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智慧電網標準及應用研討會

TCA

IEC 61850 XMPP 於國外綠能之應用

劉俊宏

Elipse Software Taiwan

elipse
software

大綱

前言

認知落差與挑戰

能源行業應用標準

解決方案

國外案例介紹

未來擴充

前言

再生能源特性

- 受天氣影響 – 間歇性
- 對電網穩定性產生衝擊
- 大潭電廠 815 大停電 (12%)

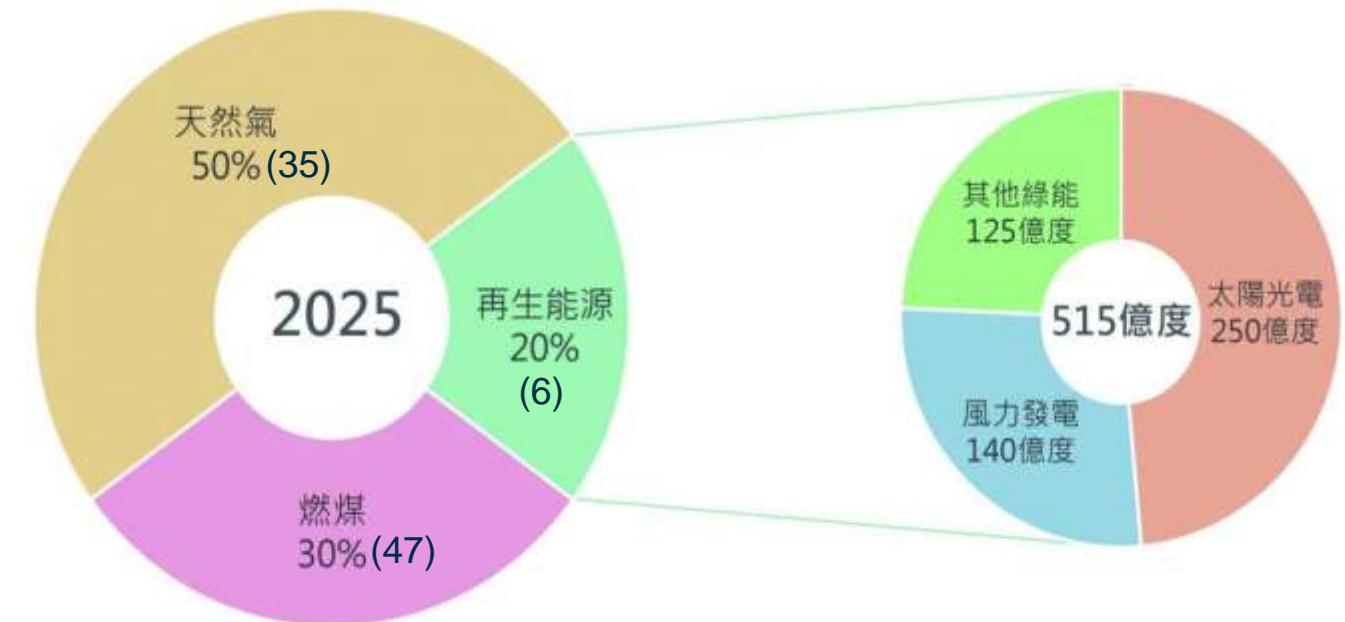
2025年再生能源占比目標20%

- PV 20GW
- 1.76萬座PV電站1.9GW (2018)
- 資訊傳回台電<100 PV電站(2018)
- 再生能源整合

能源物聯網

- 電力系統 + 工業務聯網

2025再生能源目標發電量



認知落差與挑戰

再生能源整合不只是資料收集

- IEC 62056 DLMS / COSEM / OpenADR / IEC 60870-5-104 / DNP 3.0
- IEC 61850-8-1 / IEC 61850-8-2 / GOOSE / IEC 61870 (CIM)

多樣性協議

- 通訊閘道器
- 資料模型

管理系統

- MDMS
- EMS
- DREAMS (DERMS)
- SCADA – CONTROL CENTER

分散式再生能源資訊整合面臨的挑戰

建置案場分散，佈建量大，系統管理困難

設備廠牌不一，供應商不一，建置方式沒有標準化

- 大多採用OPC / Modbus等非能源專用協議
 - Modbus 點表 – 非系統建模概念
 - DNP3 – IEC 61850–80-2 但還是基於MMS架構
- 建置廠商對電力通訊標準陌生
- 沒有依照標準建模方式，整合困難

控制中心資通架構以傳統方式建構

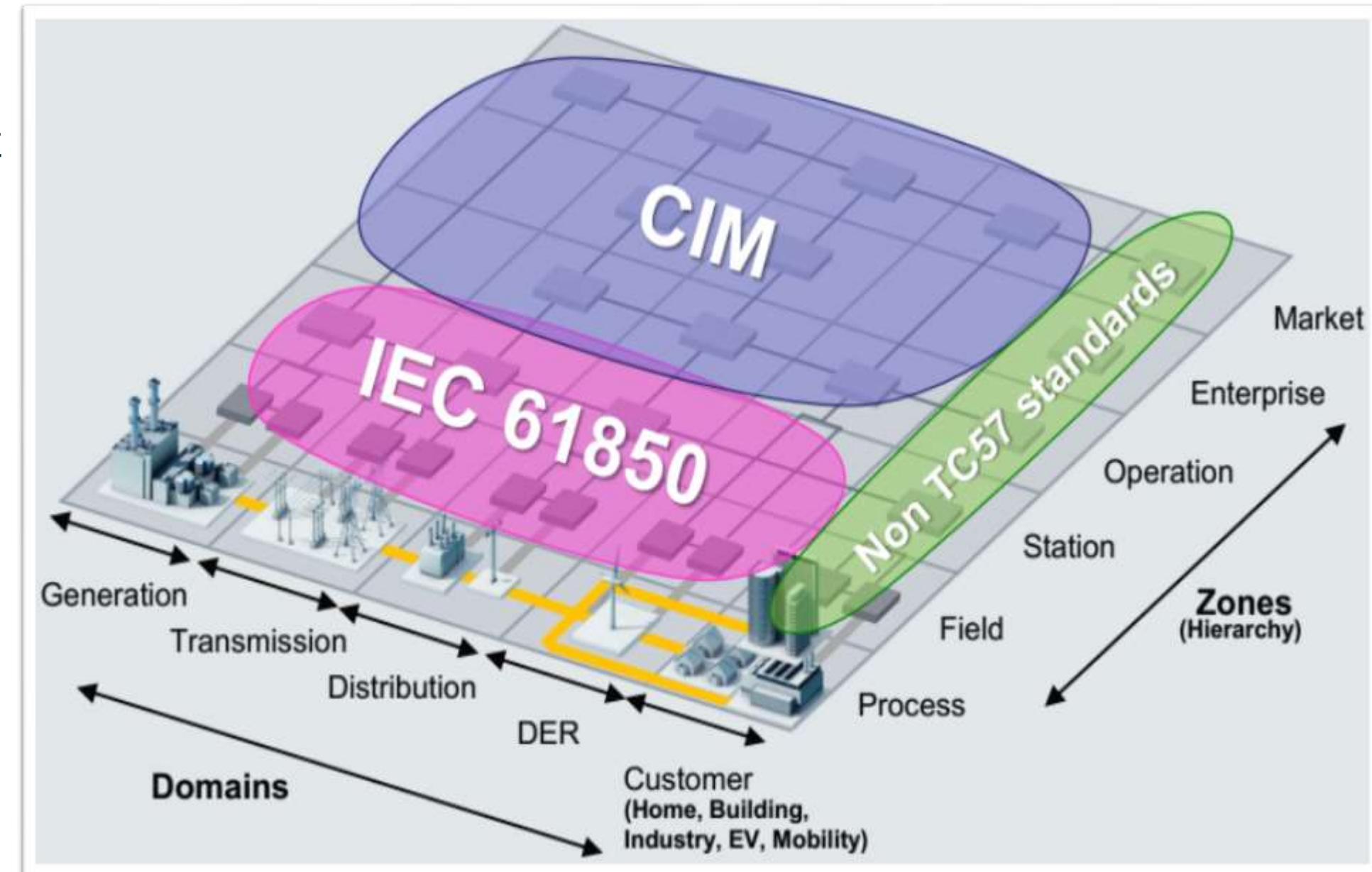
資料互通性不足，導致整合困難

跨網域，跨網路整合，資料安全性考量及認證困難

能源行業應用標準

IEC 62357

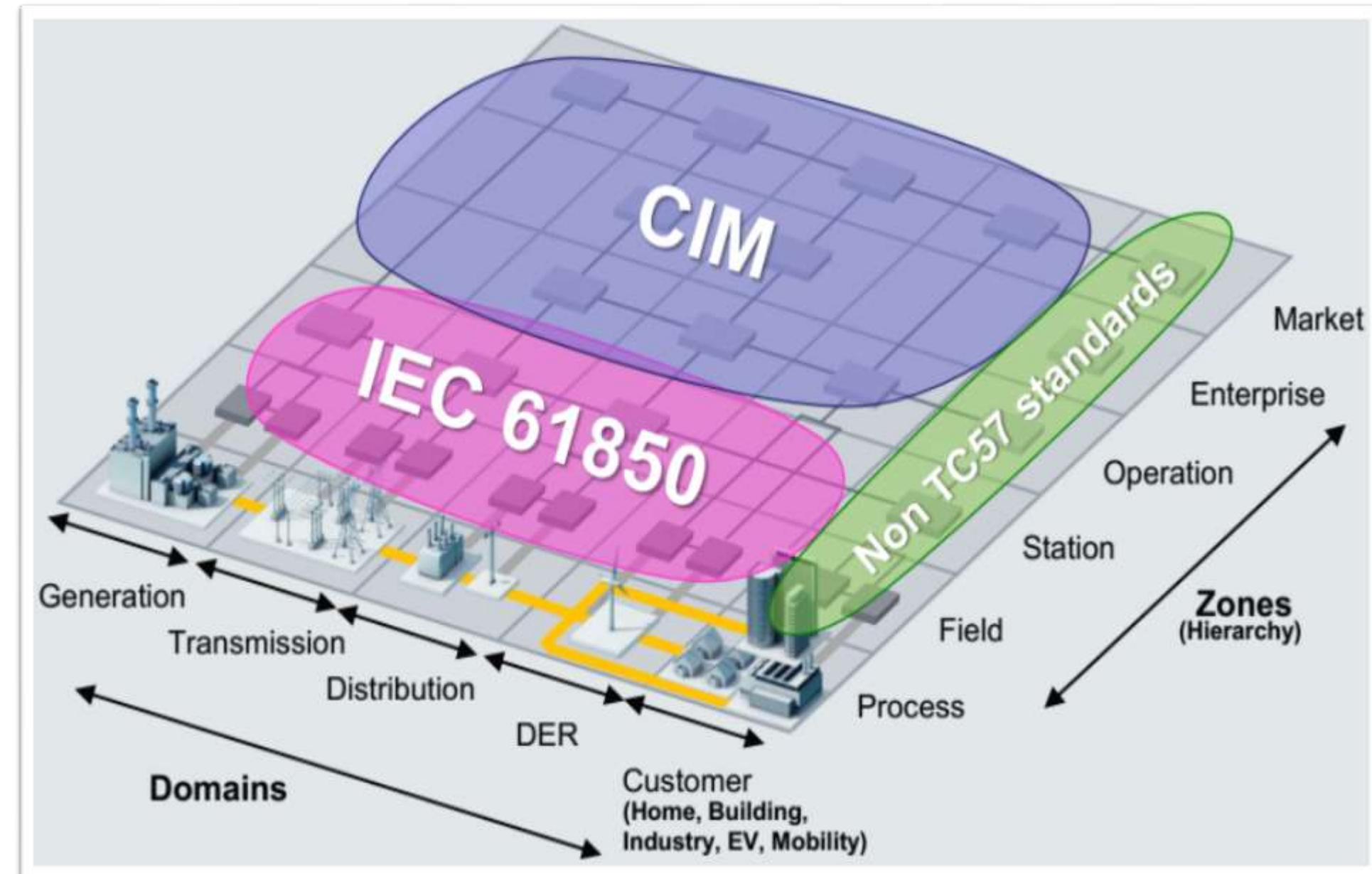
- 智慧電網互通性架構



能源行業應用標準

IEC 62357

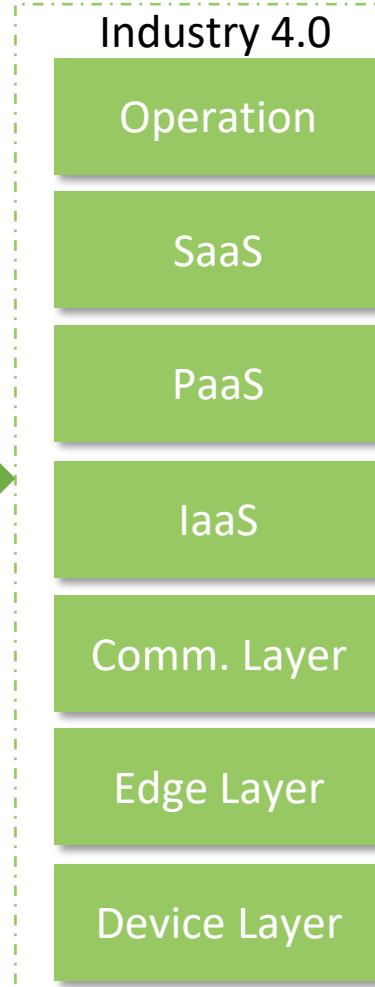
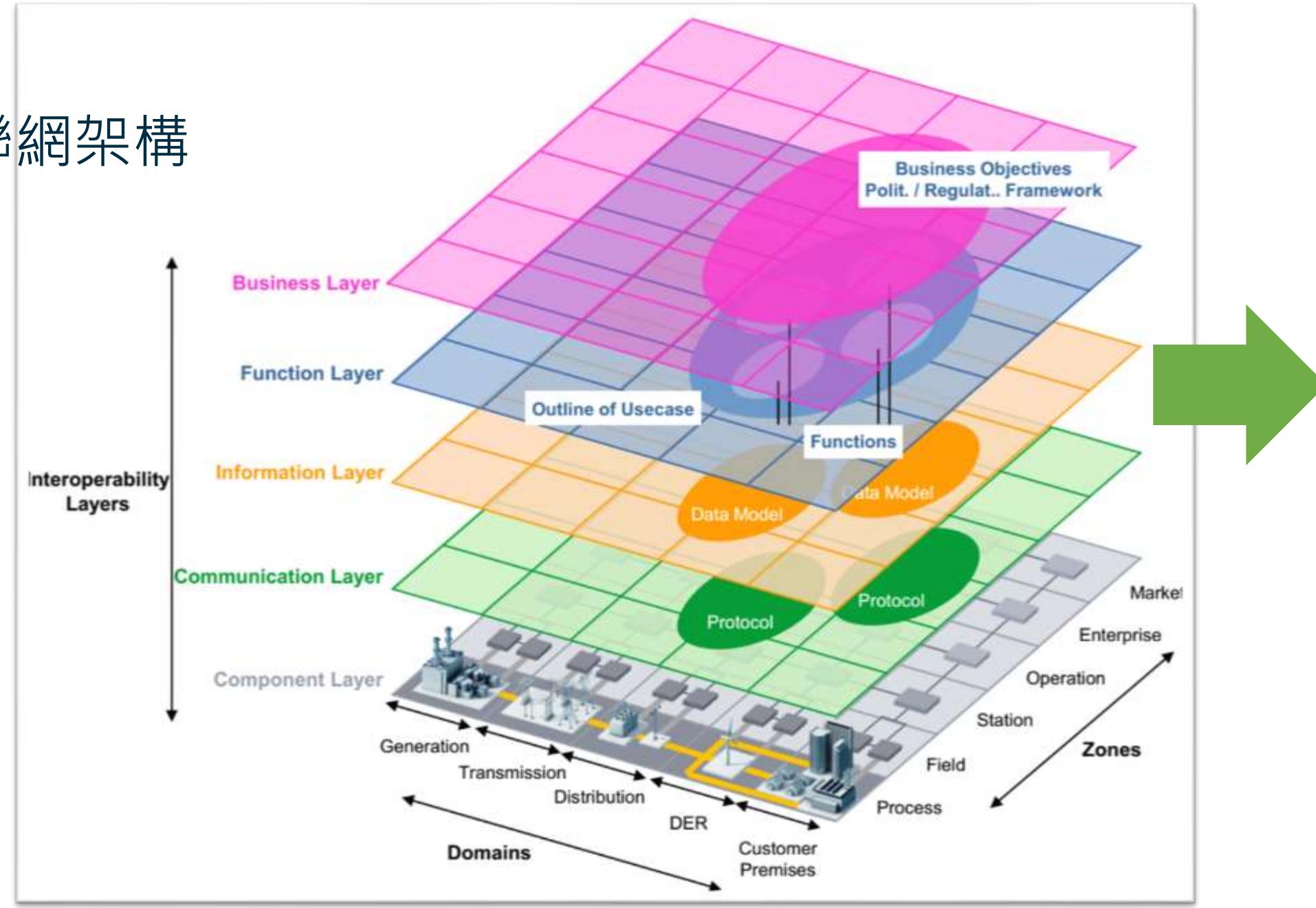
- 智慧電網互通性架構



能源行業應用標準

IEC 62357

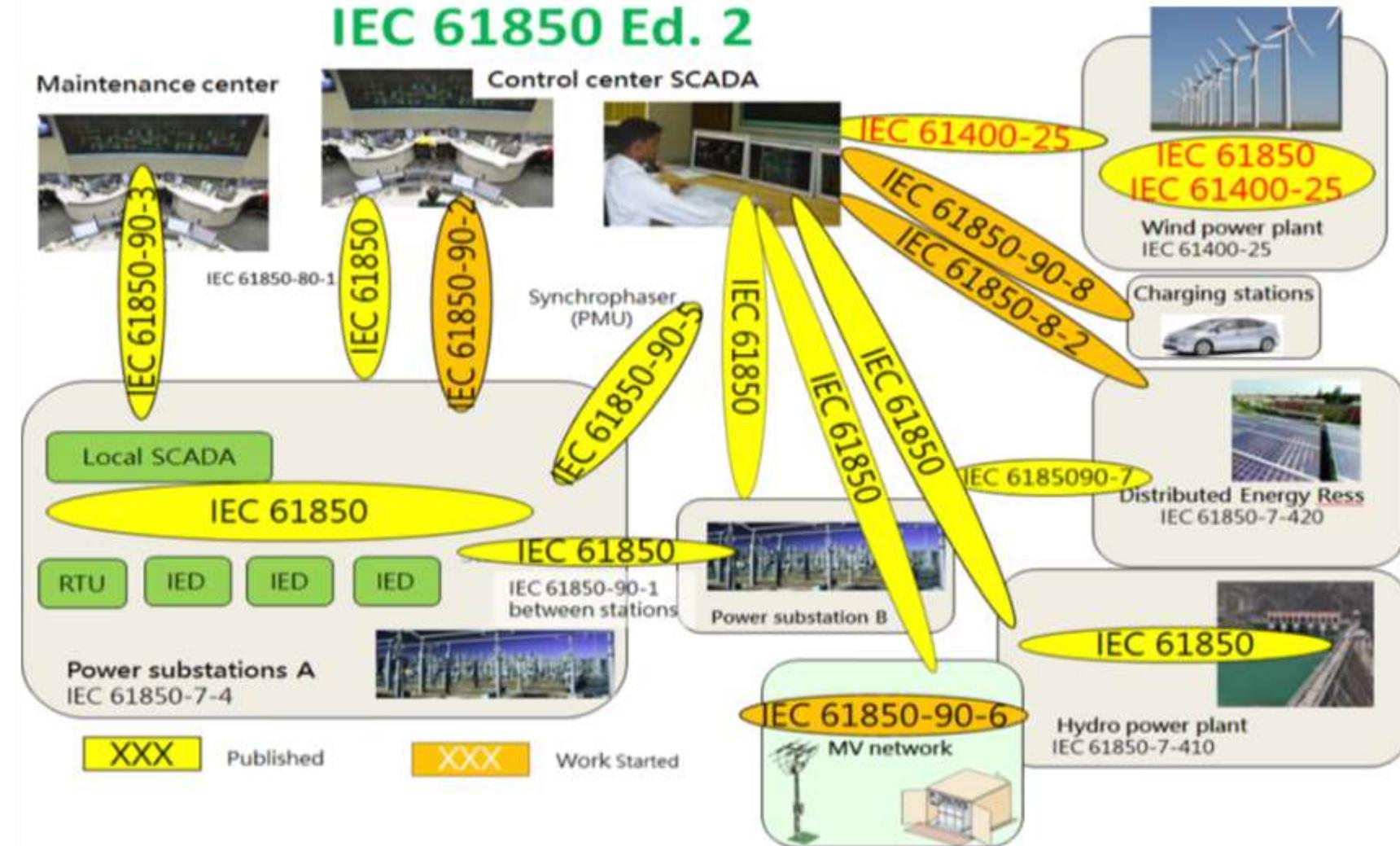
- 對應到物聯網架構



能源行業應用標準

IEC 61850

- 智慧電網(能源)標準



本研究案建置解決方案(初期導入階段)

依IEC 62357 智慧電網通訊標準架構(Smart Grid Architecture Model)

依照IEC 61850-7-420 建立標準再生能源模型 – 標準化

參考IEC 61850-80-2 (IEC 61850 – DNP3 映射規則)建構通訊轉換

參考IEC 61970-301 CIM 建立PV 站模型 – 標準化

開發IEC 61850-8-2 XMPP 通訊協議建構於雲端平台

- 用戶授權認證管理 (SASL)
- 資料加密(TSL)

採用工業物聯網參考架構(IIRA)，導入雲端管理平台: DM / DA

嵌入TR-069電信標準架構，達到遠端設備維護管理功能

提供PV站之通訊協定轉換器: 標準化，建模與隨插即用功能

提供標準RESTFul API供其他服務存取CIM 模型資訊

期刊論文

Information at the 2011 IEEE Transient Protection
2013 International Conference on Electrical
Design and Implementation of Energy Resources Informa

tion

Systems, Oct. 26-29, 2013, Busan, Korea

Received at the 2011 IEEE Transient Protection
2013 International Conference on Electrical

Design and Implementation of Energy Resources Informa

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IEC 61850 and Energy Management Considering Edge Computing

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Abstract—To improve the extensibility and reuse DER information exchange based on IEC 61850, a new communication method is proposed. DER information exchange method based on XMPP is presented. XMPP-based edge computing techniques proposed verify that the design of DER system integration is feasible, and can be used to realize large-scale distributed systems. The proposed technique is able to realize various functions and protocols in rapid integration and flexible organization and management. It is also able to realize standardization of communication, which is an important issue in large hydropower plant automation. Large hydropower plant communication infrastructure for SCADA system will be accomplished.

Index Terms—IEC 61850, edge computing, distributed system, hybrid energy system, smart grid, renewable energy, system integration, system methodology.

Integration of energy mix of power generation will be accomplished by using distributed system methodology.

The integration of distributed system methodology for hybrid energy system will be accomplished by using distributed system methodology.

XMPP-based Network Management for agile IoT applications configuration

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Marc Jentsch²

¹Istituto Superiore M
²Federal University of T
³Fraunhofer FIT, Schloss
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ABSTRACT Electric vehicle transfer capabilities in scheduling can be utilized to enable a number of platform services.

Although a lot of different levels of deployment and simple configuration have been proposed, the design of communication platform needs to provide the descriptions of the So

fware and the commissioning infrastructure of the system.

Furthermore, the paper describes the eXtensible Messaging and Publish/Subscribe (XMPP) which interacts with the Resource Adaptation Interface for Cloud Platform's Infrastructure.

Resource Adaptation Interface for Cloud Platform's Infrastructure (RAI) is connected to the network, and the application design, which has been developed in the discovering services design.

Keywords—DER, XMPP, IEC 61850, edge computing, system methodology, distributed system, renewable energy, system integration.

INDEX TERMS

E
energy management
message presence
messaging presence

NOMENCLATURE

E _{storage}	E _{storage}
E _{grid}	E _{grid}
charge, discharging	charge, discharging
load	load
power	power
planning	planning
Res	Res
storage	storage
transmission	transmission

Keywords—Internet of Management, infrastructure, Driven Development, XMPP

In the recent papers around the topics

people

XMPP-based architecture

Received July 28, 2017; accepted August 2017
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A Lightweight XMPP-based architecture for Resource Management

HENG WANG, (Member)

Key Laboratory of Industrial Corresponding author:

This work was supported by Grant 2015AA04380 and Grant csc2015(jy)

ABSTRACT Wireless enabled lead existing integrated of edge

Demand and pa

adjustment is used

and it is used in

management and

supports the e

flexibility cou

computation is not

aggregators to moni

grid. Moreover,

check for updates

Overexploitation of fossil fuel is a critical issue that impacts the environment. Renewable energy is a new energy source that can reduce the impact of fossil fuel on the environment.

Catastrophic disasters to the human race, moreover, the environment accelerates these situations. Renewable energy generation approaches from traditionally friendly energy generation approaches (an international accredited registrar and classification development, policy, and investment pro

Article

Received July 28, 2017; accepted August 2017
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energies

Modeling and Integrating PV Stations into IEC 61850 XMPP Intelligent Edge Computing Gateway

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Abstract—Distributed energy resources (DERs) are being widely interconnected to electrical power grids. The dispersed and intermittent generational mixes bring technical and economic challenges to the power systems in terms of stability, reliability, and interoperability. In practice, most of the communication technologies in DER are provided by proprietary communication protocols, which are not designed for the prevention of cyber security over a wide area network, and methodology of DER integration is not unified. This has made it technically difficult for power utilities and aggregators to monitor and control the DER systems after they are interconnected with the intelligent grid. Moreover, peer to peer communication between DER systems and the intelligent grid is required to reduce decision latency and enhance the stability of the smart grid or microgrid. In this paper, the first novel architecture of IEC 61850 XMPP (extensible messaging and publishing protocol) of the edge computing gateway, involving advanced concepts and technologies, was developed and completely studied to counter the above-mentioned challenges. The results show that the proposed architecture can enhance the communication latency and enhance the stability of the smart grid. This has developed a new communication architecture between DER systems defined in IEC 61850-7-420, to the IEC 61850-7-4 logical nodes and the DER-specific logical nodes defined in IEC 61850-8-2 XMPP communication and transparency for interoperability. The novel and advanced information models according to the IEC 61850-7-4 logical nodes and the DER and utility and DER and the Resource Adapter Infrastructure for Cloud Platform's Infrastructure for Cloud Platform's Infrastructure (RAI) were developed. The paper describes the RAI interface for Cloud Platform's Infrastructure for Cloud Platform's Infrastructure (RAI) which is connected to the network, and the application design, which has been developed in the discovering services design.

Keywords—DER, IEC 61850, XMPP, edge computing, gateway, smart grid

解決方案

導入智慧電網標準應用架構

- CEN-CENELEC-ETSI智能電網協調小組(SG-CG)
- IEC 62357 NIST智慧電網互操作性標準
- 智慧電網架構模型(SGAM)

工業物聯網平台 (AWS Cloud)

- 設備管理、可視化
- Middleware
- 資料處理、儲存、分析、演算模型

邊緣計算閘道器

- Multi-protocol (Legacy): 450+ protocols / Agent (TR-069)
- Intelligent Edge Analytic and storage

案例介紹

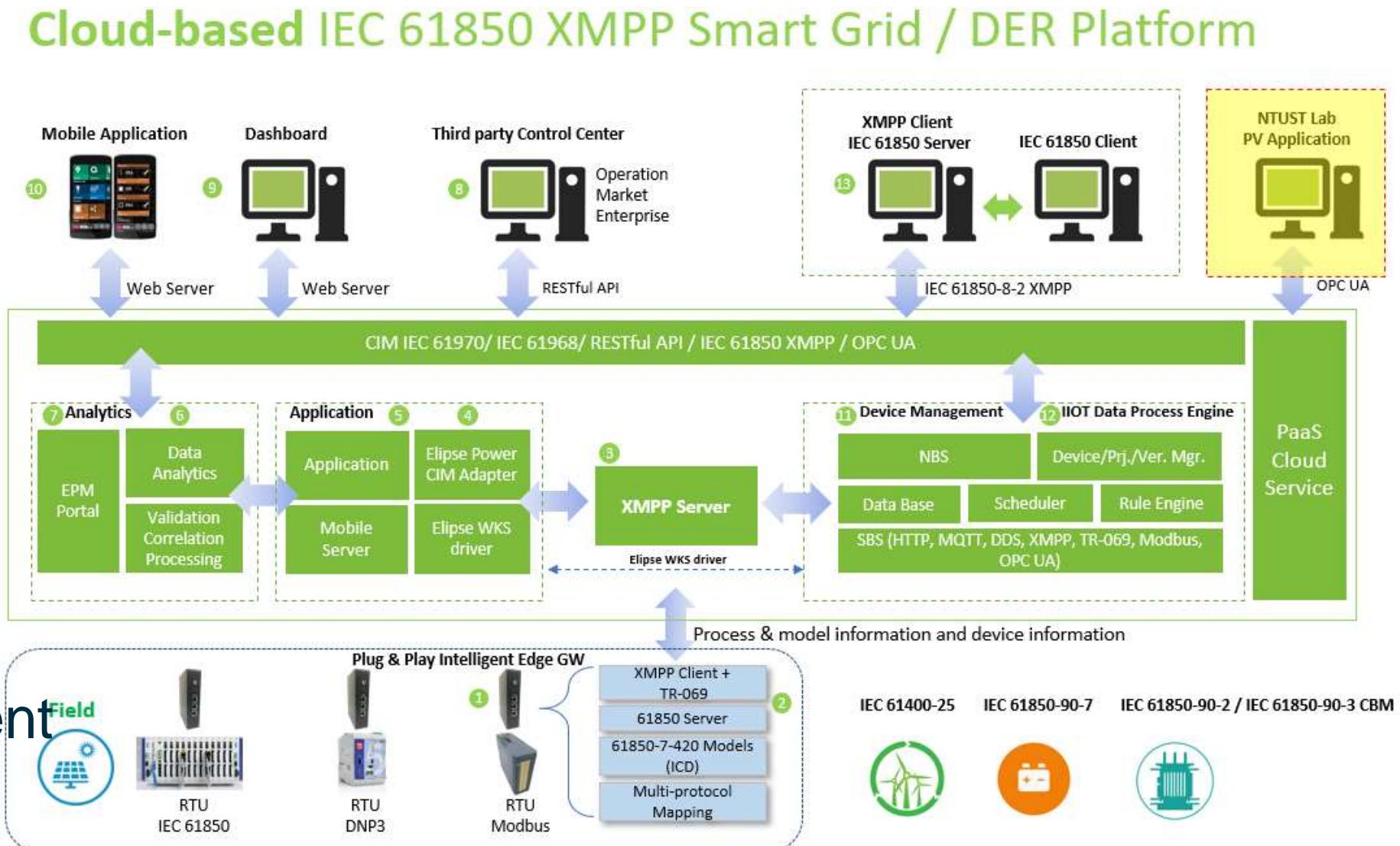
Cloud-based IEC 61850 XMPP Smart Grid / DER
Platform

Deployed in Taiwan (Private cloud) and Thailand (AWS Cloud)

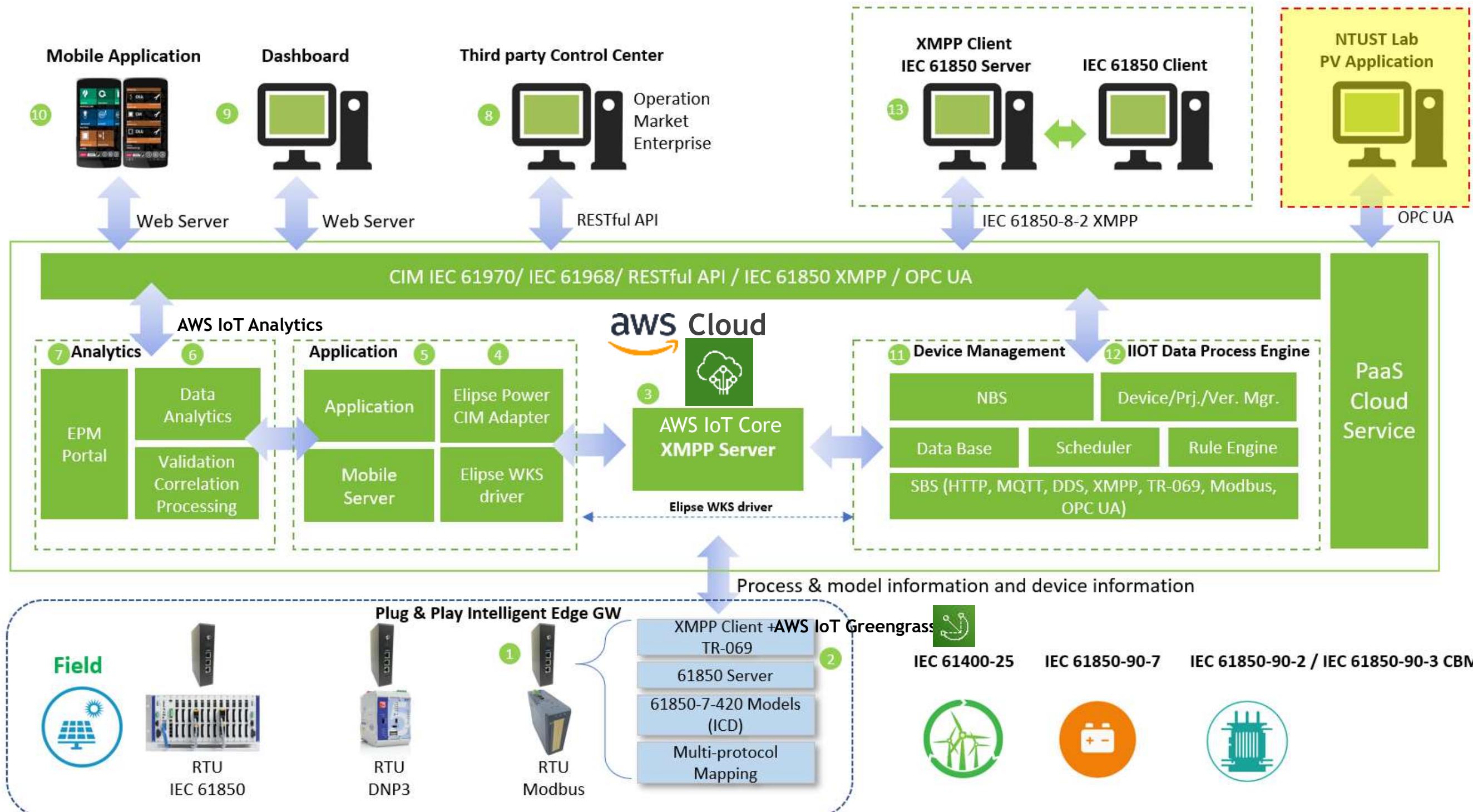
能源行業應用標準

特色

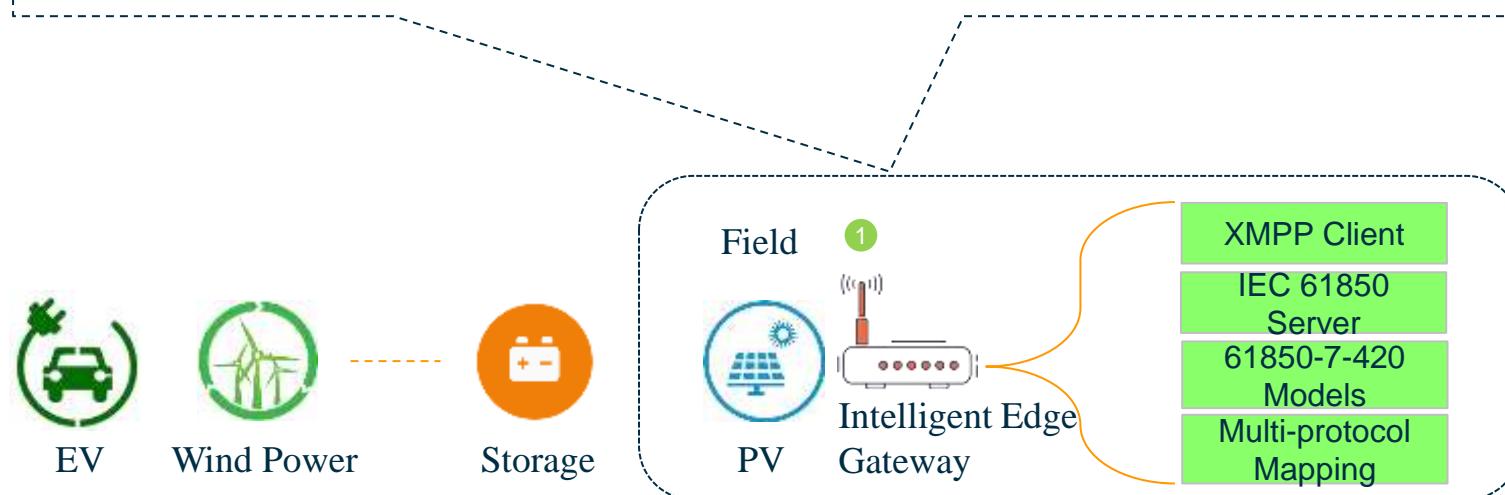
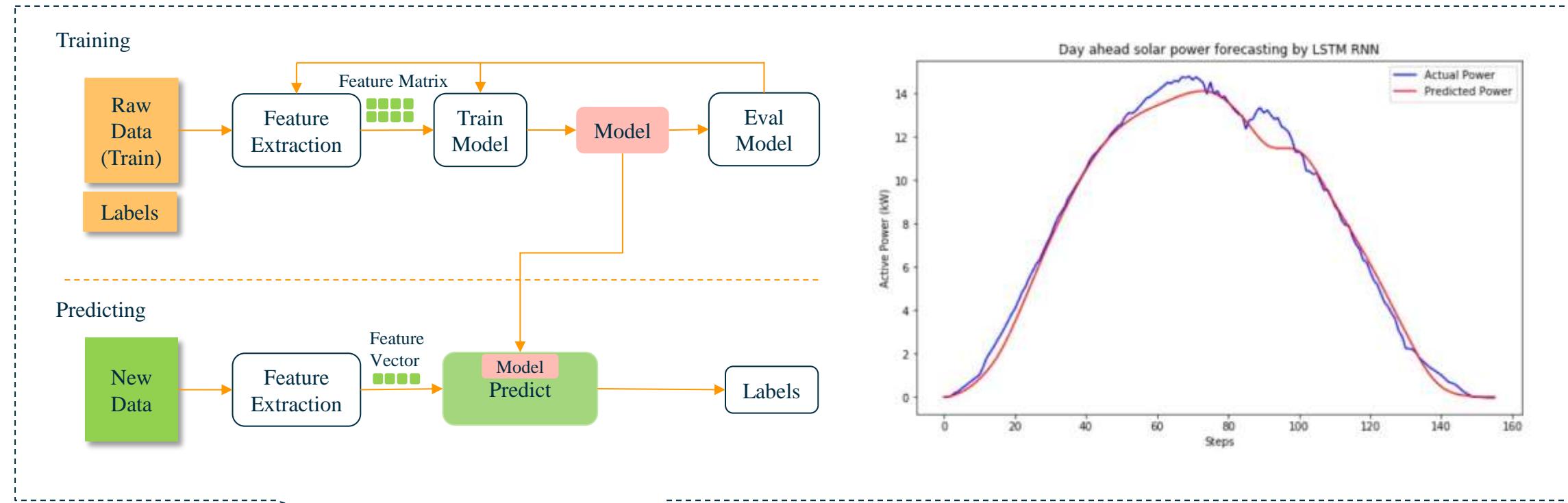
- 智慧電網標準架構
- IEC 61850 XMPP
- DMS
- IEC 61970 CIM
- Data Analytics
- 邊緣計算閘道器
 - DER Data modeling
 - IEC 61850 XMPP Client
 - TR-069 Agent
 - Solar power forecasting
 - AWS Greengrass



Cloud-based IEC 61850 XMPP Smart Grid / DER Platform

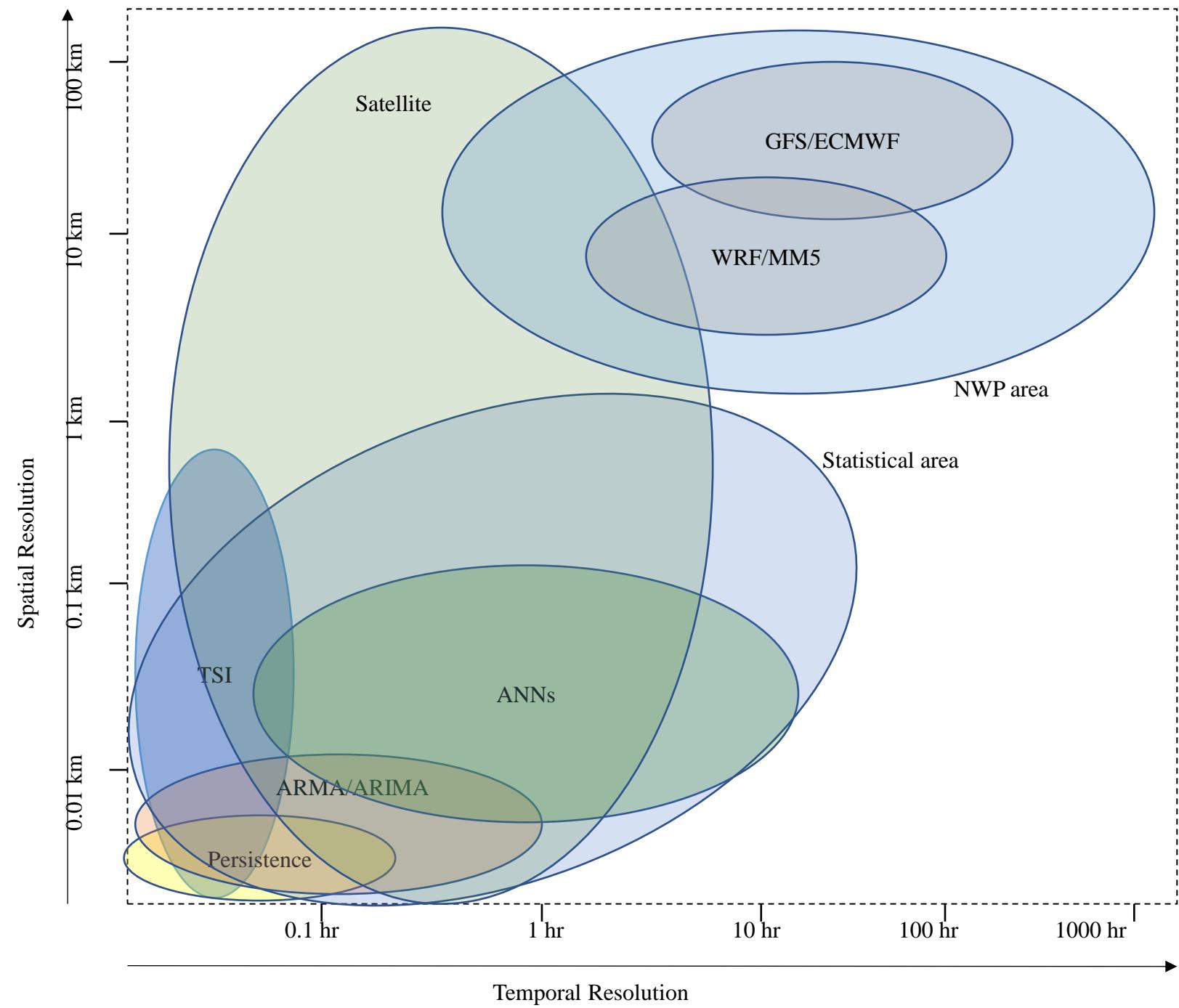


發電預測模型



發電預測模型

Spatial resolution
Temporal resolution

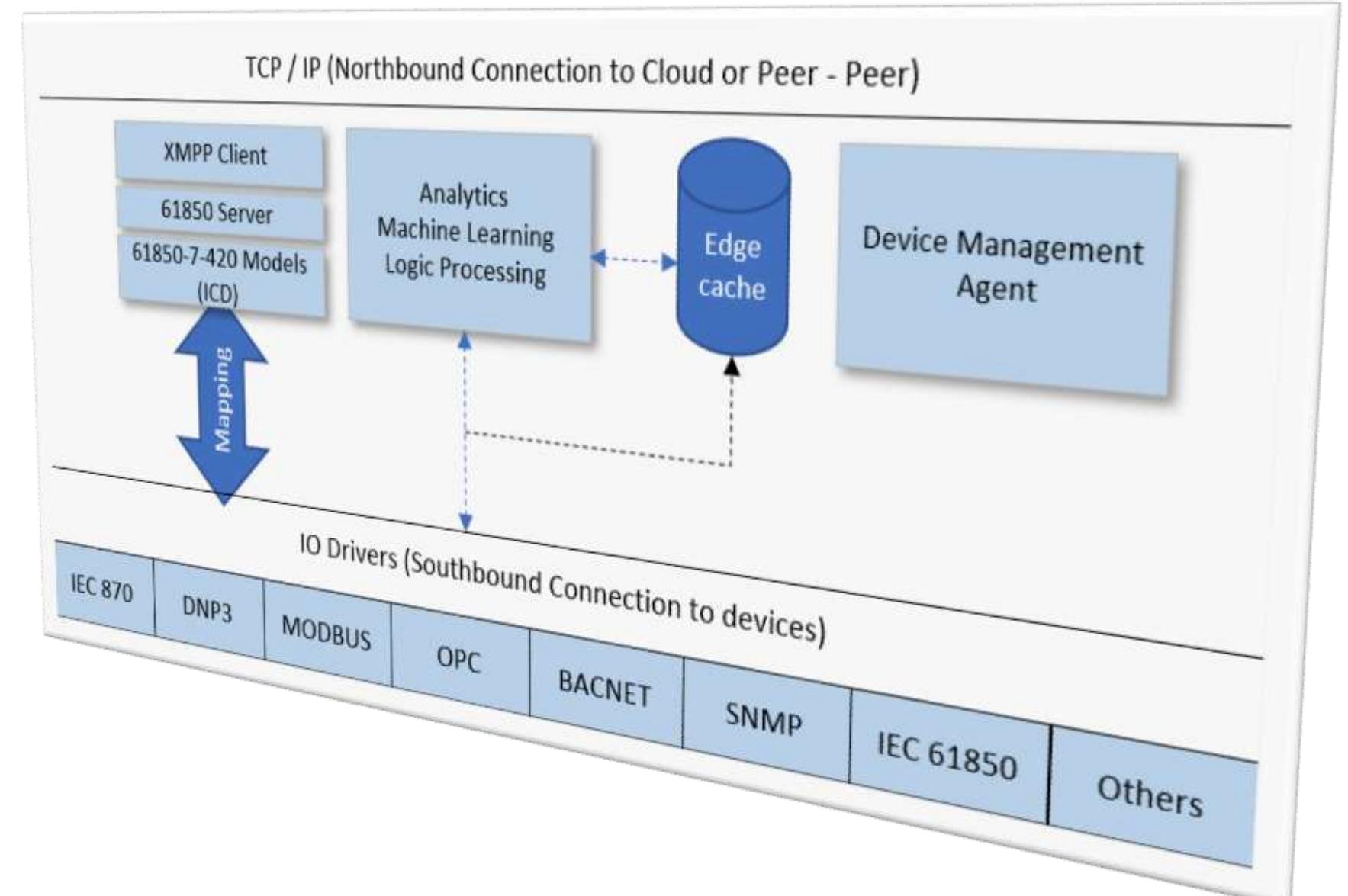


發電預測模型

建置邊緣計算閘道器

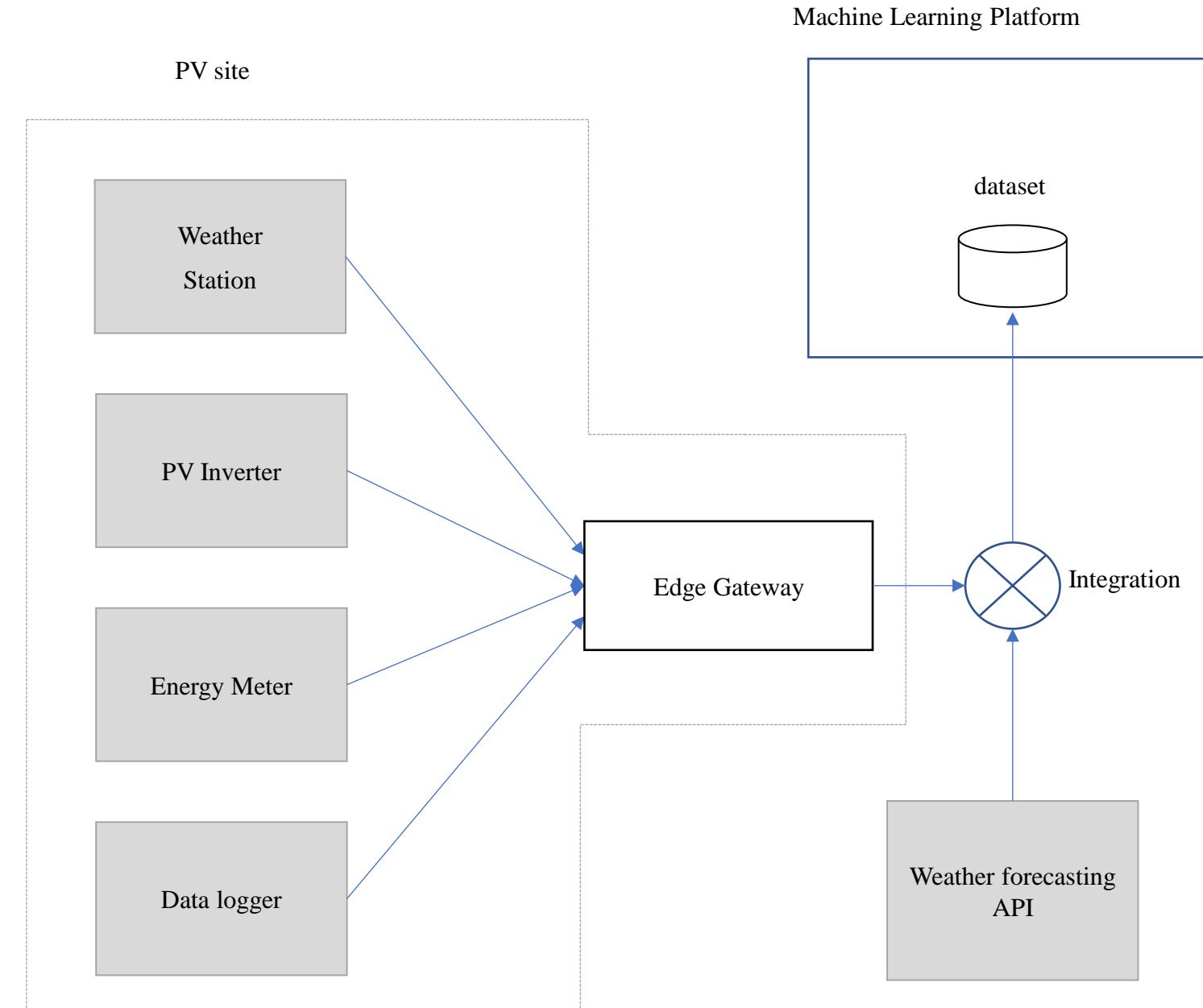
Machine Learning

LSTM Multi-step Time series



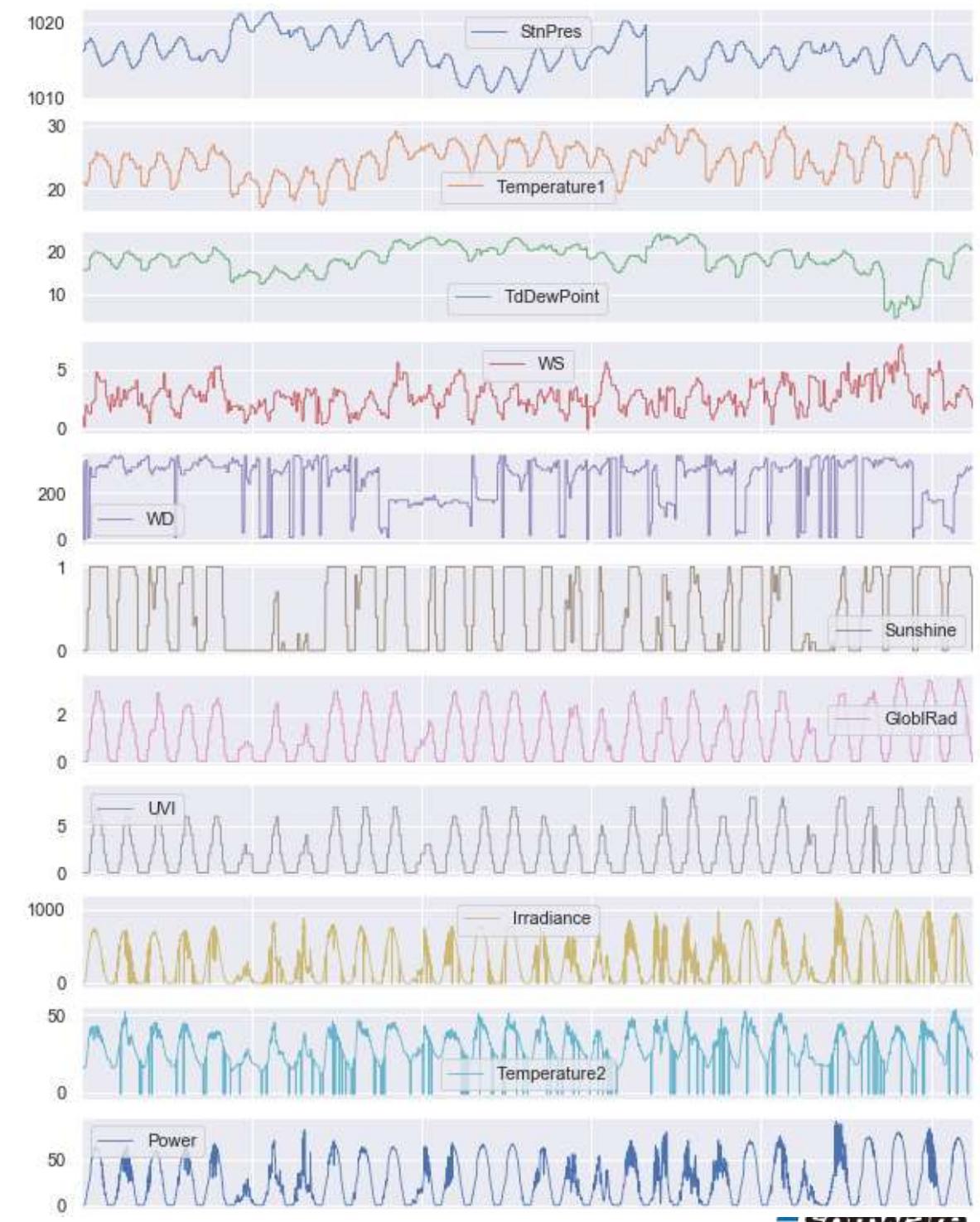
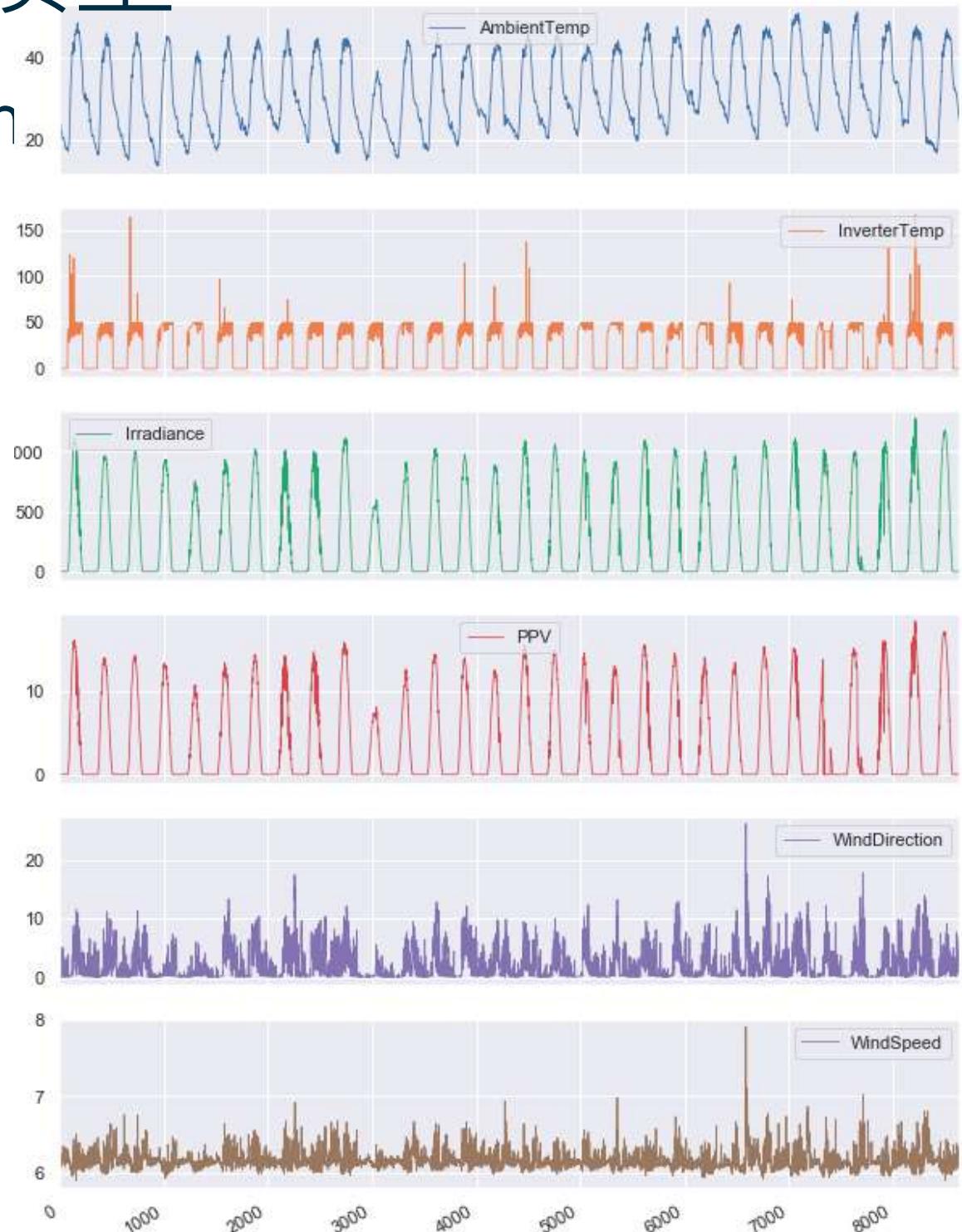
發電預測模型

Data collection



發電預測模型

Data inspection



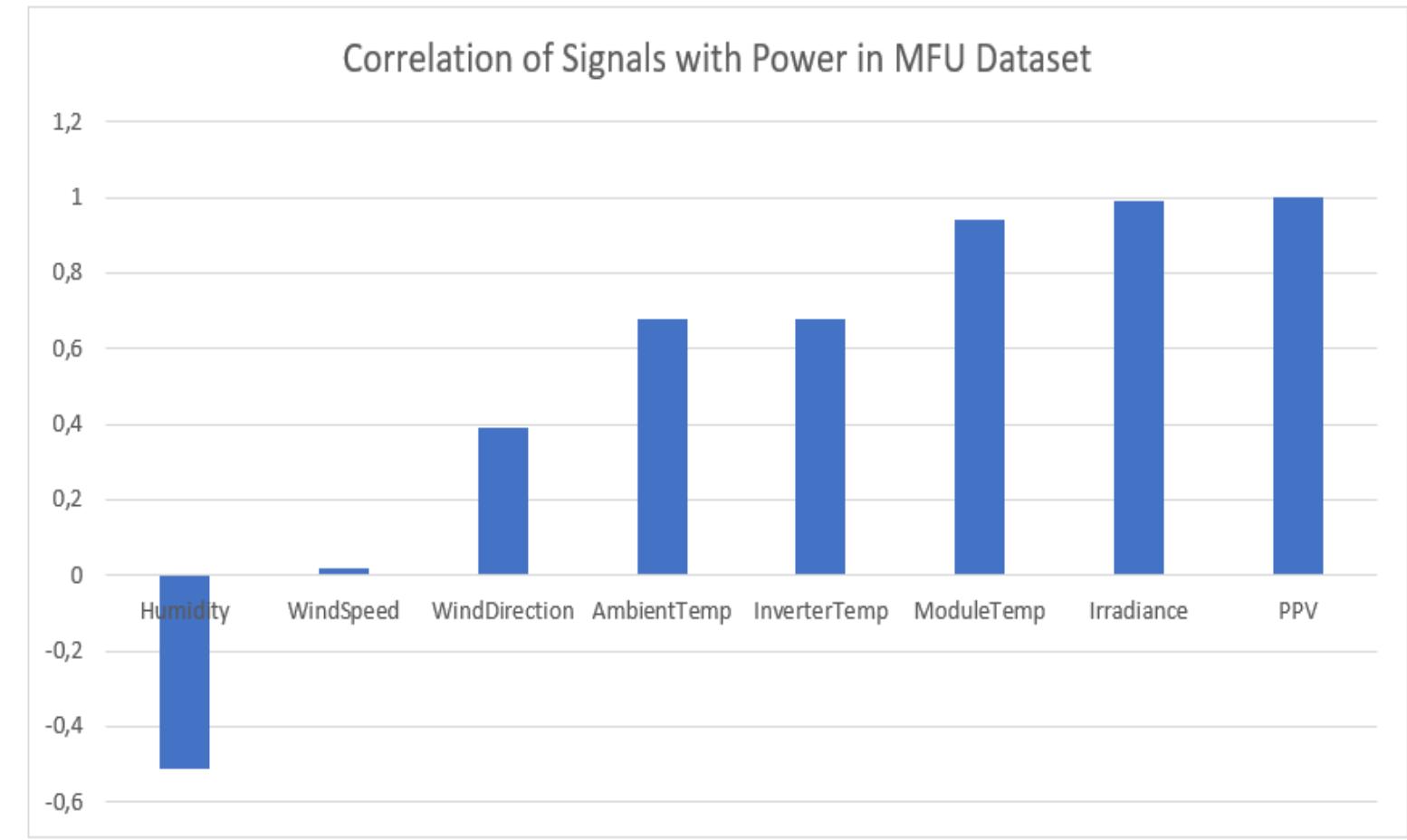
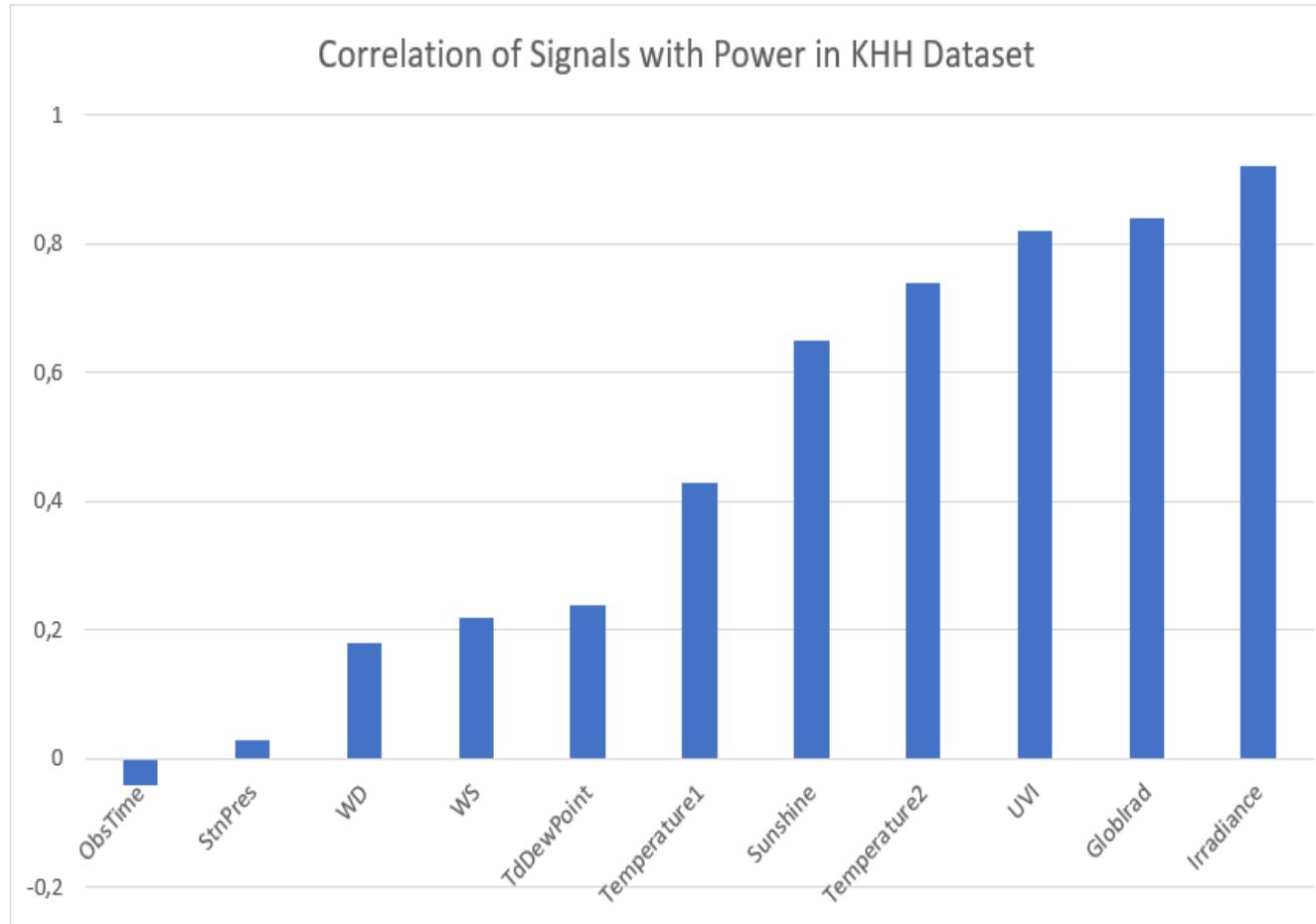
發電預測模型

Signal correlations



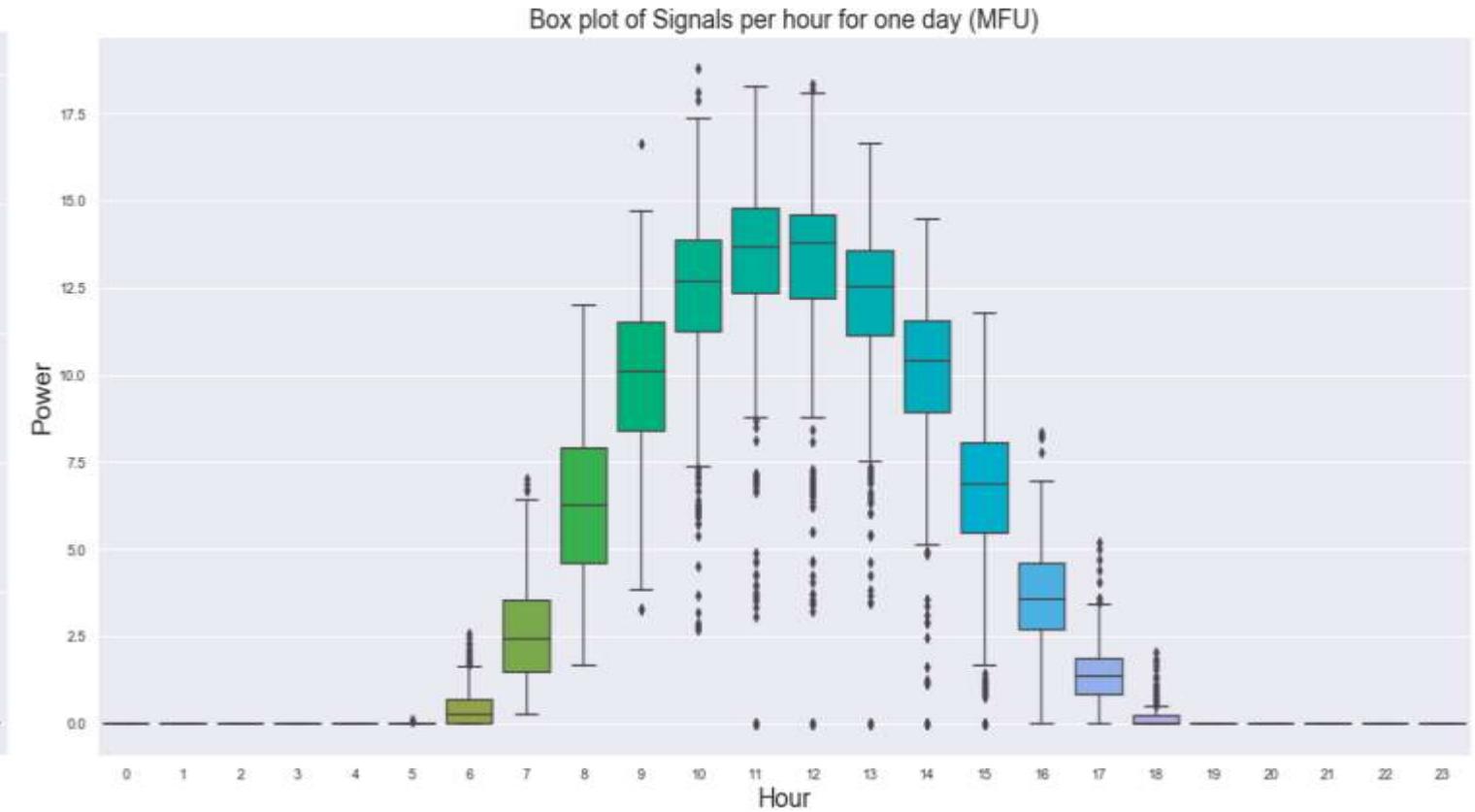
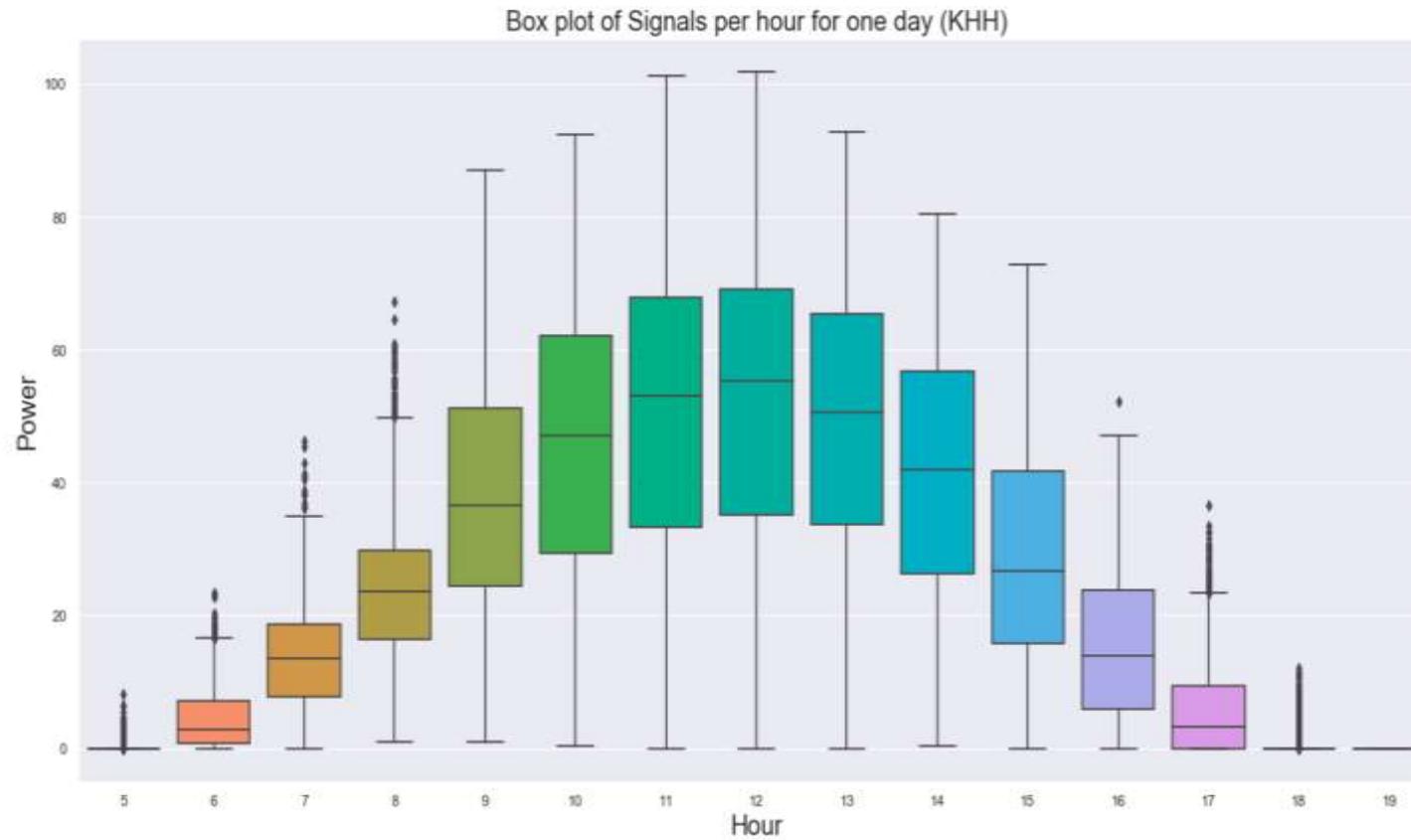
發電預測模型

Signal correlations



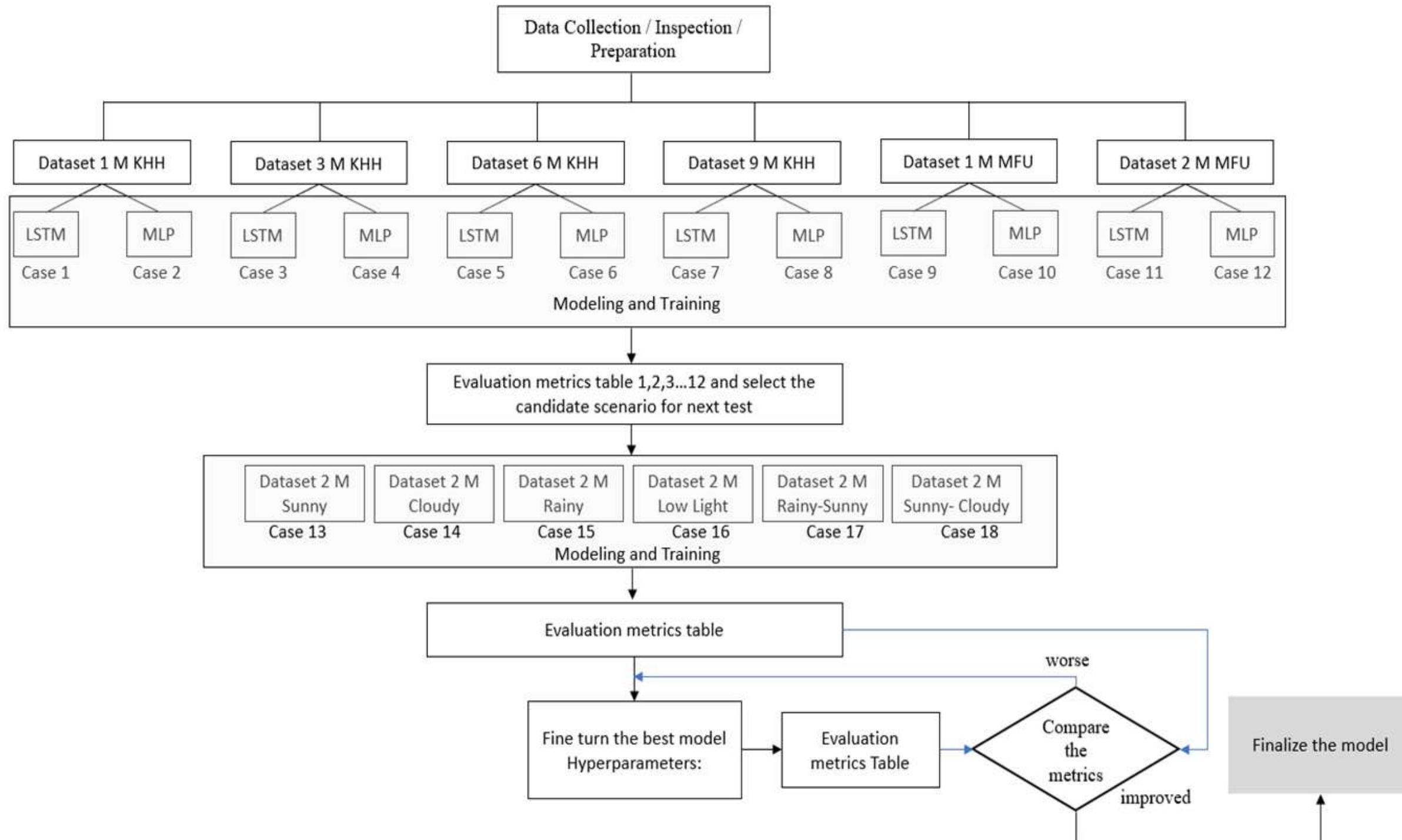
發電預測模型

Box plot of power per hour for one day



Box plot of Power signal per Hour for one Day

發電預測模型



發電預測模型

LSTM Model training

LSTM - Accuracy while training
Loss : 0.318 Validation Loss : 0.397

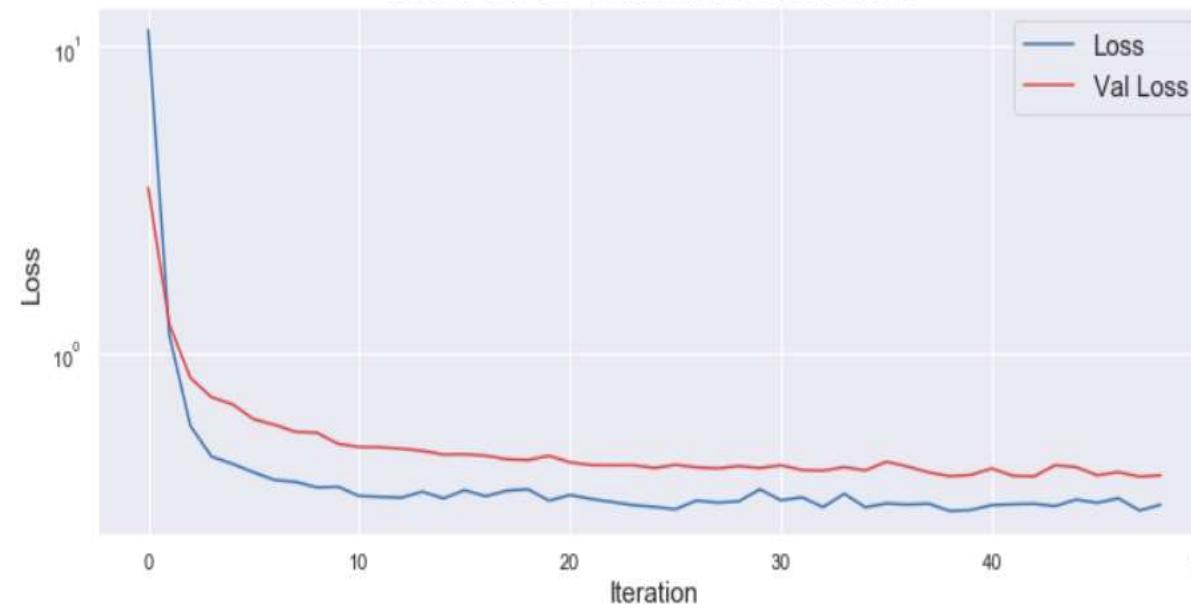


Figure 1-21 : Loss and Validation Loss for the trained model with 30 days

Table 1-13: Metrics Table for Relu Activation Function

Activation Function : Relu				
Test Case	#23	#24	#25	#26
Metric	50 nodes	100 nodes	150 nodes	200 nodes
Loss	0.533	0.358	0.337	0.341
Validation Loss	0.374	0.358	0.396	0.395
Validation RMSE	0.408	0.407	0.465	0.455

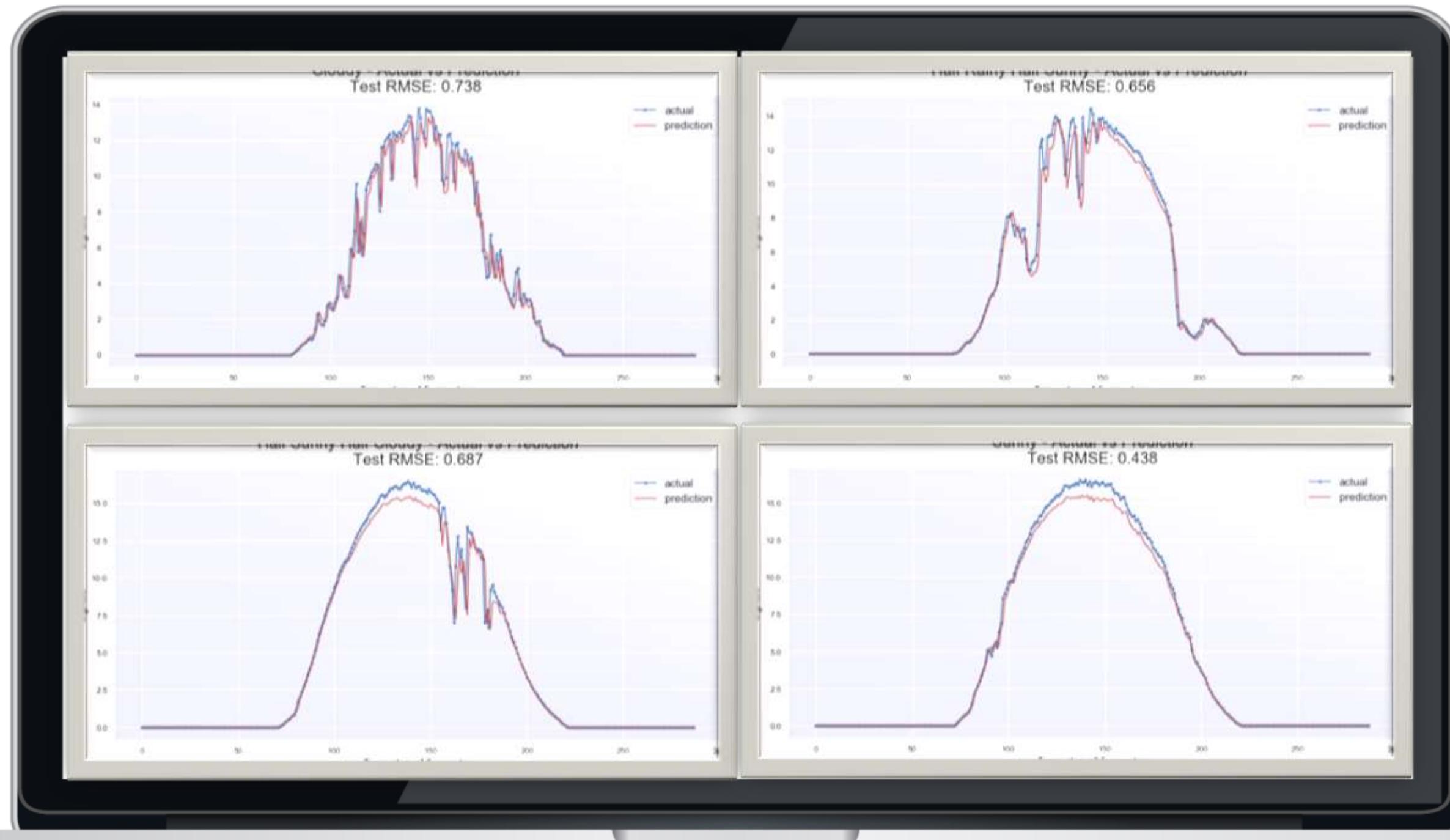
Weather Scenario	Test RMSE	Test RMSE	Test RMSE	Test RMSE
Sunny	0.377	0.295	0.270	0.261
Cloudy	0.723	0.718	0.755	0.745
Rainy	0.604	0.625	0.638	0.659
Low Light	0.136	0.145	0.164	0.156
Half Rainy, Half Sunny	0.603	0.599	0.635	0.644
Half Sunny, Half Cloudy	0.688	0.638	0.669	0.664
Average	0.522	0.503	0.522	0.522

Table 1-14: Metrics Table for TanH Activation Function

Activation Function : Tanh				
Test Case	#27	#28	#29	#30
Metric	50 nodes	100 nodes	150 nodes	200 nodes
Loss	0.415	0.318	0.289	0.287
Validation Loss	0.407	0.400	0.404	0.473
Validation RMSE	0.418	0.450	0.449	0.530

Weather Scenario	Test RMSE	Test RMSE	Test RMSE	Test RMSE
Sunny	0.395	0.267	0.269	0.321
Cloudy	0.719	0.739	0.739	0.775
Rainy	0.645	0.621	0.640	0.674
Low Light	0.143	0.161	0.159	0.249
Half Rainy, Half Sunny	0.605	0.615	0.617	0.684
Half Sunny, Half Cloudy	0.703	0.654	0.669	0.684
Average	0.535	0.509	0.516	0.565

發電預測結果 (不同天氣類型)



可視化界面

SCADA
Web Server
Modulization
Machine Object Lib
Play back



診斷分析

Historical Trending
Professional Analytics
Predictions



效益

PV 站監控設備資訊模型化 (IED 61850-7-420 Data Model)

- 隨插即用及遠端設備管理(TR-069)
- 縮短系統建置時間
- 系統擴充容易

邊緣計算閘道器

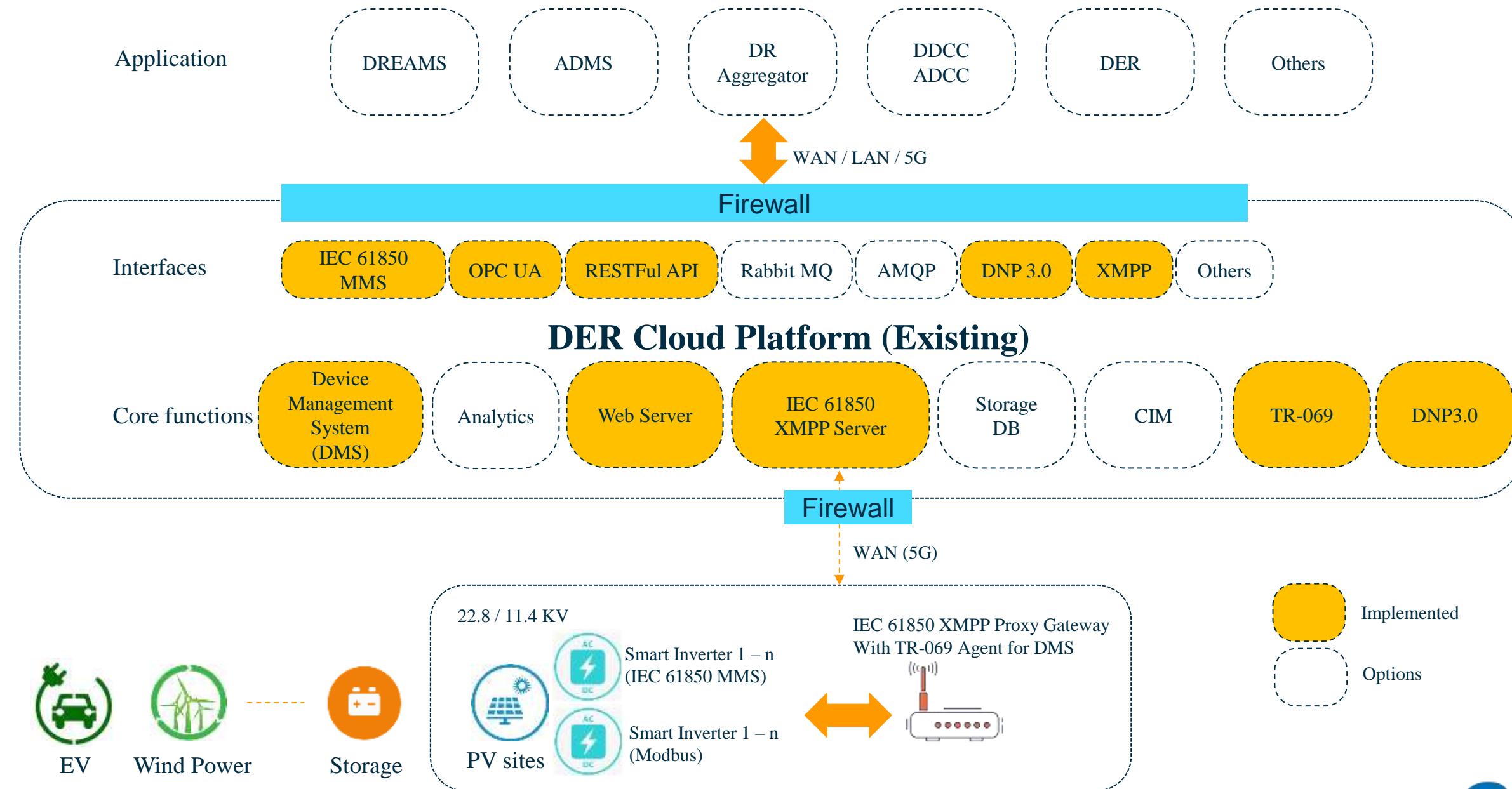
- 支援多通訊協議整合 (450+)
- 導入機器學習功能: 發電預測、狀態維護模型 (CMB)

DER 雲平台系統 (AWS Cloud)

- 互通性標準
- AI 計算能力
- 圖形介面

未來擴充

Architecture Smart Grid Cloud Platform



Thank you!

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