IEC 61850 在分散式能源的應用

劉俊宏 博士

Nov. 06, 2024

NATIONAL LEADER IN AUTOMATION SOFTWARE
AND MANAGEMENT OF INDUSTRIAL PROCESSES

ABOUT US

INNOVATION AND EXPERTISE IN
SOFTWARE SOLUTIONS FOR PROCESS MANAGEMENT

SOLUTIONS
in Automation and
Process Management

LEADERSHIP
in South America

EXPERIENCE
38 Years

OFFICES
USA, Brazil (5) and Taiwan

30 COUNTRIES
partners in the
world

60,000
systems
installed

Company is registered in USA

elipse software

Solution in Energy

Substation Automation

Reduce engineering and comissioning costs during the deployment of substations

Generation Plants

Generation Operation Centers, wind farms, hydroelectric, thermoelectric and photovoltaic plants

Distribution Centers

Electrical system intelligent management

ADMS

Electrical system intelligent management

DERs Management

Check how you can operate and manage multi-vendor wind farms

Transmission Centers

Optimize the operational processes and improve the quality of power supply

INNOVATION AND EXPERTISE IN SOFTWARE SOLUTIONS FOR PROCESS MANAGEMENT

elipse software

Certificate

UCA International Users Group

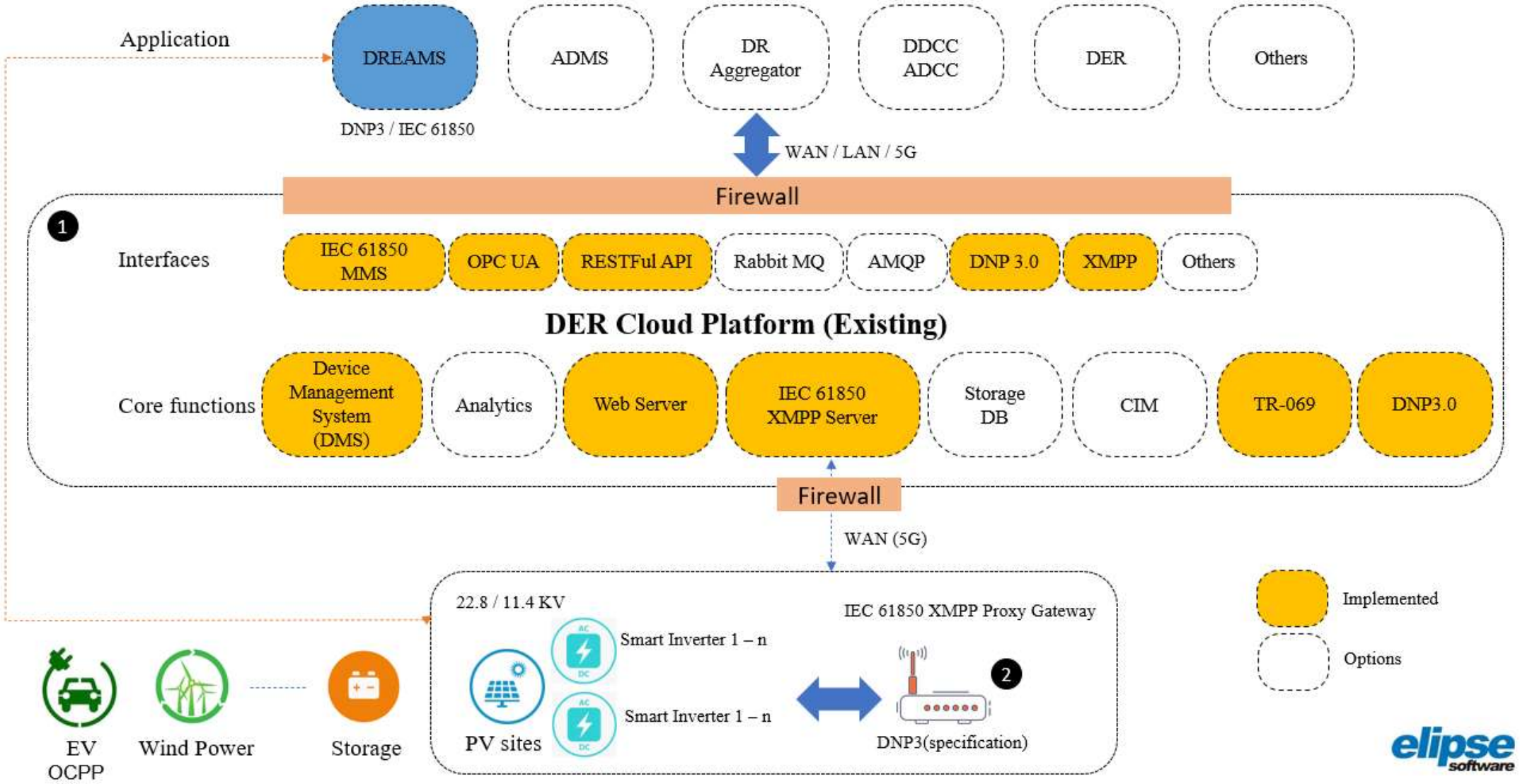
IEC 61850 Certificate Level A[1]

No. 10147432-INC 19-2400

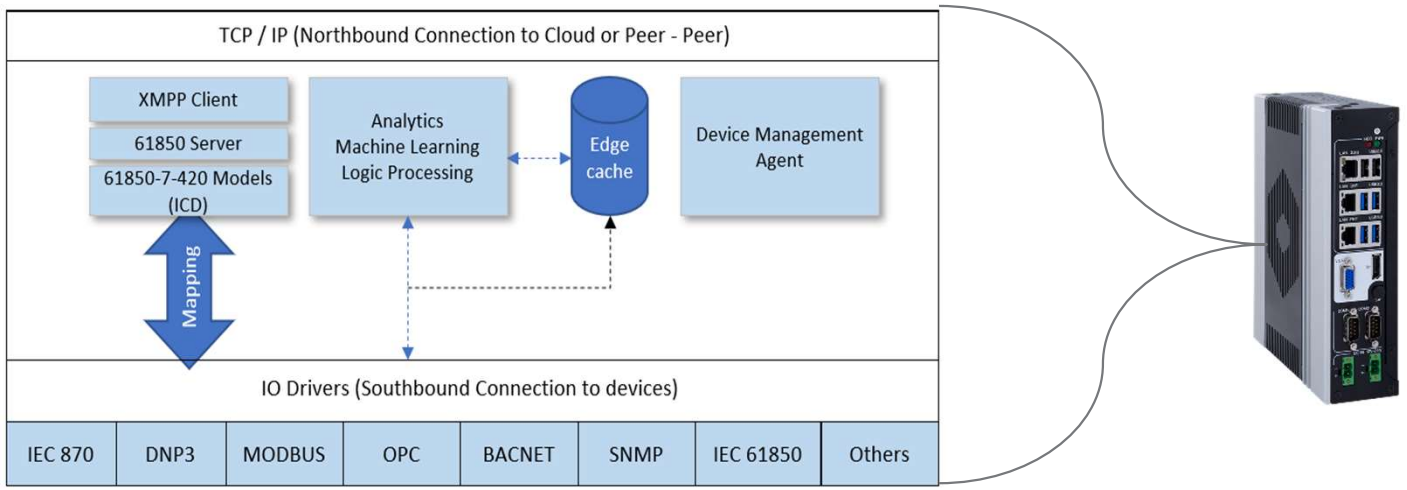
Issued to:
Elipse Software
Rua 24 de Outubro, 353-10 Andar
90510-002 Porto Alegre RS
Brasil

For the client system:
Elipse Power
IEC 61850 client driver version: 3.0.1
Hardware: Lenovo Ideapad 320 with Windows 10 Enterprise

Architecture

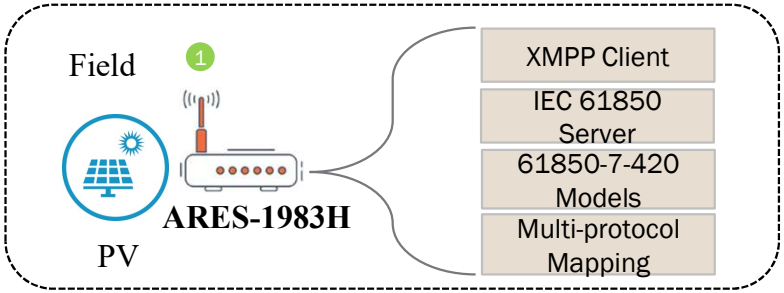


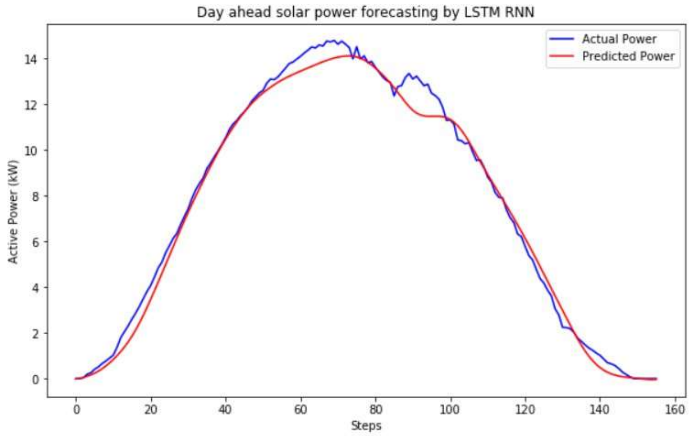
Edge AI Gateway for DERs



Protocol supports
IEC 61850 Client / Server
IEC 60870-5-101 / 103/ 104
DNP3.0
Modbus RTU / TCP
OPC
BACnet
Others
450+ protocols

Embedded
DMS
IEC 61850-7-420 standards

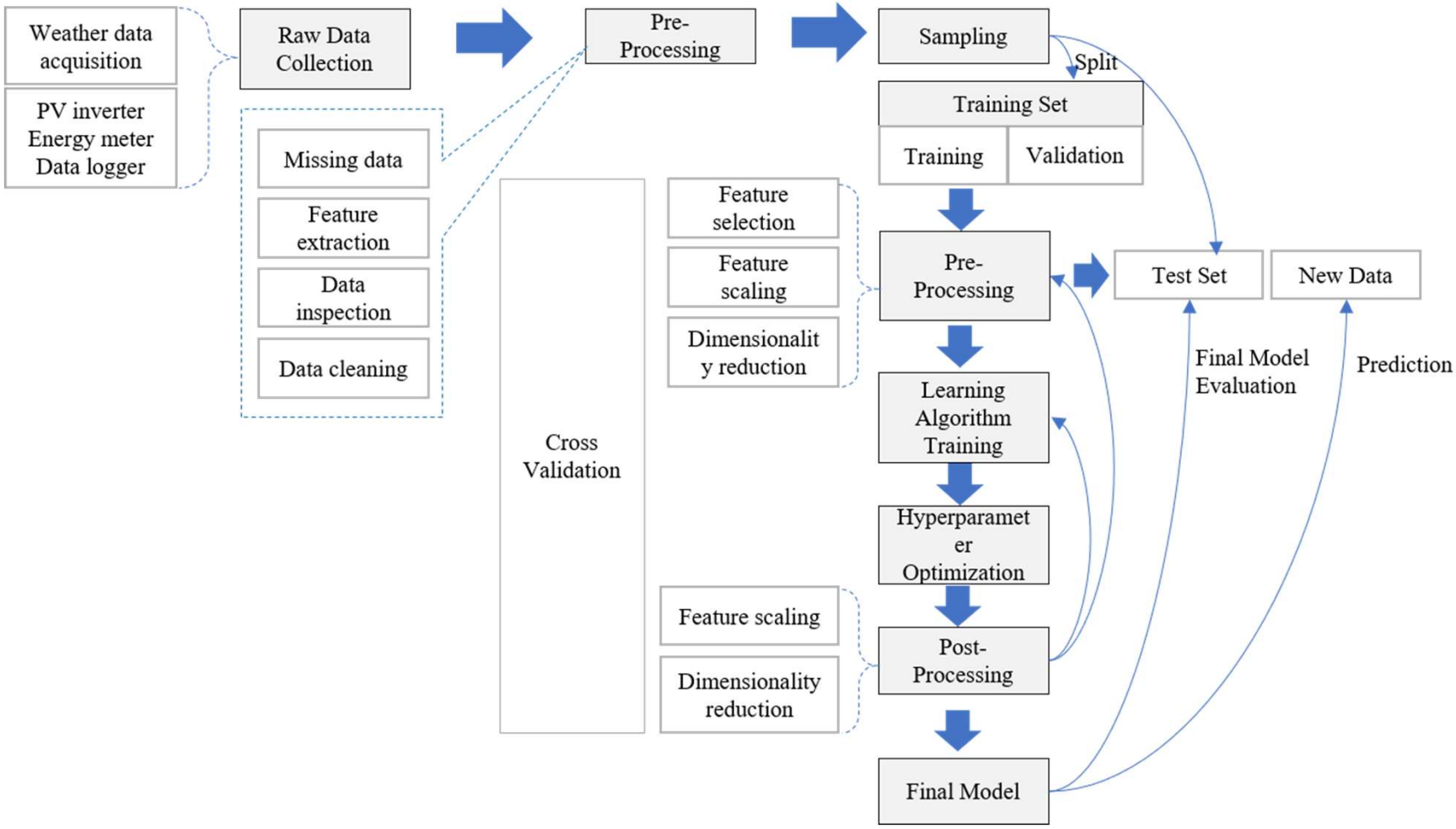




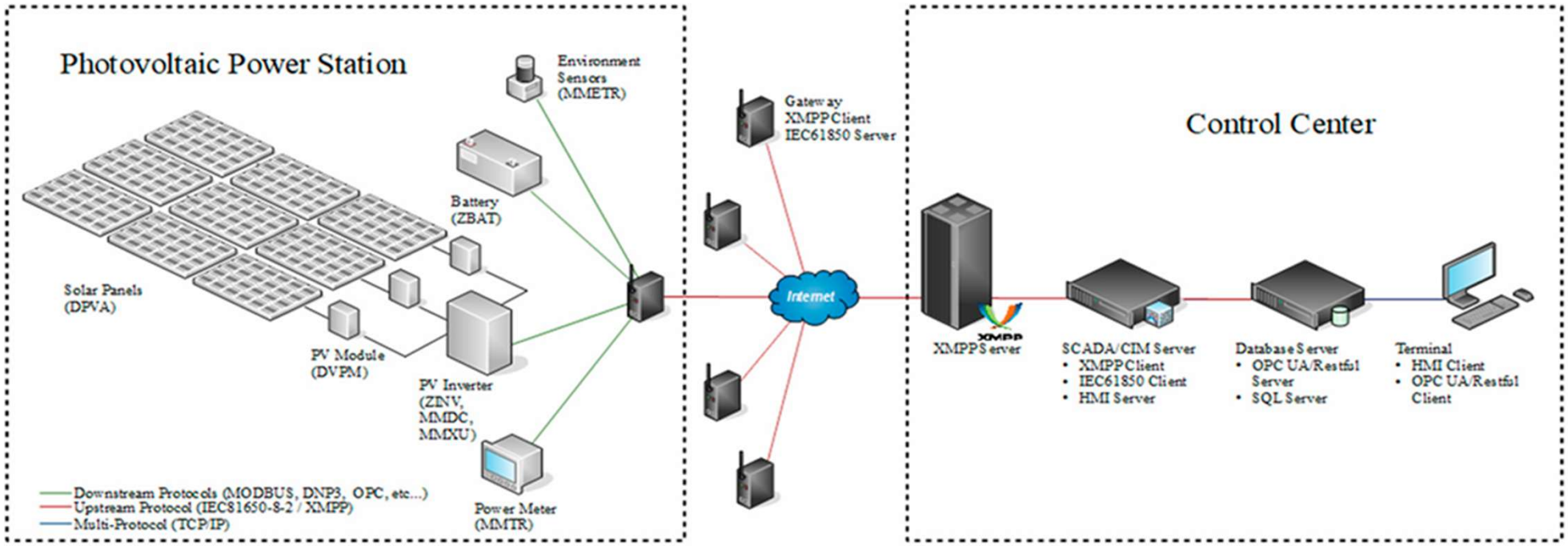
INNOVATION AND EXPERTISE IN SOFTWARE SOLUTIONS FOR PROCESS MANAGEMENT

elipse software

Architecture of Machine Learning



Application of System Architecture



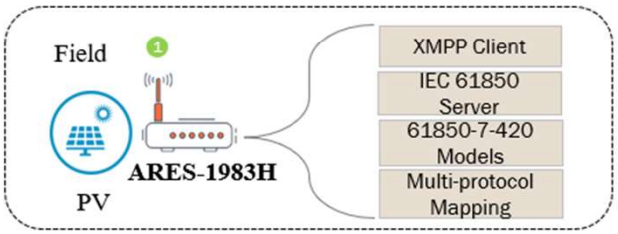
Comparison of different middleware

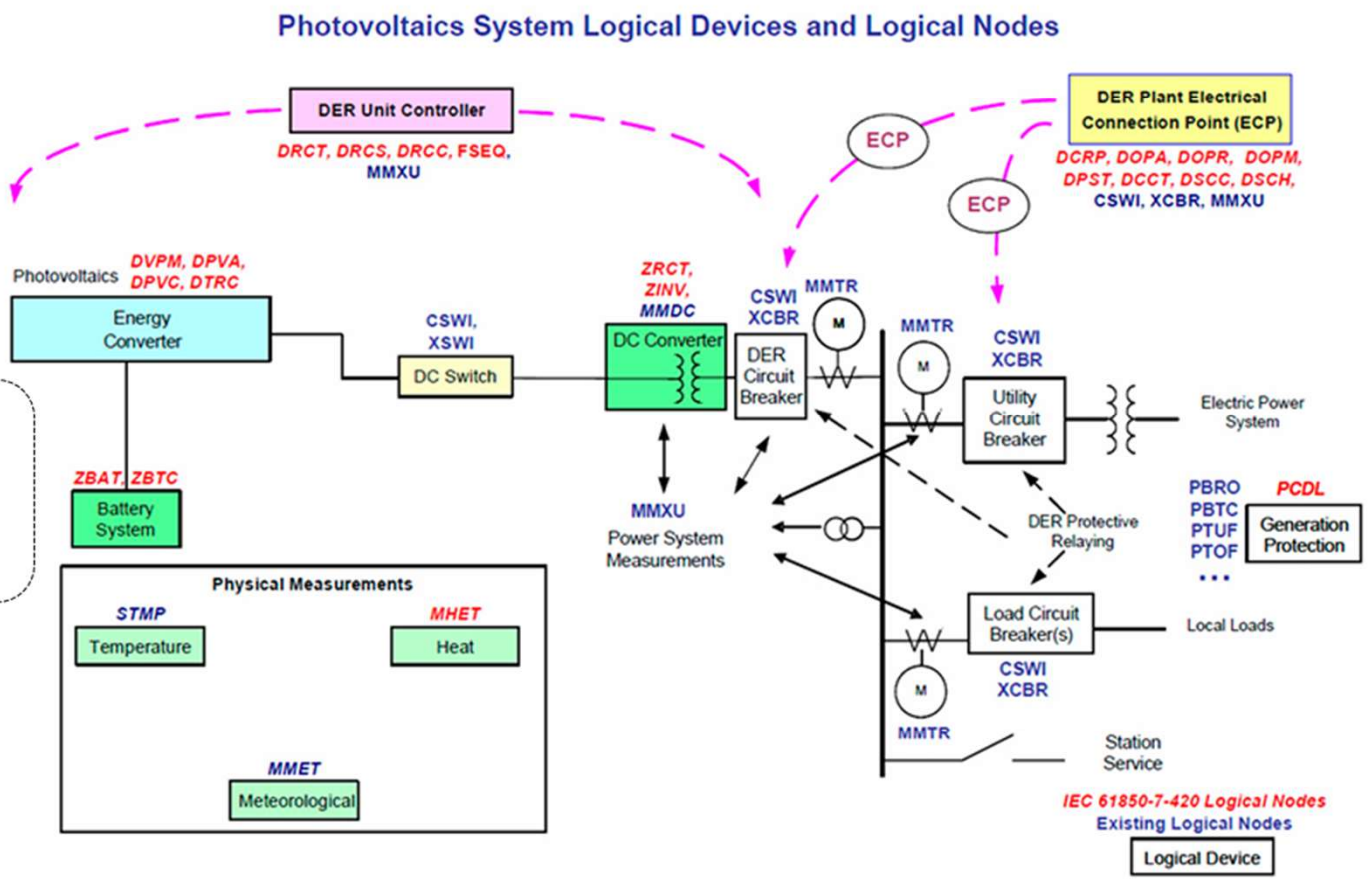
Features\Protocols	XMPP	MQTT	AMQP	OPC UA	YAMI4	ZeroMQ
Cyber security	Very high	Medium	Medium	Very high	Very high	Medium
Scalability	Very high	High	High	Very high	Very low	High
Commercially driven	No	No	No	Yes	No	Yes
Message types supported	P-S, P-P	P-S, P-P	P-S, P-P	P-S, P-P	P-S, P-P	P-S, P-P
Development effort	High	Low	Low	High	Very low	Low
Recommended by standards	Yes	No	No	No	No	No

P–S: publish–subscribe message, P–P: push–pull message
XMPP: extensible messaging and presence protocol
MQTT: message queuing telemetry transport
AMQP: advanced message queuing protocol
OPC UA: OPC unified architecture
YAMI4: messaging solution for distributed systems
ZeroMQ: high-performance asynchronous messaging library

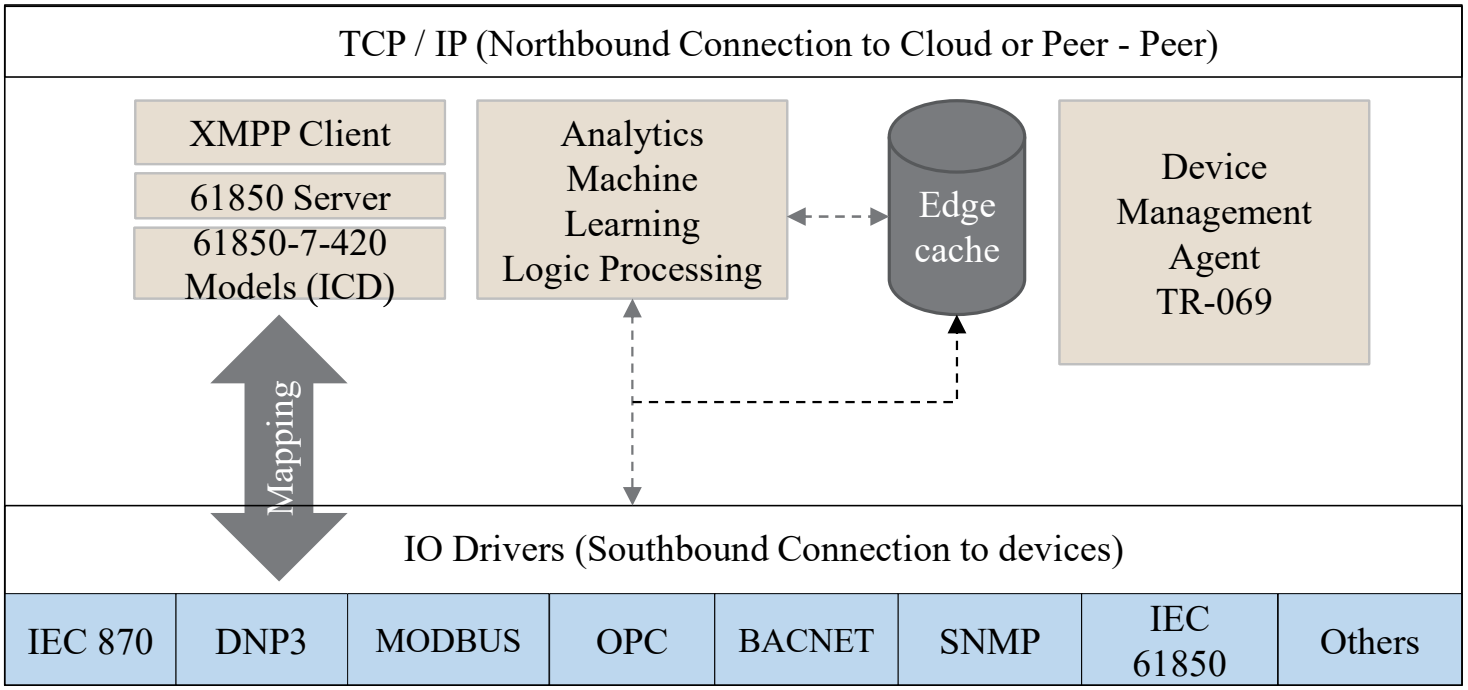
Table 2. Comparison of different middleware solution characteristics.

Logical Devices and Logical Nodes

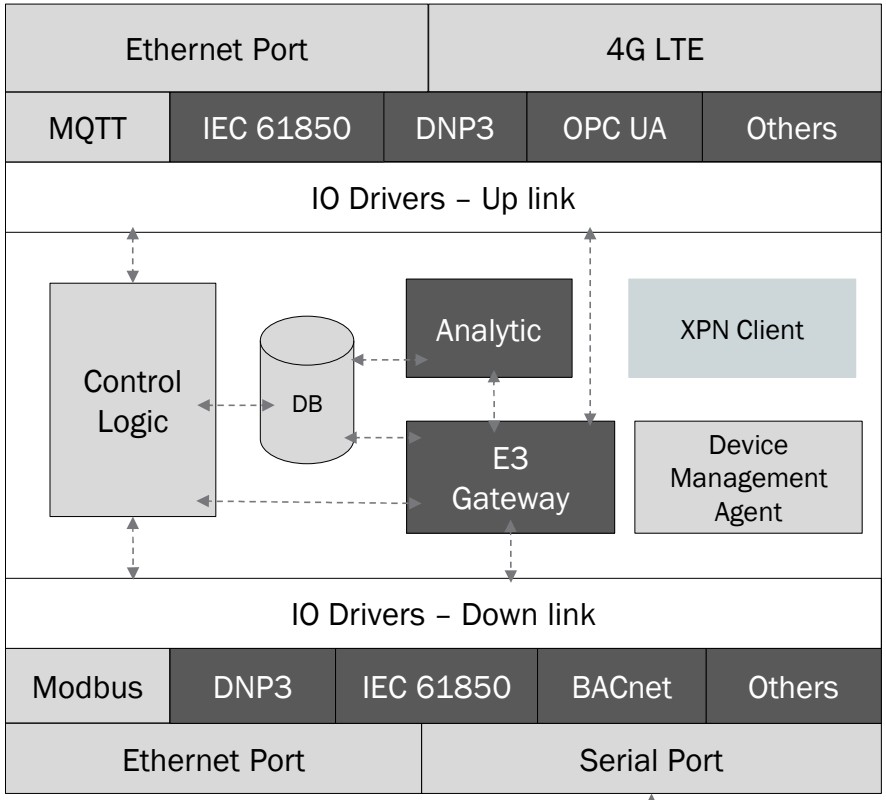




Intelligent Gateway Architecture



Concept of Edge RTU



Basic

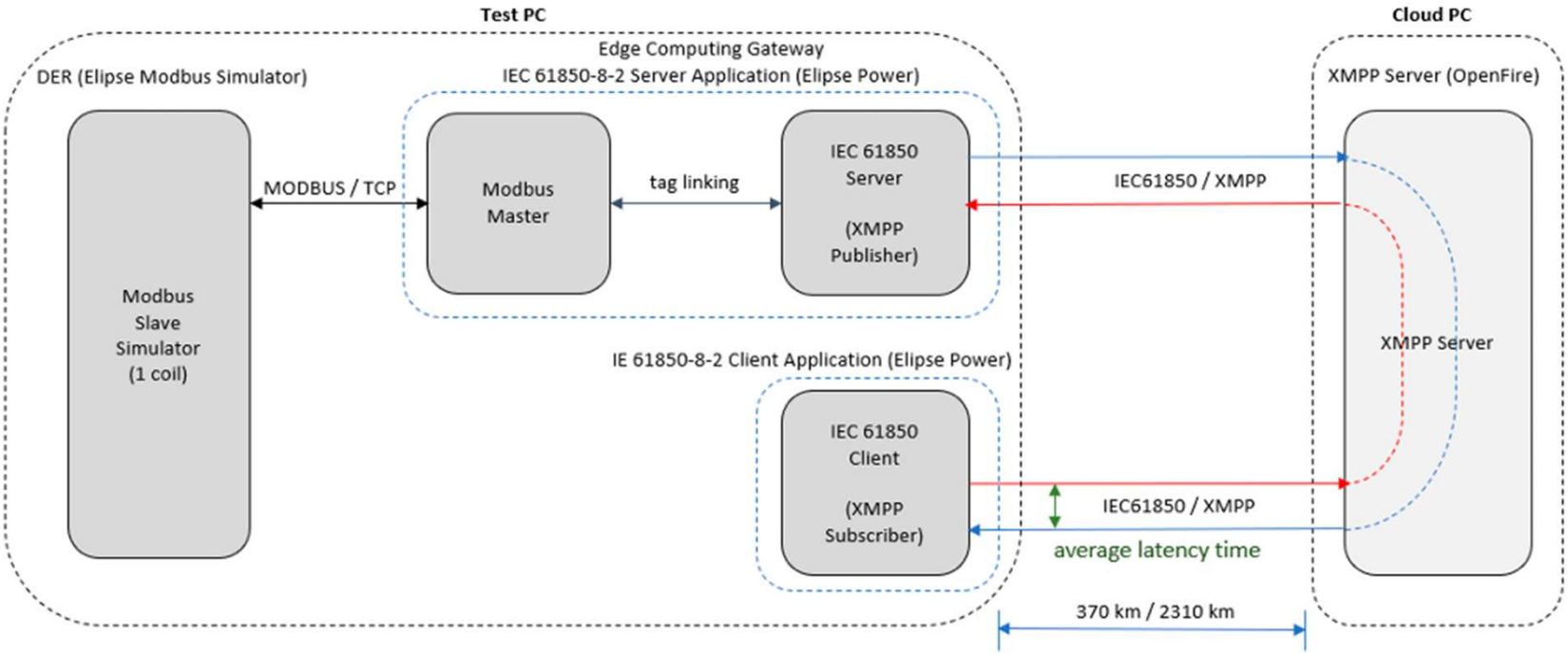
Advance

Remote I/O Modules

INNOVATION AND EXPERTISE IN SOFTWARE SOLUTIONS FOR PROCESS MANAGEMENT

elipse software

Test environment for latency test



Hardware Specifications

Test PC (Kaohsiung)
- Operating System : Microsoft Windows 10 Home Edition 64 bit
- CPU : Intel Core i7 Dual Core @ 2.2 GHz
- Memory : 12 GB RAM

Cloud PC (Taipei)
- Operating System : Microsoft Windows Server 2012 R2 64 bit
- CPU : Intel Xeon (Sandy Bridge) 4 Cores @ 2.6 GHz
- Memory : 16GB RAM

Legend

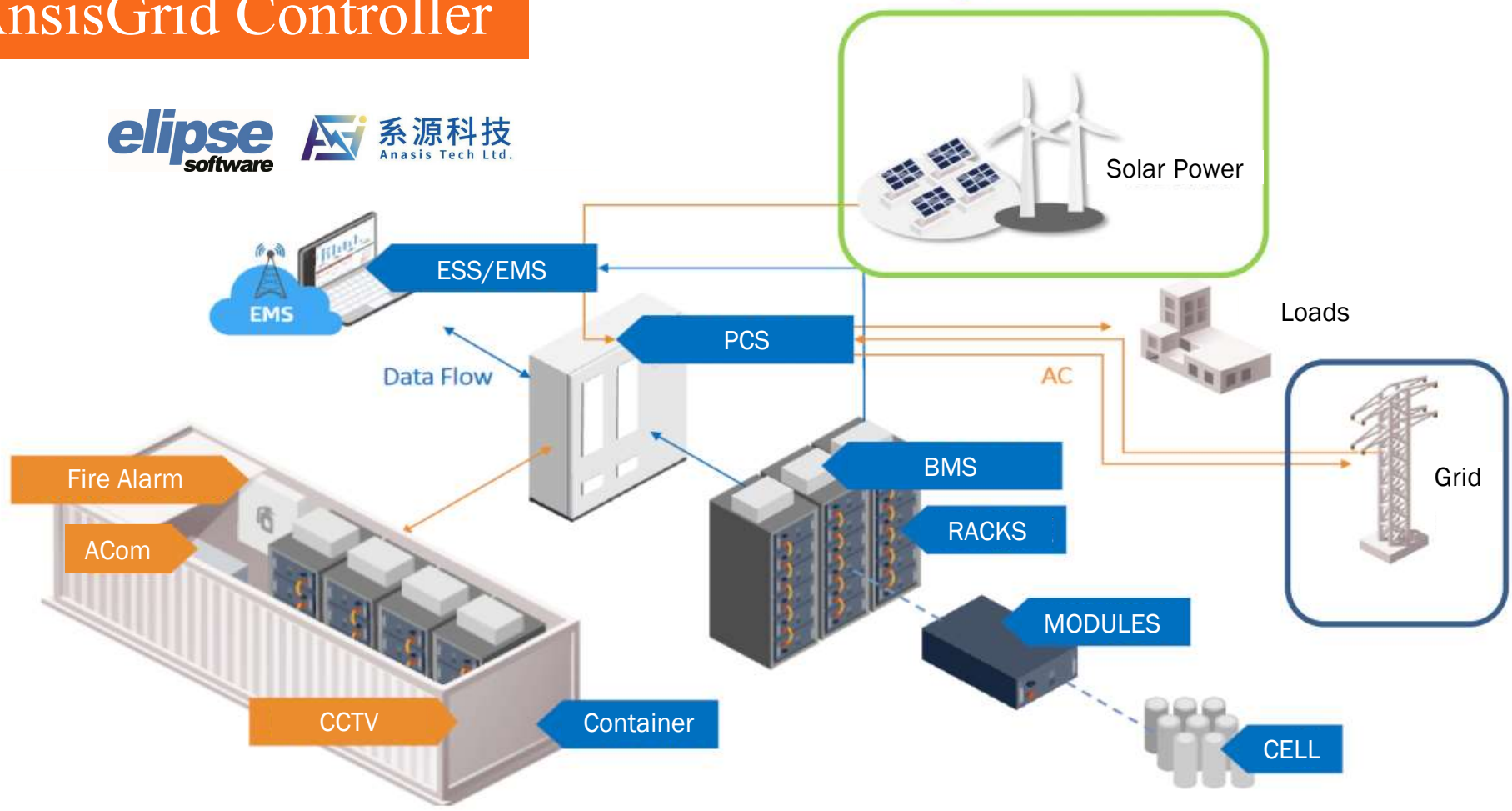
command
feedback
read & write

Test environment for latency test

	IEC 61850 Server		IEC 61850 Client		Internal Tag		Results (Sec)
	Value	Timestamp	Value	Timestamp	Value	Timestamp	Latency
#1	50275	15:59:54.171	50275	15:59:54.171	50275	15:59:55.097	0.873
#2	14366	15:59:54.171	14366	15:59:54.171	14366	15:59.55.097	0.866
#3	25607	15:59:54.171	25607	15:59:54.171	25607	15:59:55.098	0.870
#4	12381	15:59:54.171	12381	15:59:54.171	12381	15:59:55.098	0.858
#5	11101	15:59:54.171	11101	15:59:54.171	11101	15:59:55.098	0.858
#6	3796	15:59:56.231	3796	15:59:56.231	3796	15:59:57.014	0.863
#7	13200	16:00:01.211	13200	16:00:01.211	13200	16:00:02.464	0.866
#8	56938	15:59:56.231	56938	15:59:56.231	56938	15:59:57.014	0.860
#9	7553	15:59:54.171	7553	15:59:54.171	7553	15:59:55.099	0.853
#10	53648	15:59:54.171	53648	15:59:54.171	53648	15:59:55.099	0.853

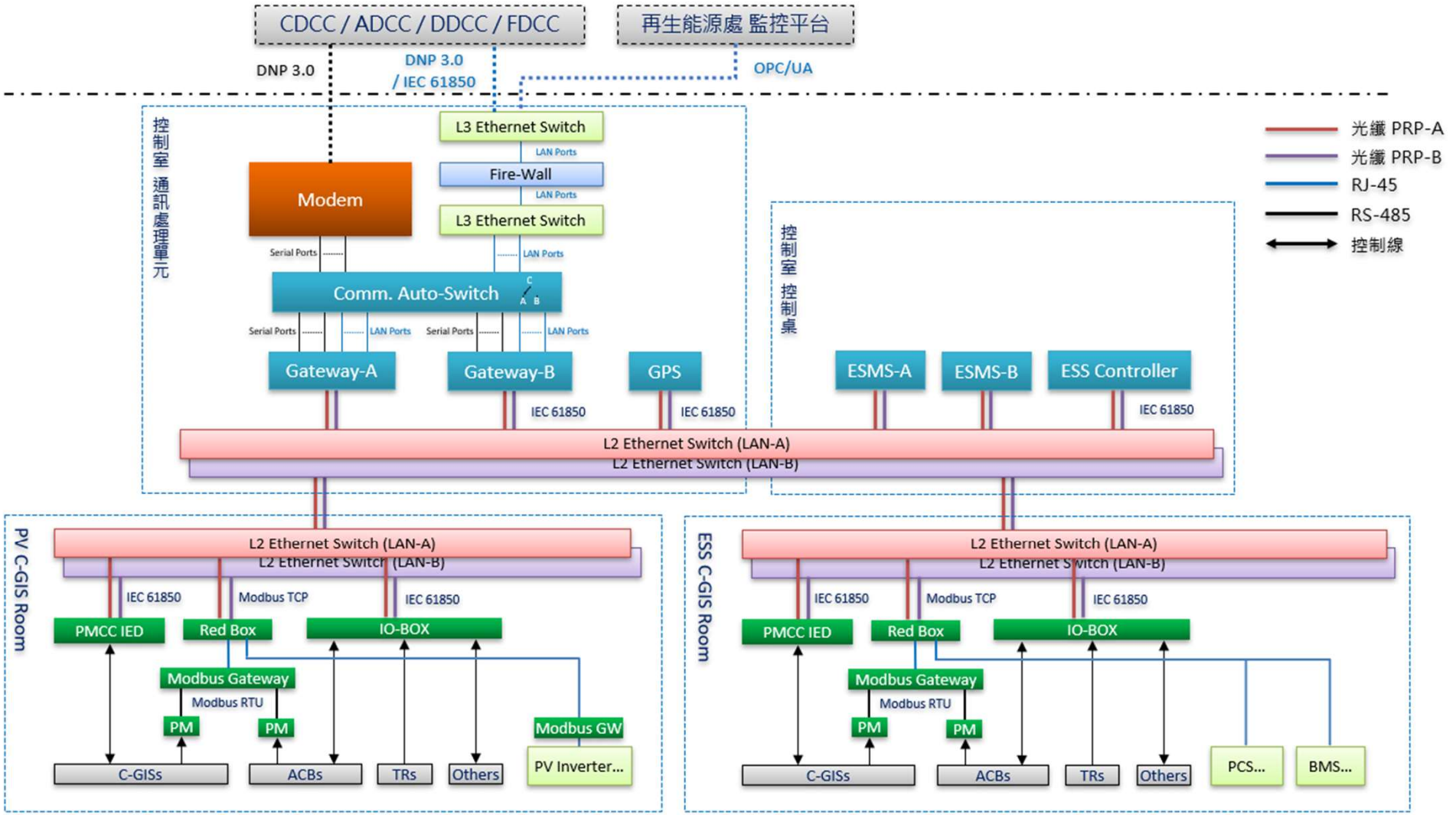
EMS & Microgrid Based on IEC 61850

AnsisGrid Controller



INNOVATION AND EXPERTISE IN SOFTWARE SOLUTIONS FOR PROCESS MANAGEMENT

Architecture of Solar + BESS + Substation



INNOVATION AND EXPERTISE IN SOFTWARE SOLUTIONS FOR PROCESS MANAGEMENT

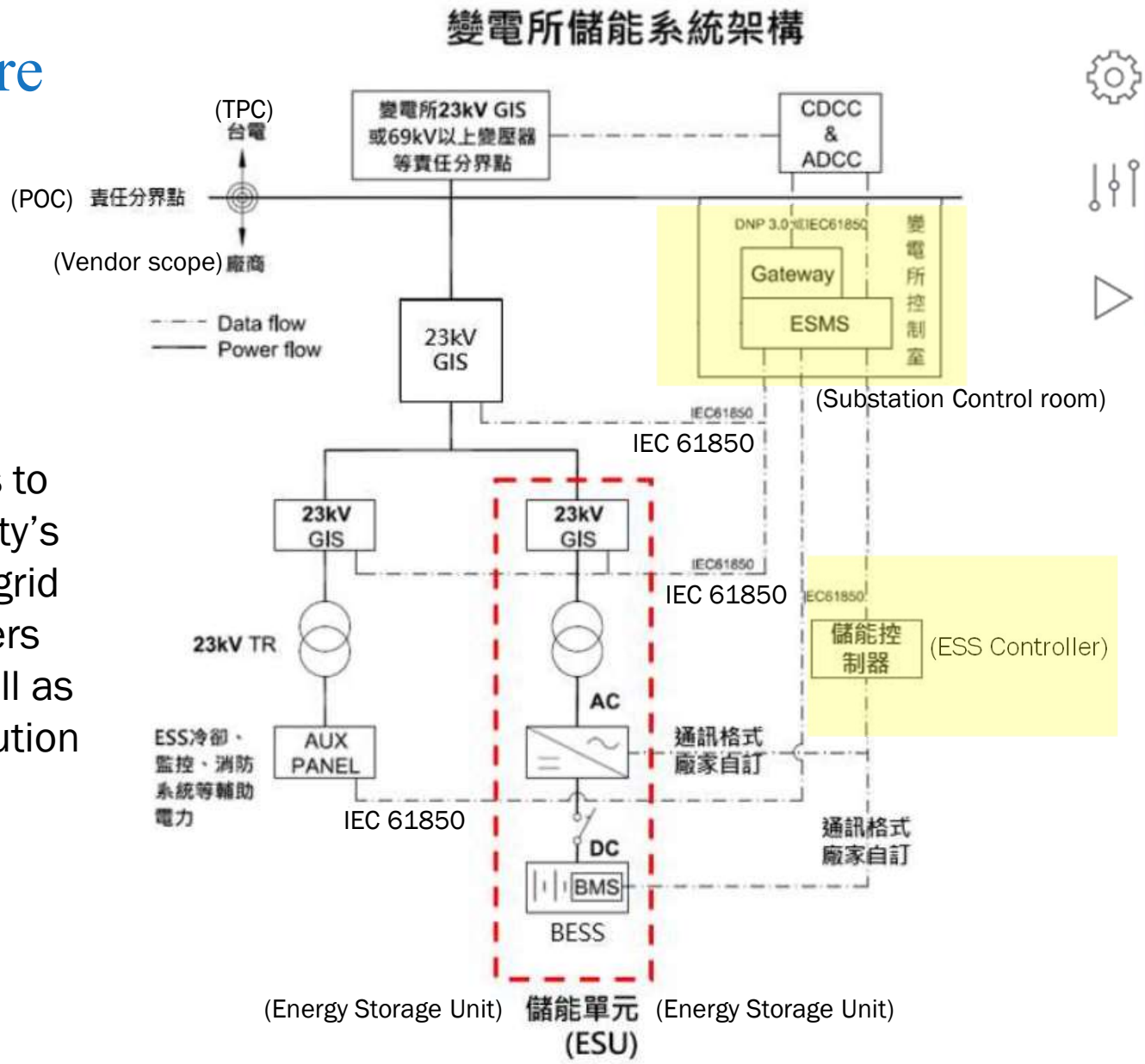
elipse software


Case study
Completed three projects in 2023
Taiwan Power Company
Energy Storage System in Microgrid application

Substation Architecture
(from TPC specification)

Elipse software scope

Elipse's scope in the project is to integrate and control third party's PCS and BMS to regulate the grid frequency and other parameters such as P,Q and voltage as well as the load control in TPC distribution network.



INNOVATION AND EXPERTISE IN SOFTWARE SOLUTIONS FOR PROCESS MANAGEMENT

elipse software

AnsisGrid Controller

Application Services
- Grid Service (0.25/0.5 dReg)
- Operation Control

Immediate operation monitoring
- Application Service Operation Status
- Battery operation status
- PCS Operation Status
- Environmental Monitoring Information

Historical Information Inquiry
- Operational Data Storage and Historical Inquiry

Energy Storage Operation Control
- PCS, BMS/Battery cabinet integrated operation control
- FP, VQ, VP, RoCoF Automatic Mode
- SOC Regulation
- Constant P, Q Control
- Cyclic Charging and Discharging

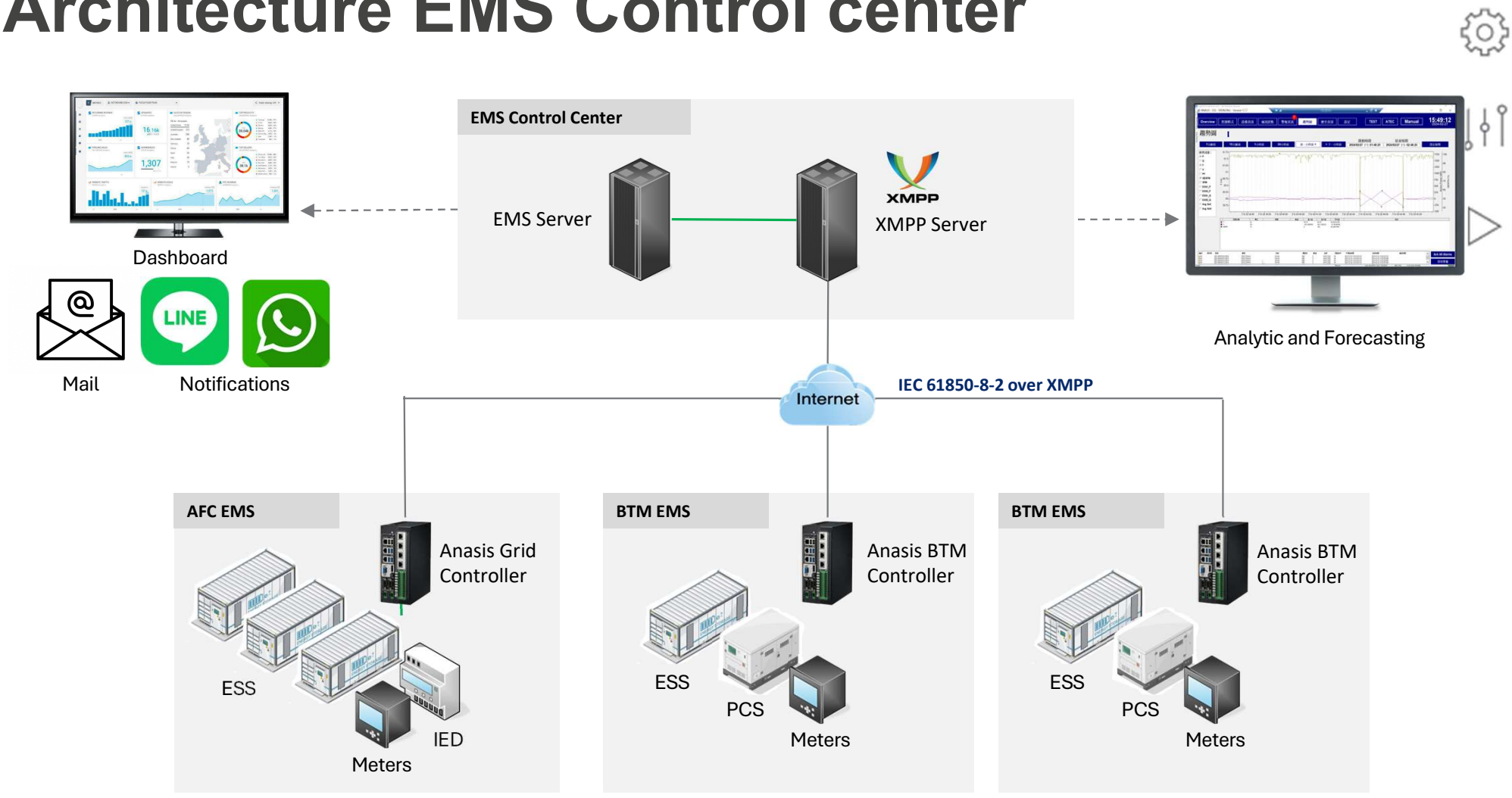
System Diagnostic Tests
- Step Output/Input Power
- Test Frequency Scan
- Rated Power Discharge Duration
- Rated Power Charge Duration
- Frequency Drop

Anomaly Detection and Alarm
- Exception Detection Parameter Settings
- HMI Display Different colors, Line Alarm

Upstream Communication
- Connection with existing SCADA Systems
- Via OPC UA, DNP3, IEC 61850, etc.
- Gateway Capabilities

Field Equipment Communication
- Connection with existing SCADA Systems
- DNP3, IEC 870-5-103, IEC 61850, Modbus, etc.
- +450 other standard legacy protocols

Architecture EMS Control center



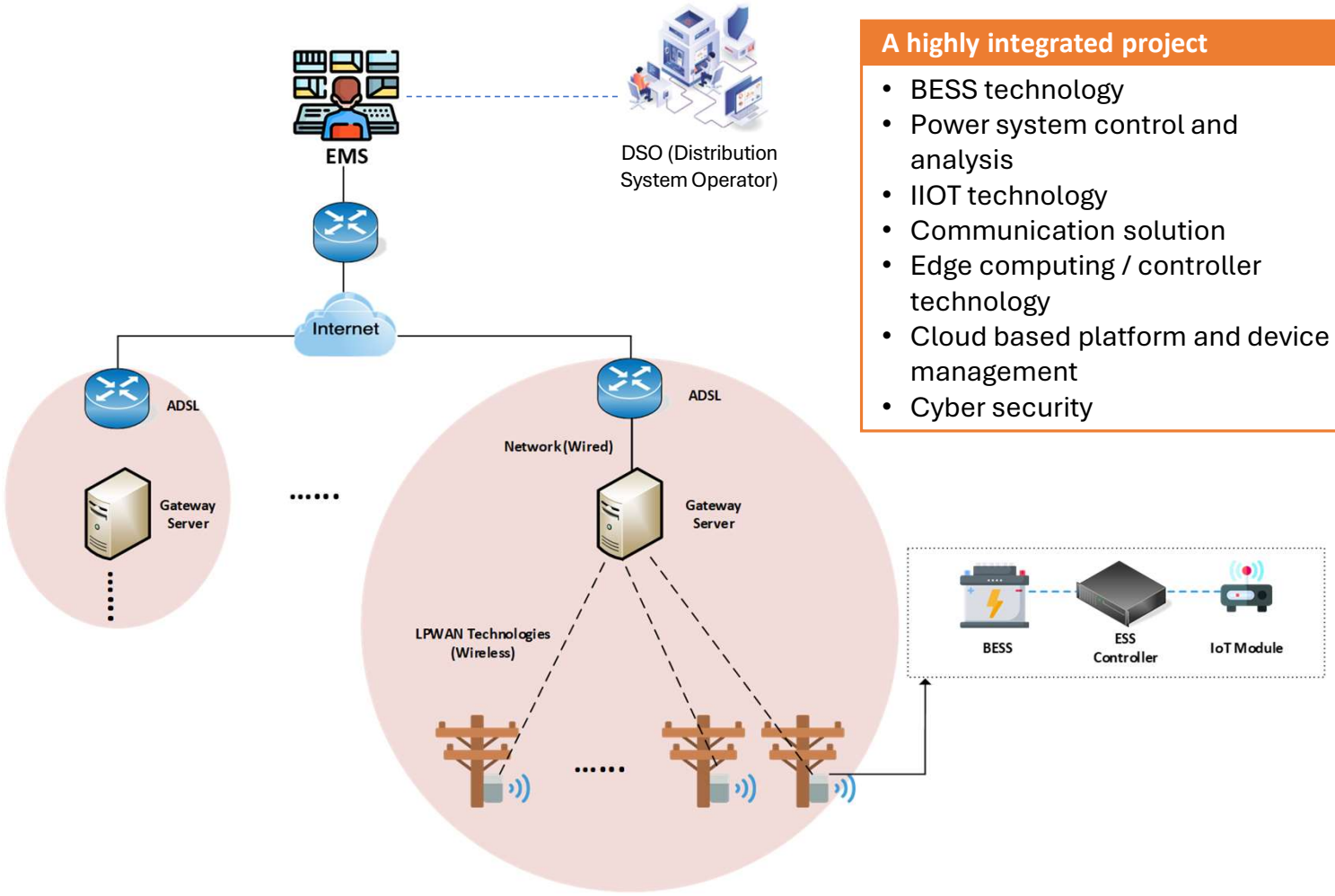
INNOVATION AND EXPERTISE IN SOFTWARE SOLUTIONS FOR PROCESS MANAGEMENT

elipse software

Distributed Pole mounted BESS

Pole-Mounted ESS Principle

- ESS installed on the **poles** in the distribution LV network.
- The number of poles are assumed to be large. Hence a **big amount of ESS controller** clients are installed in each area.
- Each area has a **gateway server** that monitors / controls the ESS controller clients via **LPWAN technologies**.
- The communication route from gateways to EMS will be **via Network**.
- The EMS needs to coordinate with **DSO**, providing the **ancillary services**.

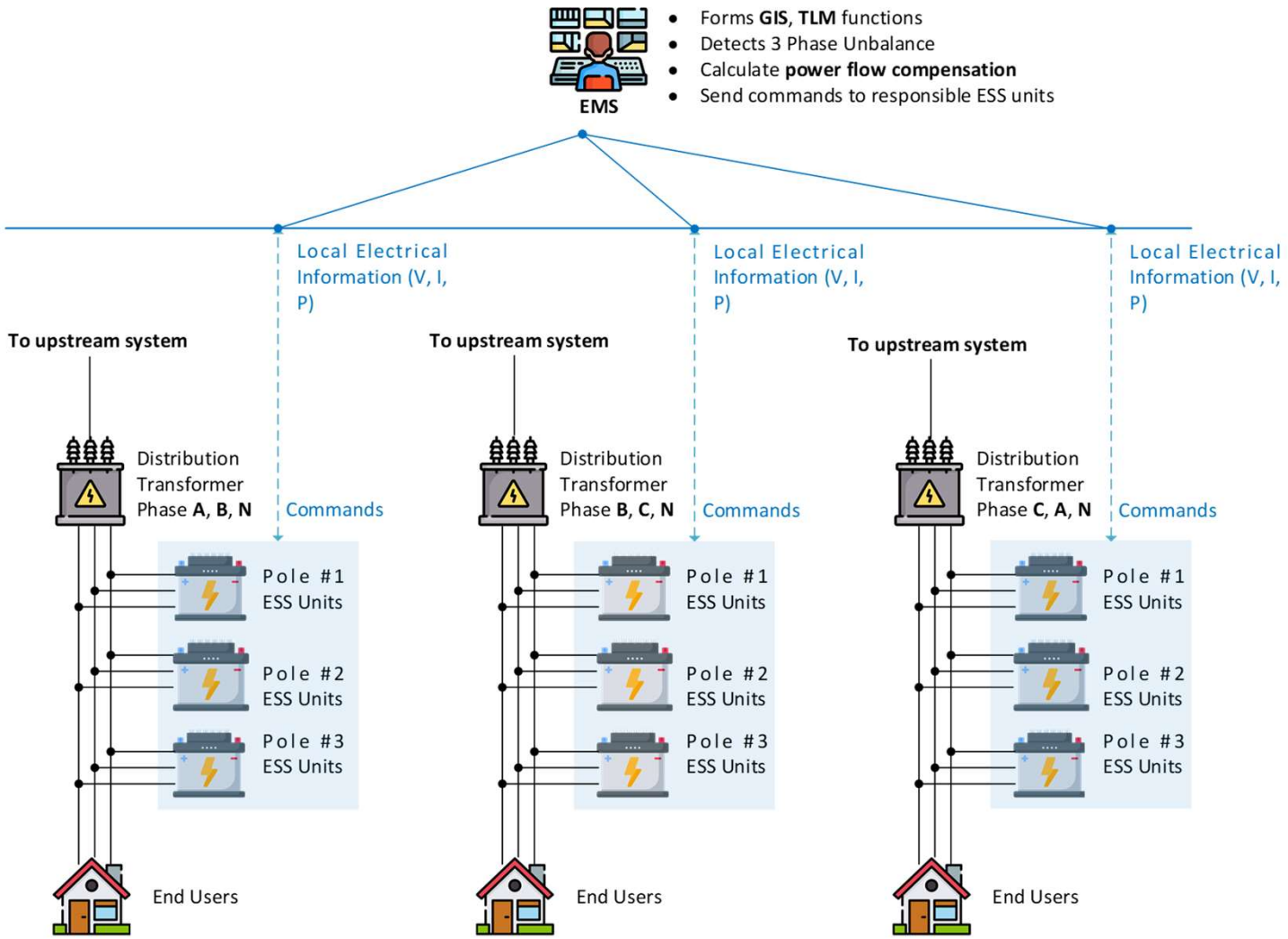


A highly integrated project

- BESS technology
- Power system control and analysis
- IIOT technology
- Communication solution
- Edge computing / controller technology
- Cloud based platform and device management
- Cyber security

The slide only proposes one of the many architectures available to this solution.

Mitigate 3-Phase Unbalance

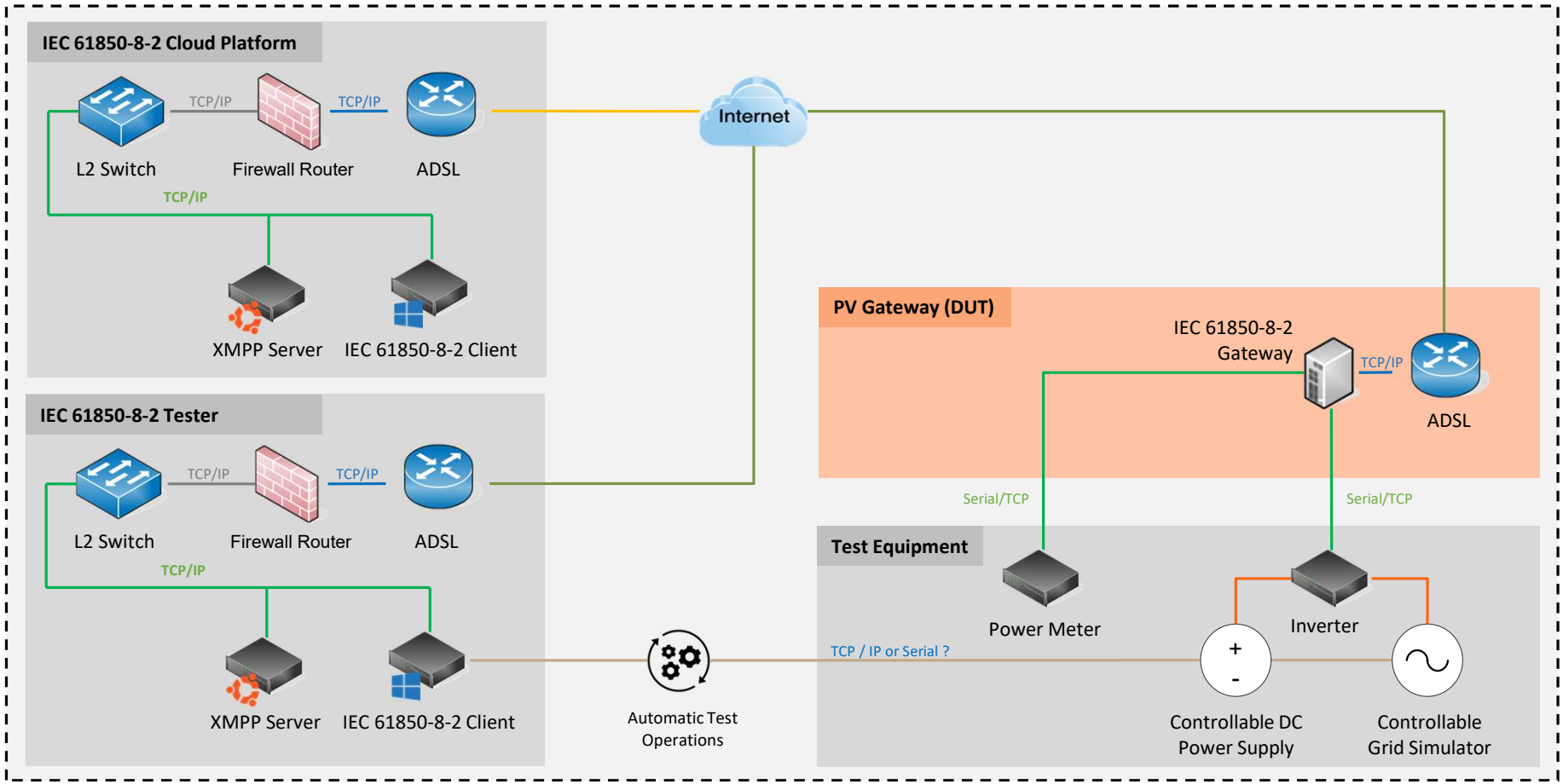


Pole-Mounted ESS Applications

- Based on the structure from previous slides, ESS units will return **local information** (split phase) to EMS.
- EMS will forms **GIS** (graphical information system) and detect three-phase unbalance.
- A sophisticated **ESS Unit management** system is required in EMS to **locate the related ESS units** of the region with unbalanced current.

- With data returned from ESS units, EMS could also develop **TLM** functions (transformer load management).

IEC 61850 XMPP Test Lab

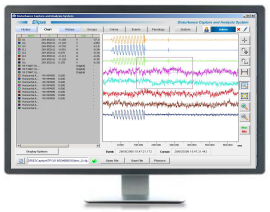


IEC 61850 Energy Transformation

Elipse Power

Control SCADA / ADMS

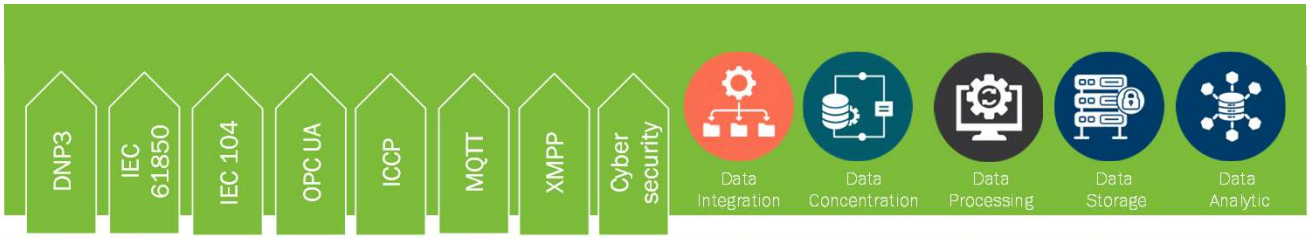
Elipse EPM

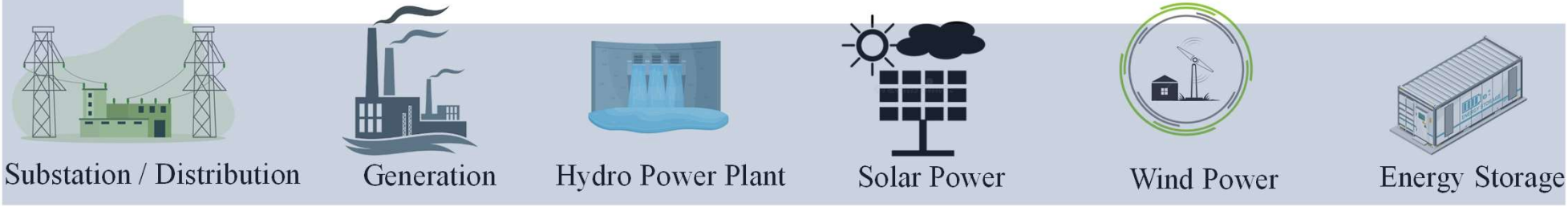


Digital Twins
Transformer Analysis

Disturbance Analysis

HMI / EDGE RTU/ GW





INNOVATION AND EXPERTISE IN SOFTWARE SOLUTIONS FOR PROCESS MANAGEMENT

elipse software

evan@elipse.com.tw

INNOVATION AND EXPERTISE IN
SOFTWARE SOLUTIONS FOR PROCESS MANAGEMENT

elipse
software