筆
正確率分母	12 栓	40 栓	8 栓
傳輸率分母	1,440 筆	4,800 筆	92,160 筆
試煉數據	I 型 (一般公寓)	II 型 (集合住宅)	III 型 (單獨表位)
正確率分子	12 栓	40 栓	8 栓
傳輸率分子	1,429 筆	4,691 筆	90,801 筆
計分	I 型 (一般公寓)	II 型 (集合住宅)	III 型 (單獨表位)
三、正確率	100%	100%	100%
四、傳輸率	99.24%	97.73%	98.53%
五、計量數據蒐集回傳方式	■網路自動蒐集回傳　□收集器拙式回傳		





3 Phases to Rollout (分階段實施)

After POC being done, TWD issued a 3-phases plan for AMR rollout：

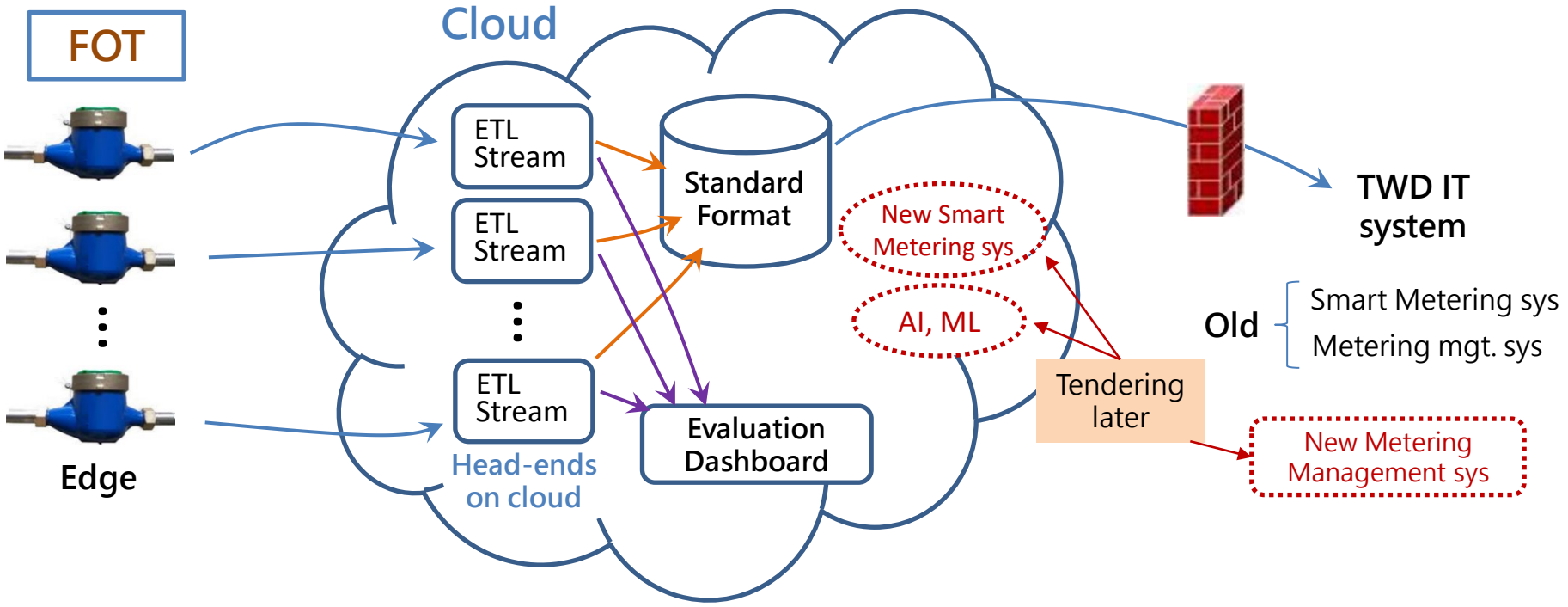
POC：While Service Chain of Taiwan is not yet ready, TWD provides simple & uniform sites for Proof of Concept (POC), to help Smart Water industries teaming & developing products.

FOT：After teams of Service Chain being assembled, TWD commences Field Operational Test (FOT) on complex & complicated sites with more meters, to seek the optimal service manners for each team, and for TWD as well.

COM：When the optimal services are established, TWD shall implement the Commercial Operations Management (COM) on a full-scale basis toward the goal of Smart Metering for 1.68 million households, with pace adjustments for new technologies & financial budgets.

FOT Evaluation (提升廠商與水處AMR效能)

During FOT, TWD invites each team & a third-party evaluator attending workshops regularly in order to improve performance for teams & TWD



The third-party evaluator monitors the data flow on cloud, from Edge through Network and to IaaS & PaaS, assessing the performance of devices on site & Head-ends on cloud installed by each team.

Newly Constructed Building (由公而私、由內而外)

應用實績

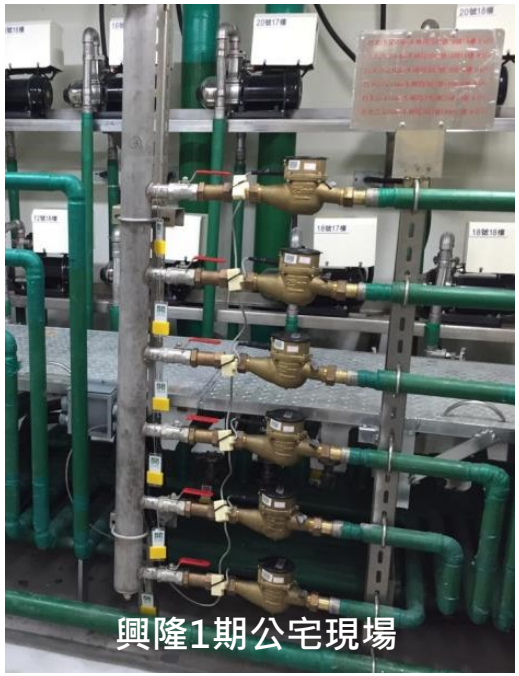

興隆2期公宅533只


興隆1期公宅275只


健康公宅524只


青年1期公宅280只


東明公宅718只


興隆1期公宅現場

A pilot project of transmission integration of Gas, Power & Water meters is undertaking

Social Housings

2,330 households


環南市場1,063只

Bulk Customers

2,811 meters

Public Markets

1,255 stalls


大龍市場192只

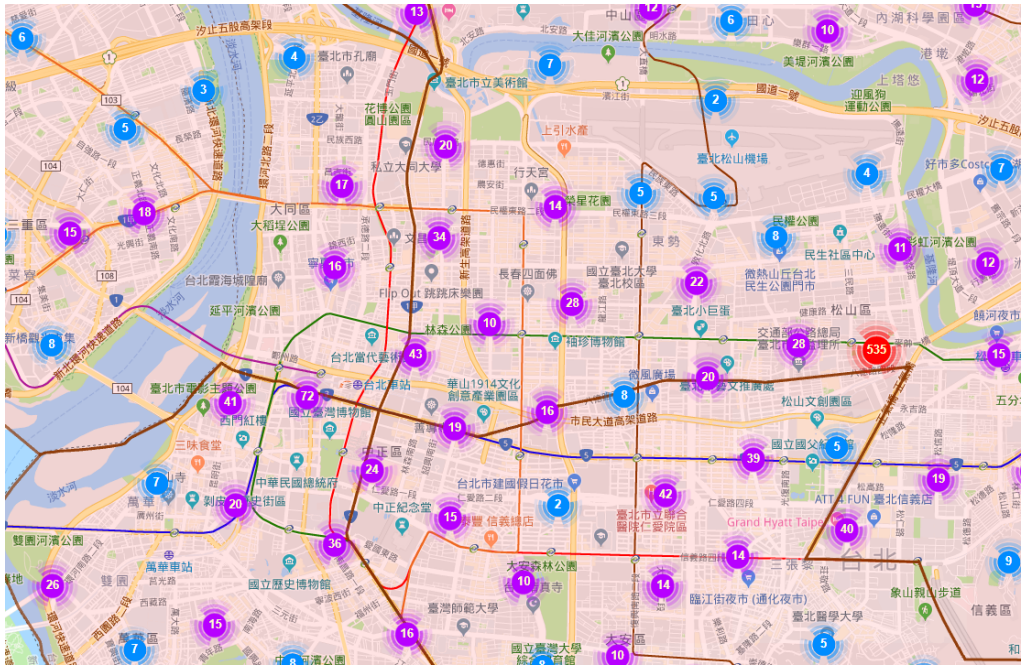
Since 2015 the first social housing piloted AMR, public buildings are introduced AMR, and all bulk customers install AMR free of charge. From 2020, all private newly constructed building in Taipei are equipped AMR with extra fee (1870 NT/per meter)

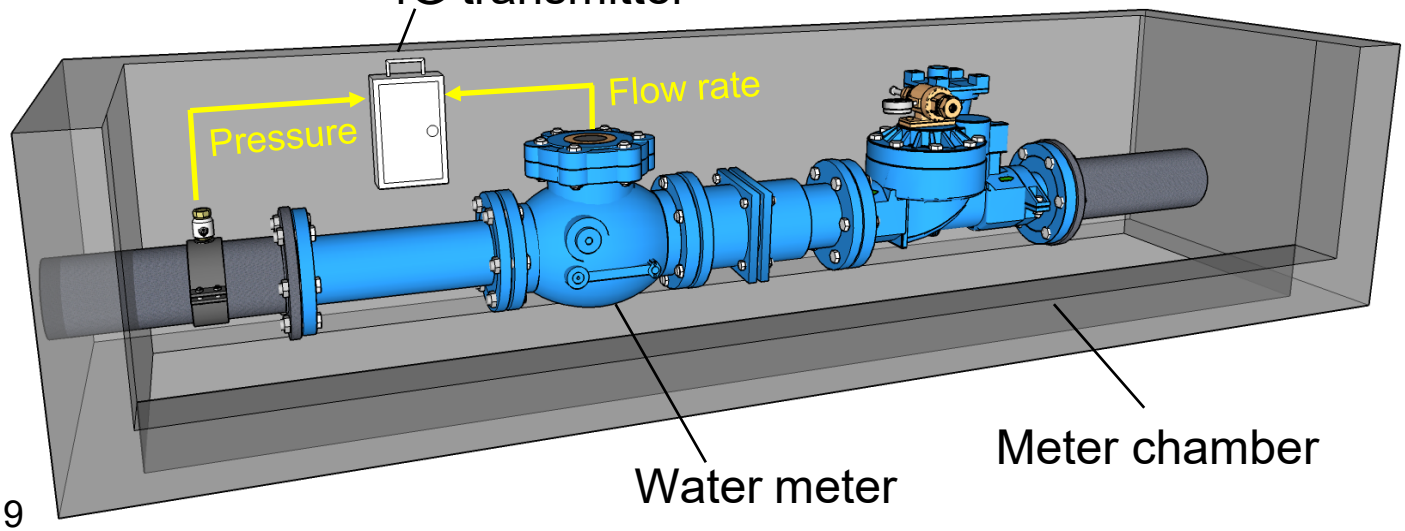
Big/bulk customers All 1800 biggest consumers are installed AMR

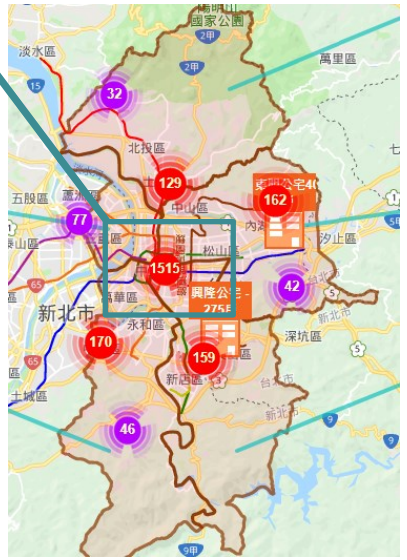
(1800超大戶佔165萬戶的0.11%，貢獻兩成水費，為管理的重點，因此免費安裝AMR)

Each one of them consume water over 1000 m^3 per month, some are even above 10000 m^3

In total 165 million customers, they contribute 20% of revenue. Constant monitoring are necessary.







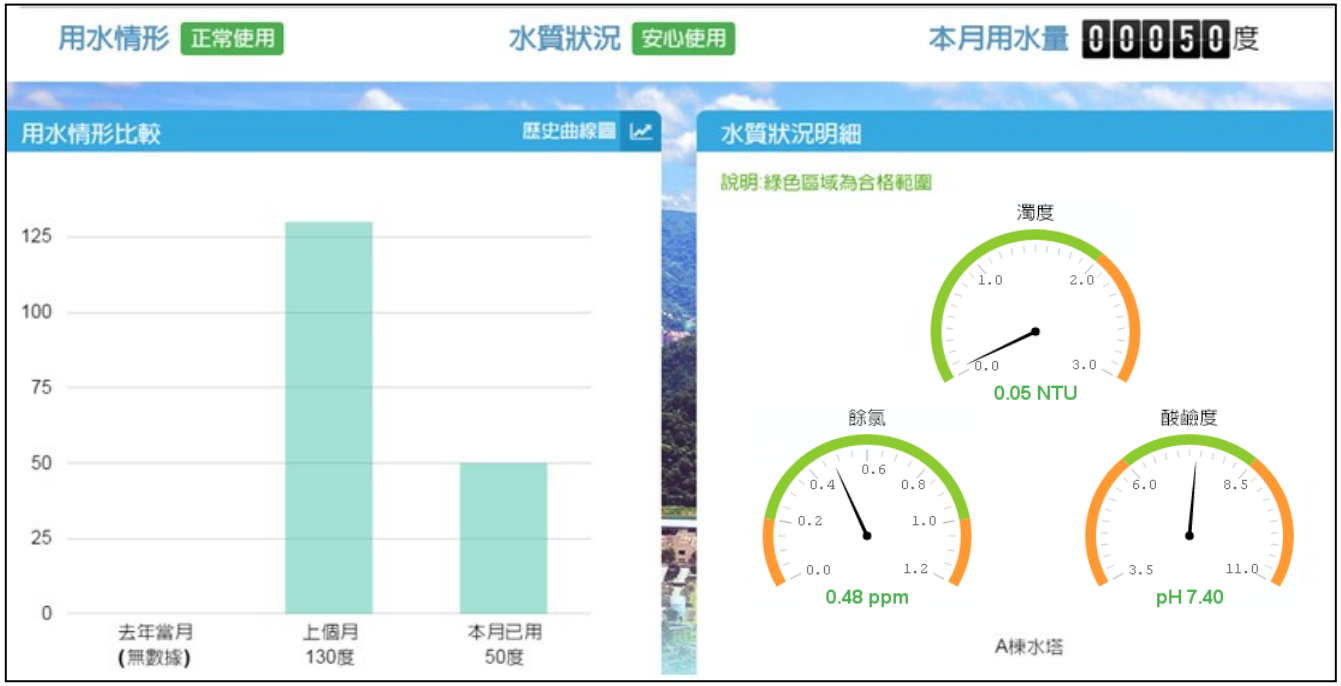
Smart Metering sys (智慧水管家)

Providing: household consumption, flowrate, water qualities

(用戶透過手機APP、電腦Web都可檢視用水狀況、水質情況，更能協助民眾節約用水)

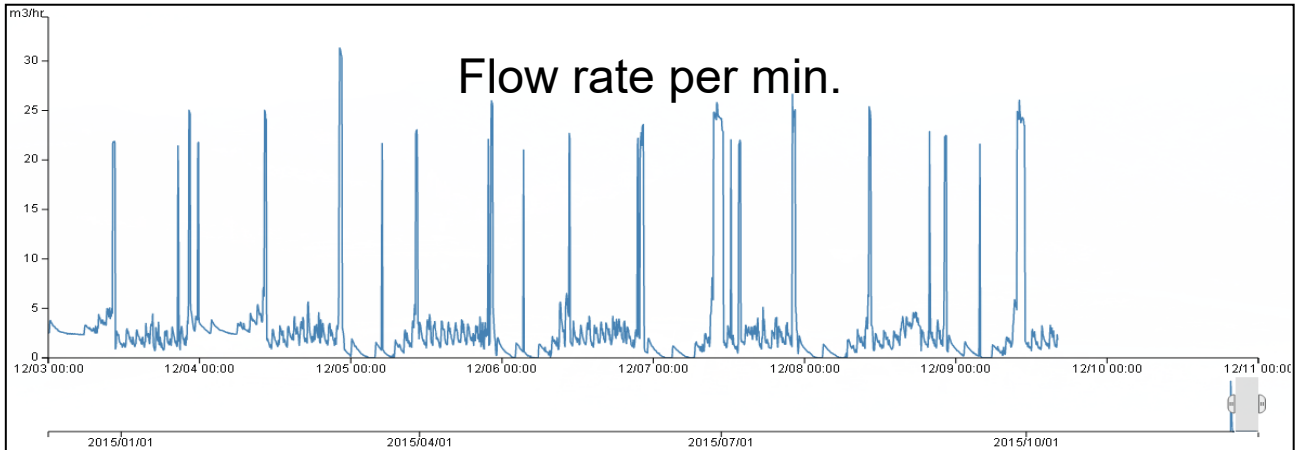
APP & Web

Helping customers conserving water, detecting leakage, & saving money



Accumulated consumption

Turbidity, Chlorine, pH



Leaks detection (查漏)

AMR detected a huge premise plumbing leak

應用實績

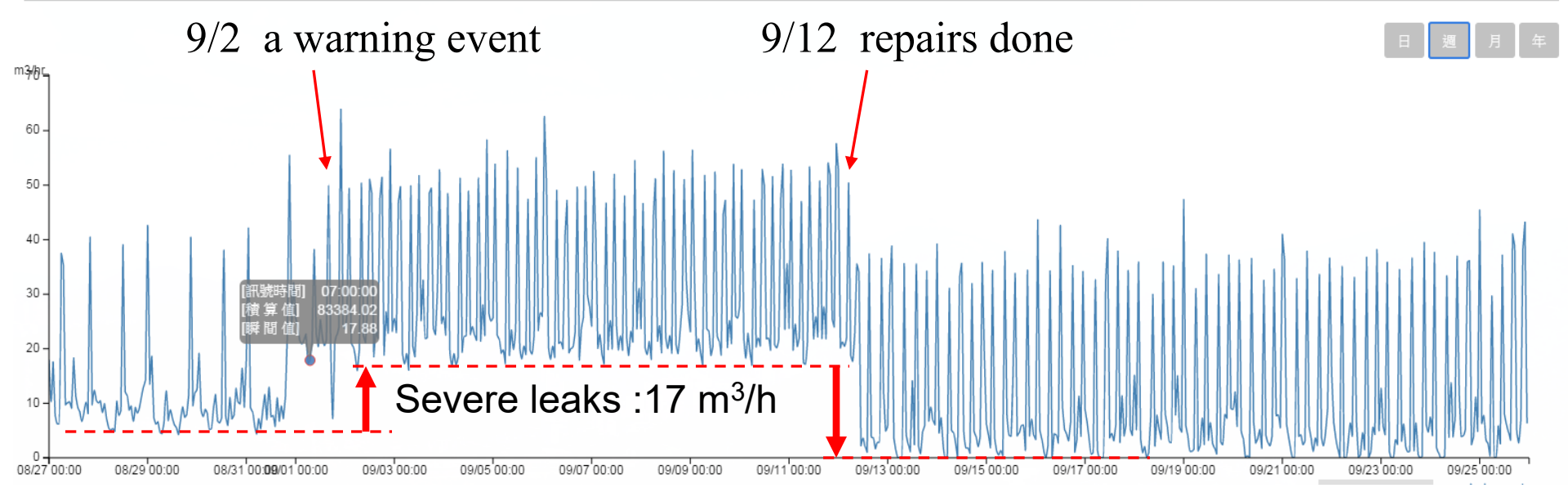
(AMR以夜間最小流察覺漏水並通知修復，過去需等2個月抄表才會發現，大用戶節約用水效果最好)

Minimum Nighttime flow identification:

With AMR: Leaking volumes about 4,000 m^3 (10 days)

Without AMR: Leaking volumes could be 250,000 m^3 (60 days)

大用戶表：
F-03-0319***



Small leaks: 4 m^3/h

No leak

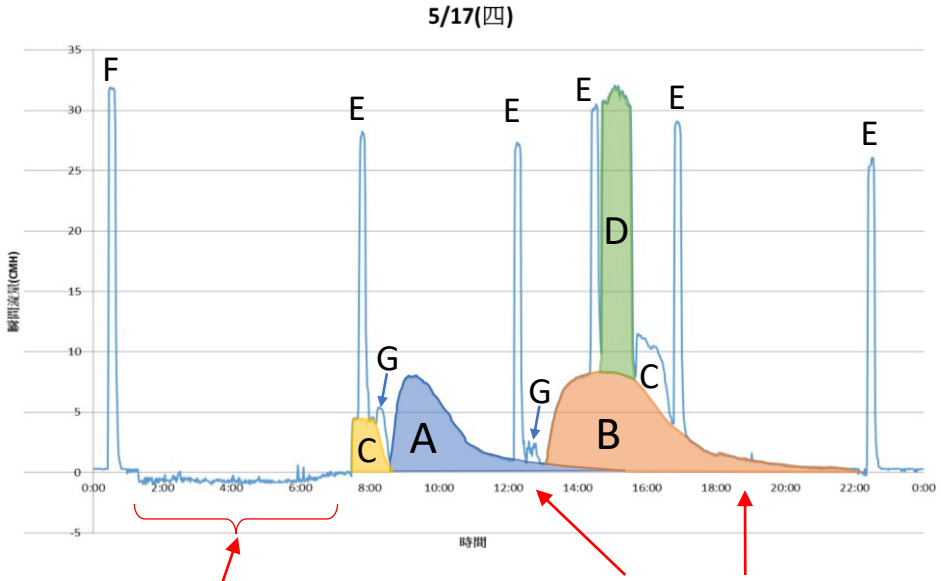
AMR sys can automatic identify the leak and sending warning message to users

(AMR系統能自動偵測漏水，並自動發送訊息告知用戶及水公司)

Diagnosis of plumbing sys.

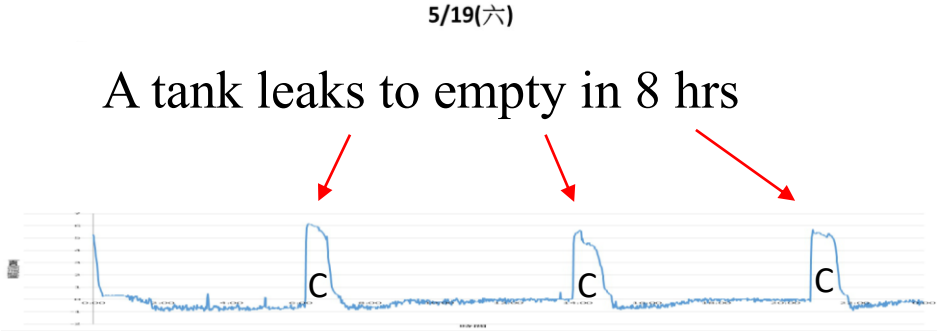
(內線異常辨識)

Identifying domestic sys problems

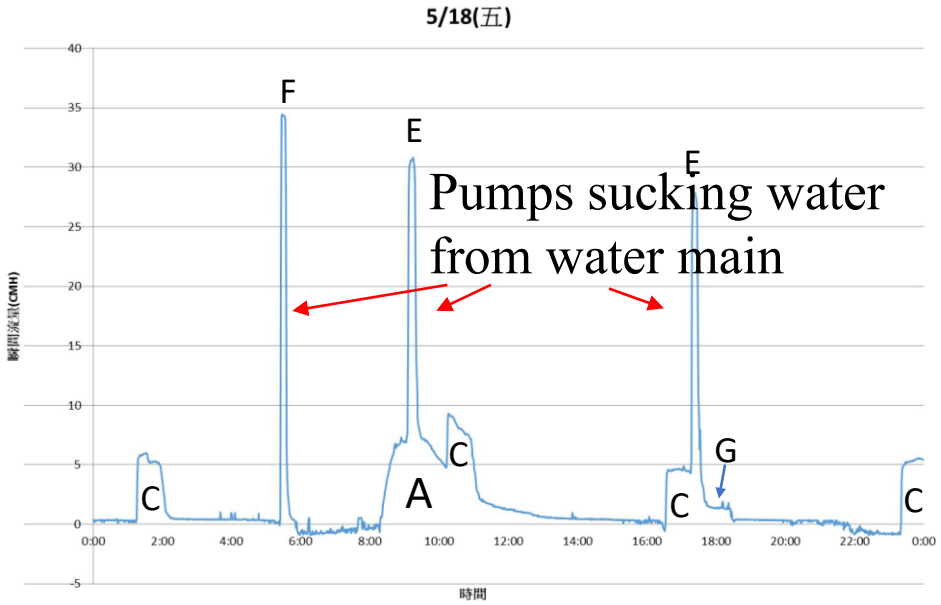


Reversed flow

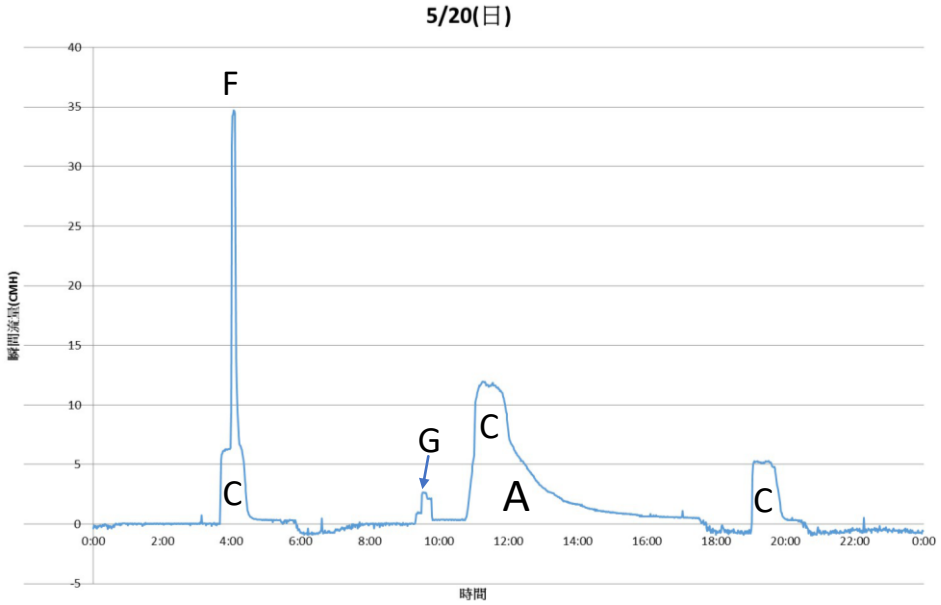
Float valve cannot fully close



A tank leaks to empty in 8 hrs



Pumps sucking water from water main



Study of LPCD

(家庭用水與疫情)

Social housing
AMR analysis

February

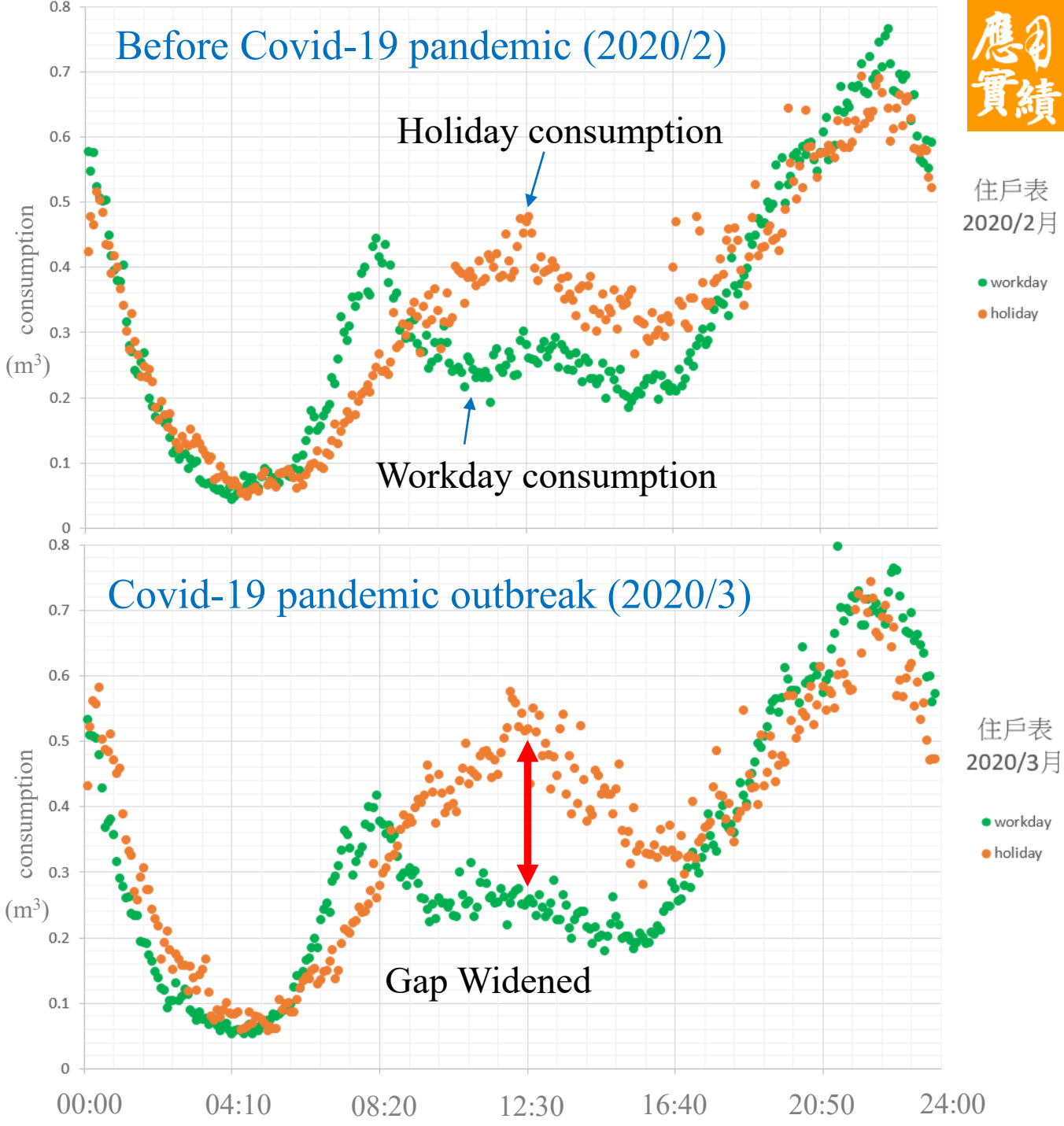
LPCD = 156.7 liters

↓

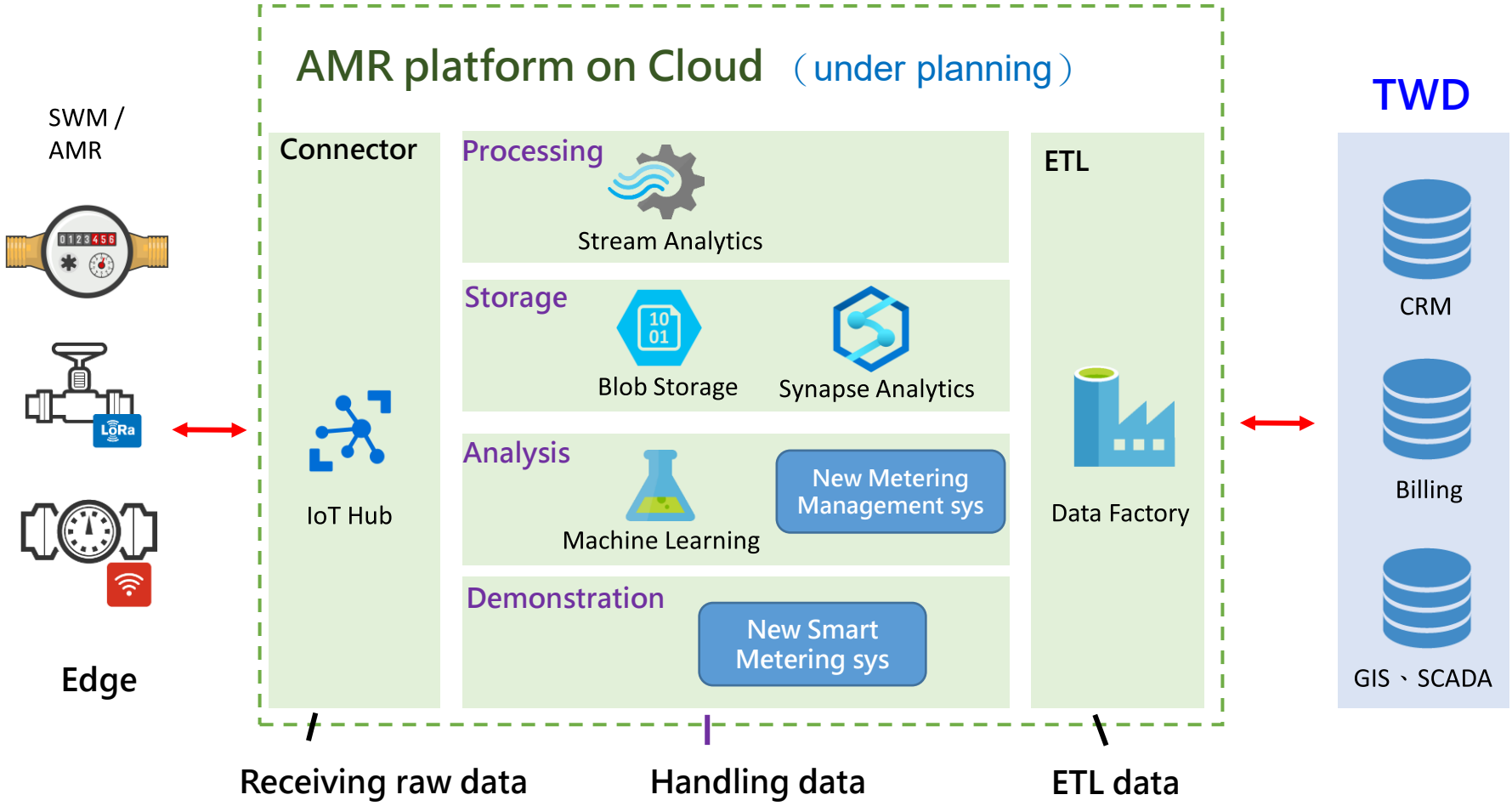
March

LPCD = 160.1 liters

Residents Stay home on holidays, use more water & consumption patterns changed significantly



Platform （雲平台） A platform with the function of Head-ends & MDMS on cloud




IoT接收中樞


數據串流分析


數據儲存體


資料倉儲


數據轉換


機器學習

Outlines

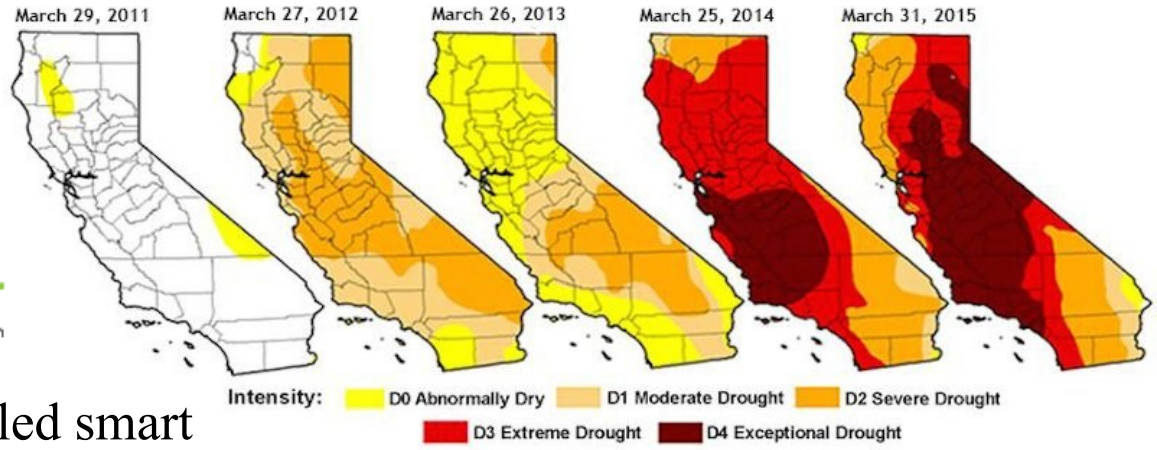
- Why Smart Water ?
  - Demands & Requirements of Taipei
- How & What To Do ?
  - Proof of Concept & Pilots Before a Rollout
- Who Can Benefit From This ?
  - Effects & Results

Ductile Iron Pipe with Valves

Against Drought (加州乾旱的啟示) A consecutive drought since 2012

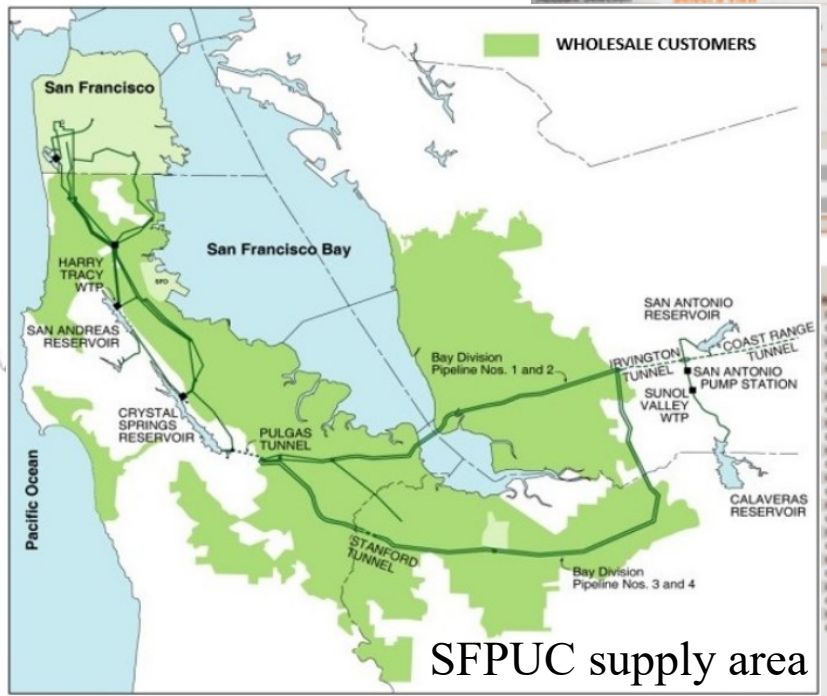
A successful story of smart metering

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

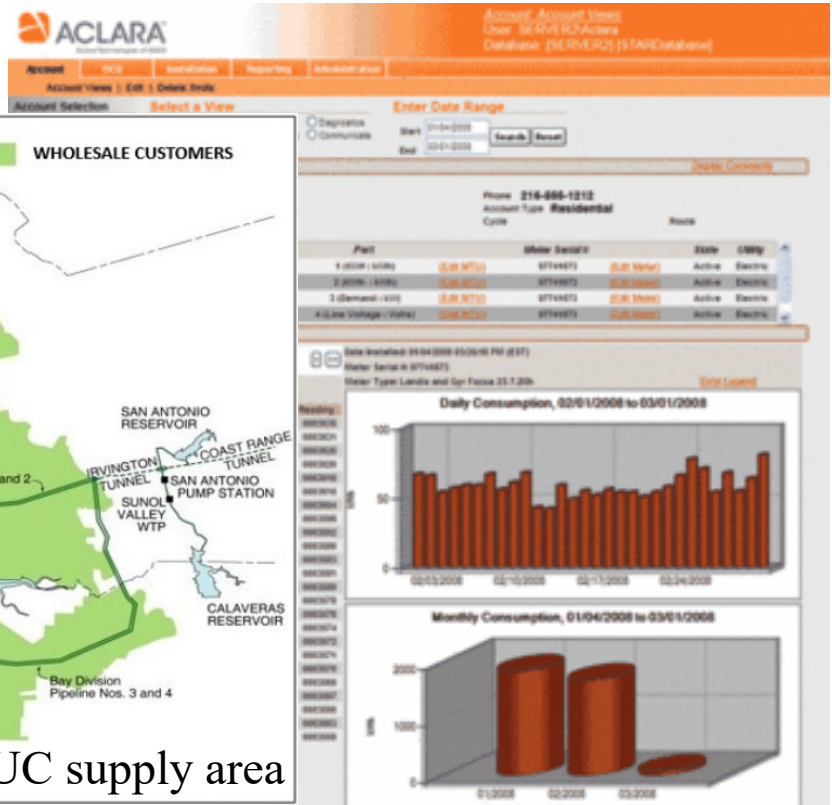


San Francisco（SFPUC）installed smart meters & AMI more than 96% by 2015, providing “Aclara” for all the customers.

Saving 8% of water in compare with summer of 2014 owing to the awareness of water conservation & AMI



SFPUC supply area

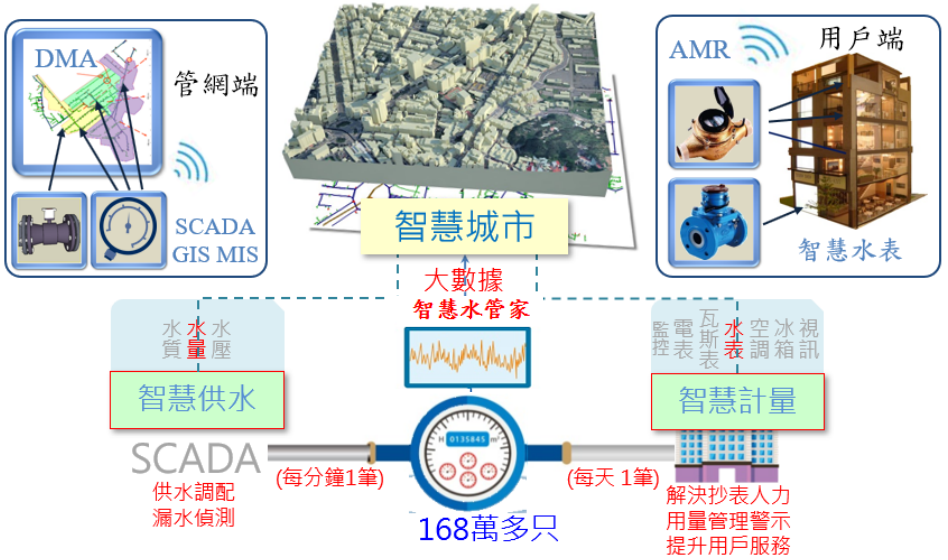


Values of Smart Water (臺北推動智慧水務的效益)

成效

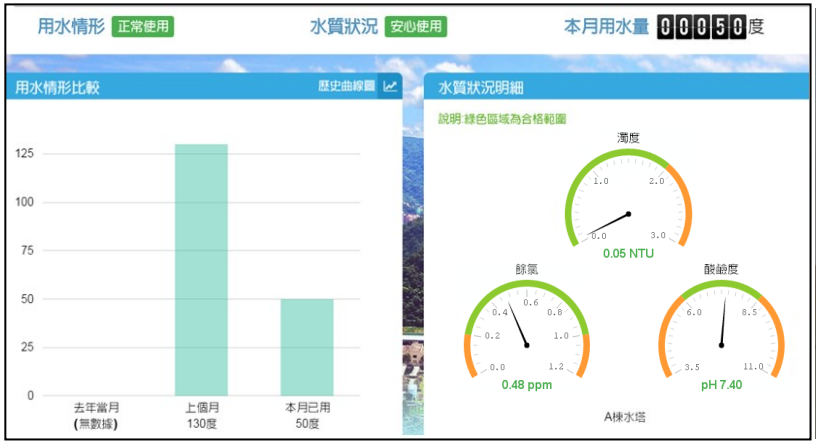
For Water Company

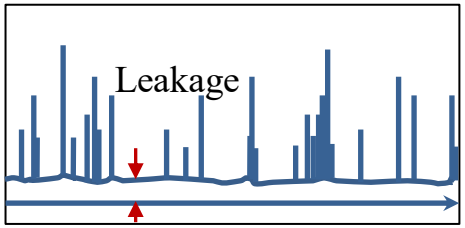
Saving human resource for meter reading, more accurate metering. Smart management for reducing energy consumption, elimination of leakage



For Private Sector

Being aware of water consumption change, alarming abnormal events, finding internal plumbing leakage & malfunctions. Saving money for water consumers





Leakage identification, prevent household plumbing water loss

For Government

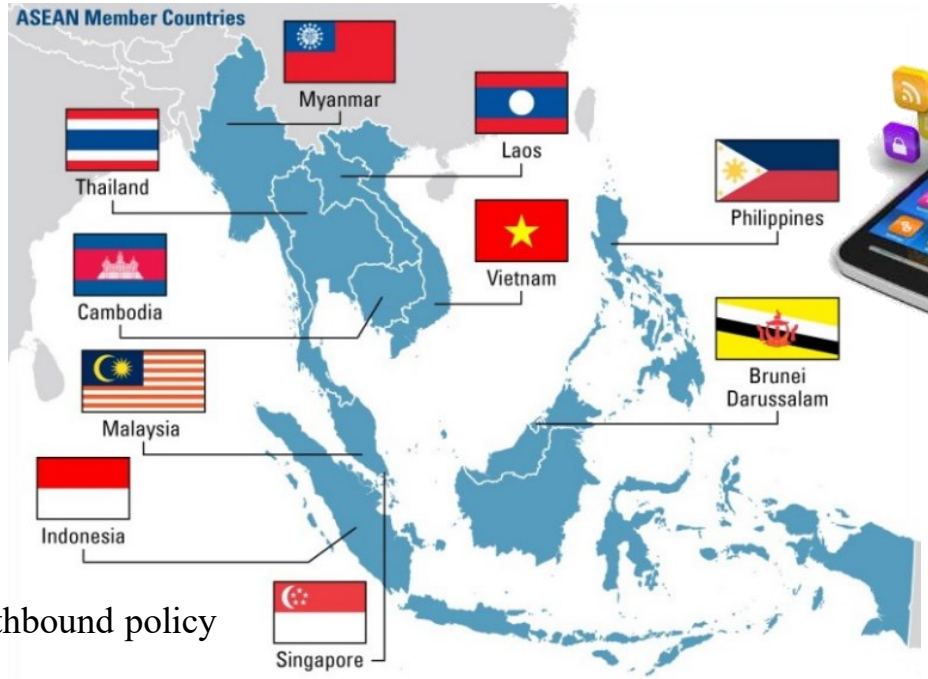
Overseeing holistic water resource usage, regional energy consumption, for policy formulation & implementation.

San Francisco saving water by smart meters

consumption monitoring

For Industry

Fostering Taiwanese IoT, ICT & Metering market by raising our demands for industry. Providing Pilot field for local product development.



New Southbound policy

Collaboration with industry

Thank you

臺北自來水事業處
TAIPEI WATER DEPARTMENT