應用 XMPP 標準串接分散式能源監控之建置

台電綜研所 資通室
卓啟翔

2022年11月11日

母片為綜研所資通室設計專用，請勿套用

大綱

壹 淨零碳排與DER標準發展

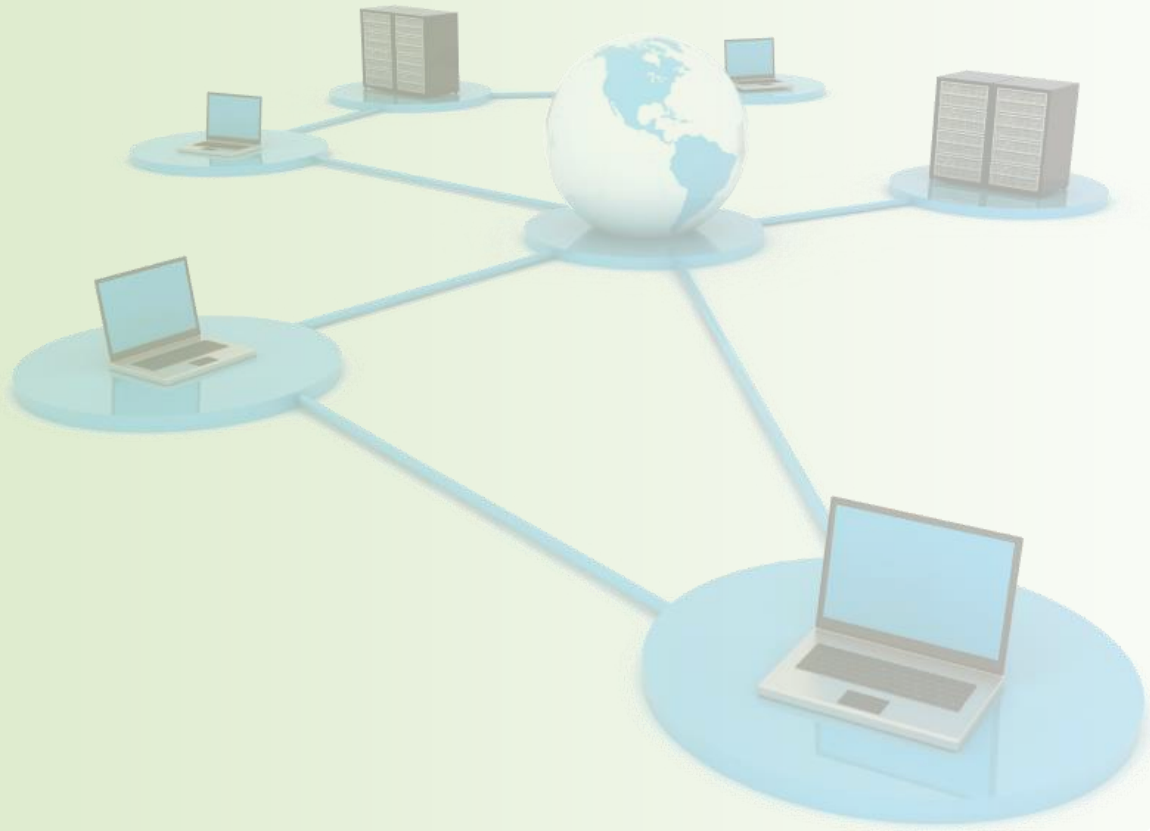
貳 智慧電網核心標準與IEC 61850 XMPP

參 XMPP平台架構說明

肆 實作與結果

伍 結論

壹 淨零碳排與DER標準發展

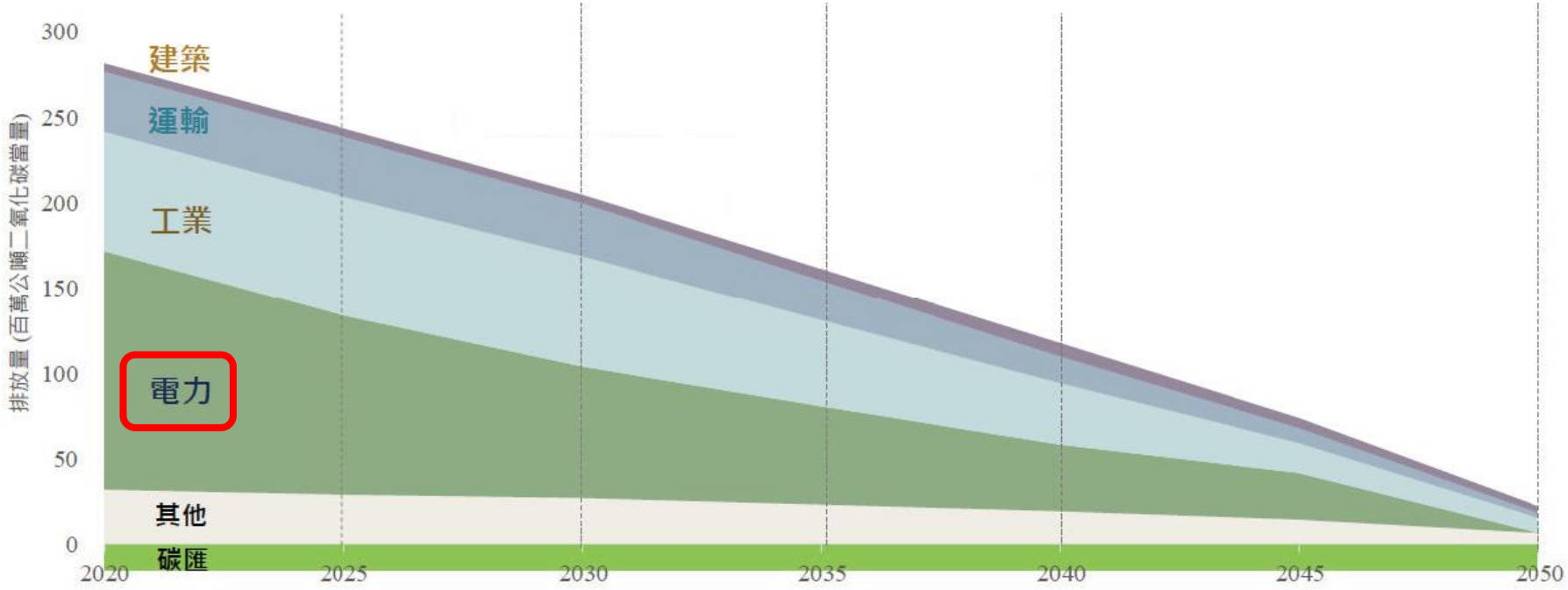


壹

國發會淨零碳排路徑

淨零碳排策略可分為建築、運輸、工業、電力、負碳技術共五類。

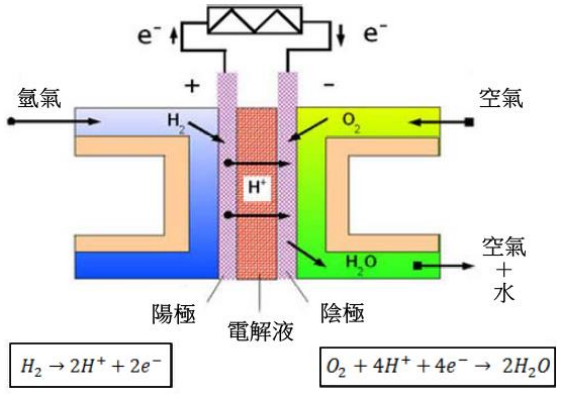
電力目標為擴大再生能源、發展新能源科技、儲能、升級電網。



資料來源：國家發展委員會

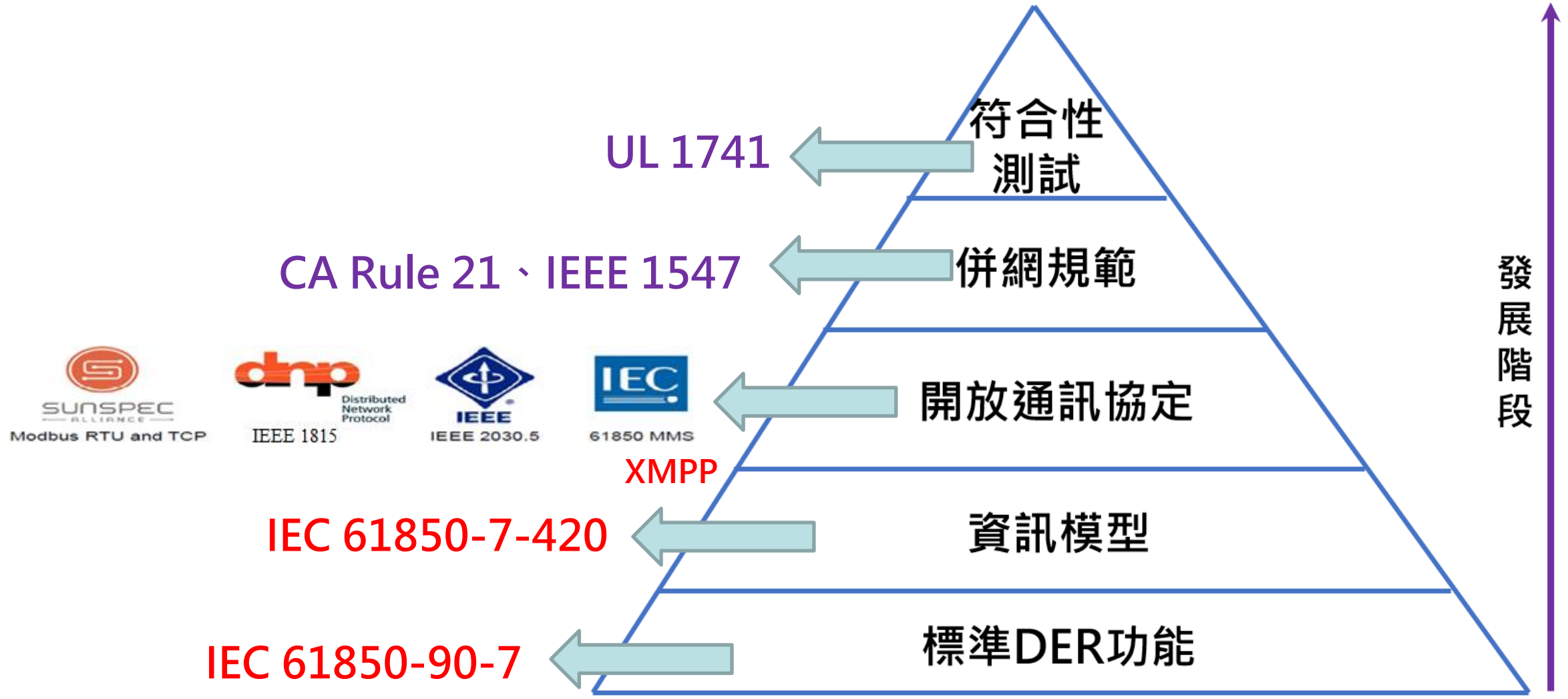
壹 DER範疇

- 全稱為Distributed Energy Resources，簡稱DER 。
- 與傳統火力、核能以及水力之集中式發電不同，主要包含太陽能發電、儲能電池、電動車與往復式發動機等。
- 大多屬不穩定電源，大量併入電網需考慮供電及調度穩定性



壹

DER標準發展



資料來源: Common Functions for Smart Inverters

貳 智慧電網核心標準

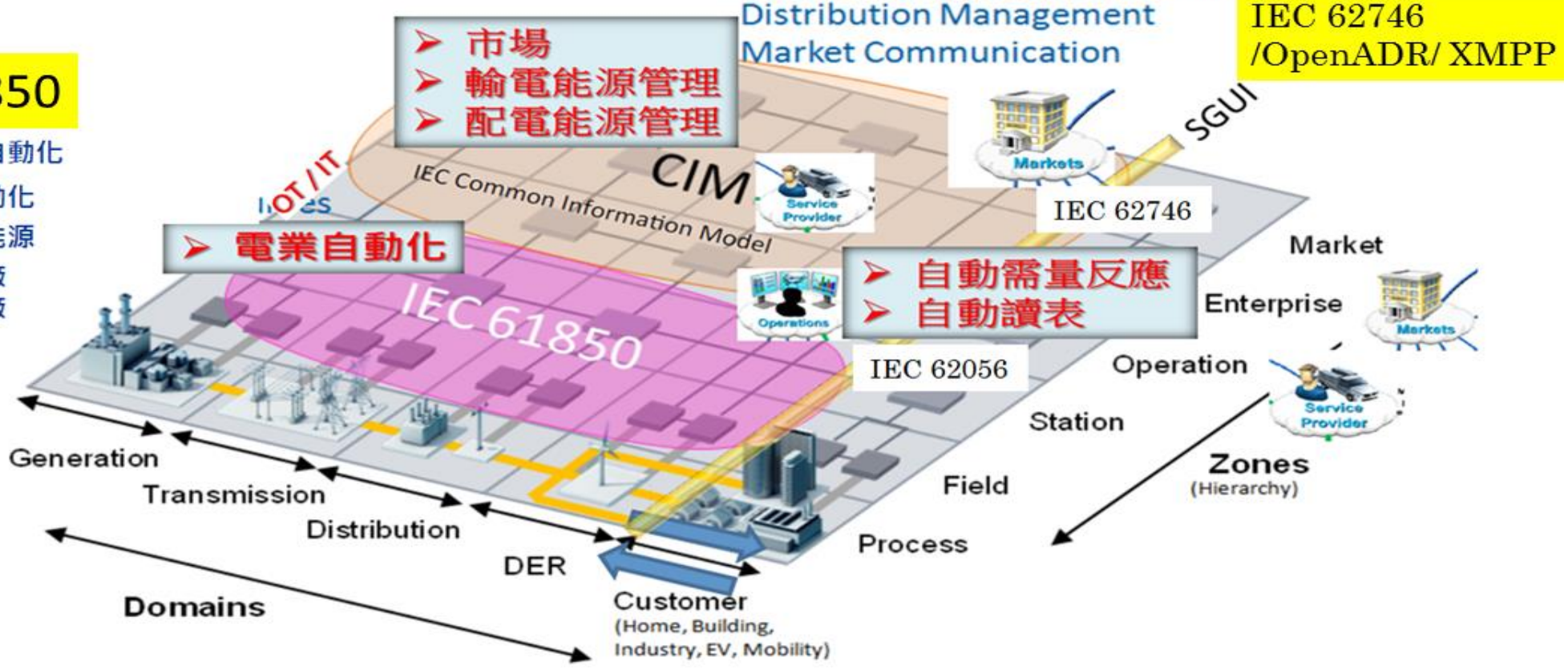
貳 智慧電網核心標準

IEC TC57 定義智慧電網資訊流主流骨幹標準

IEC 62351

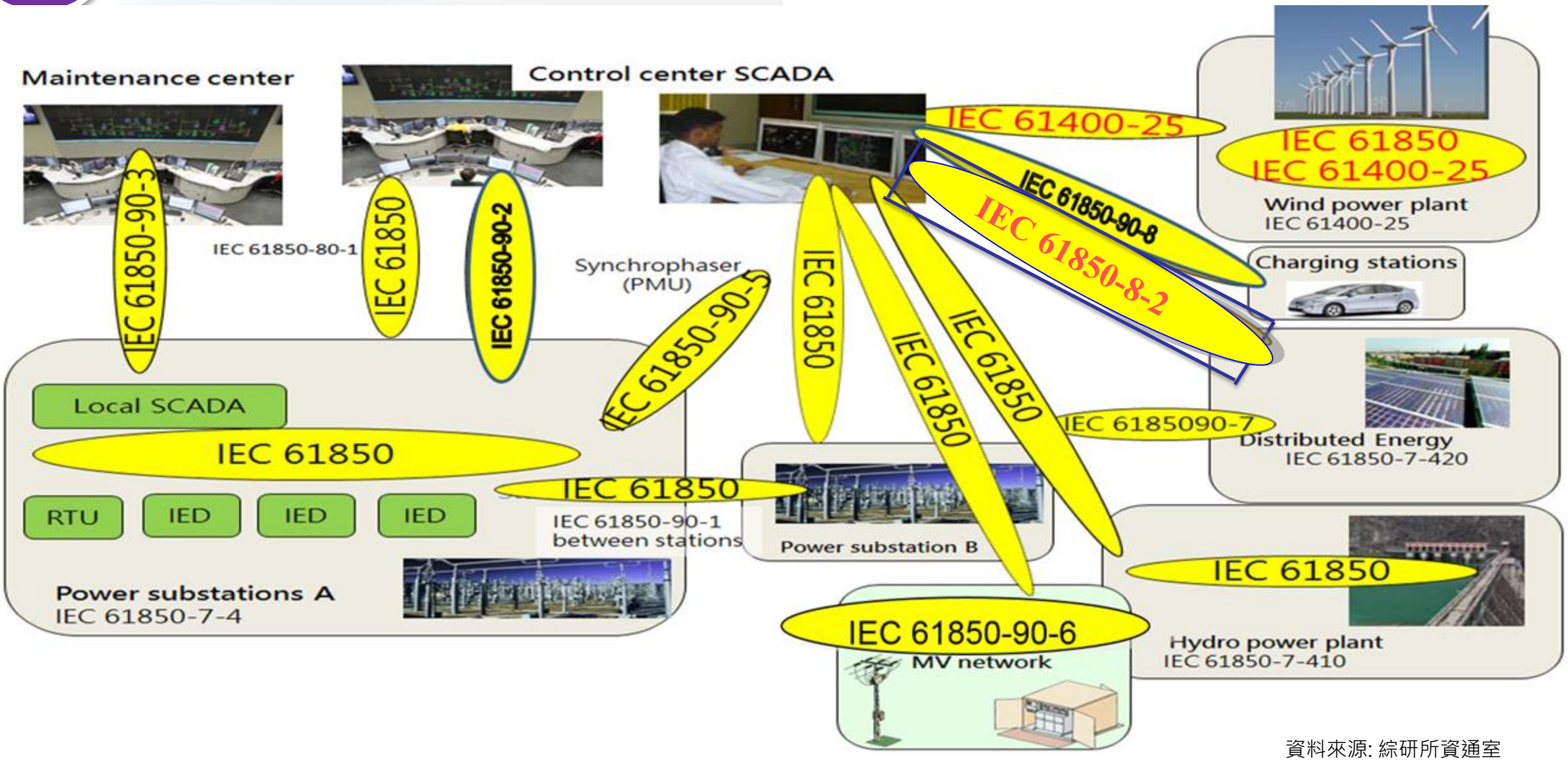
IEC 61850

變電所自動化
配電自動化
分散式能源
水力電廠
風力電廠
...



資料來源: IEC TC 57

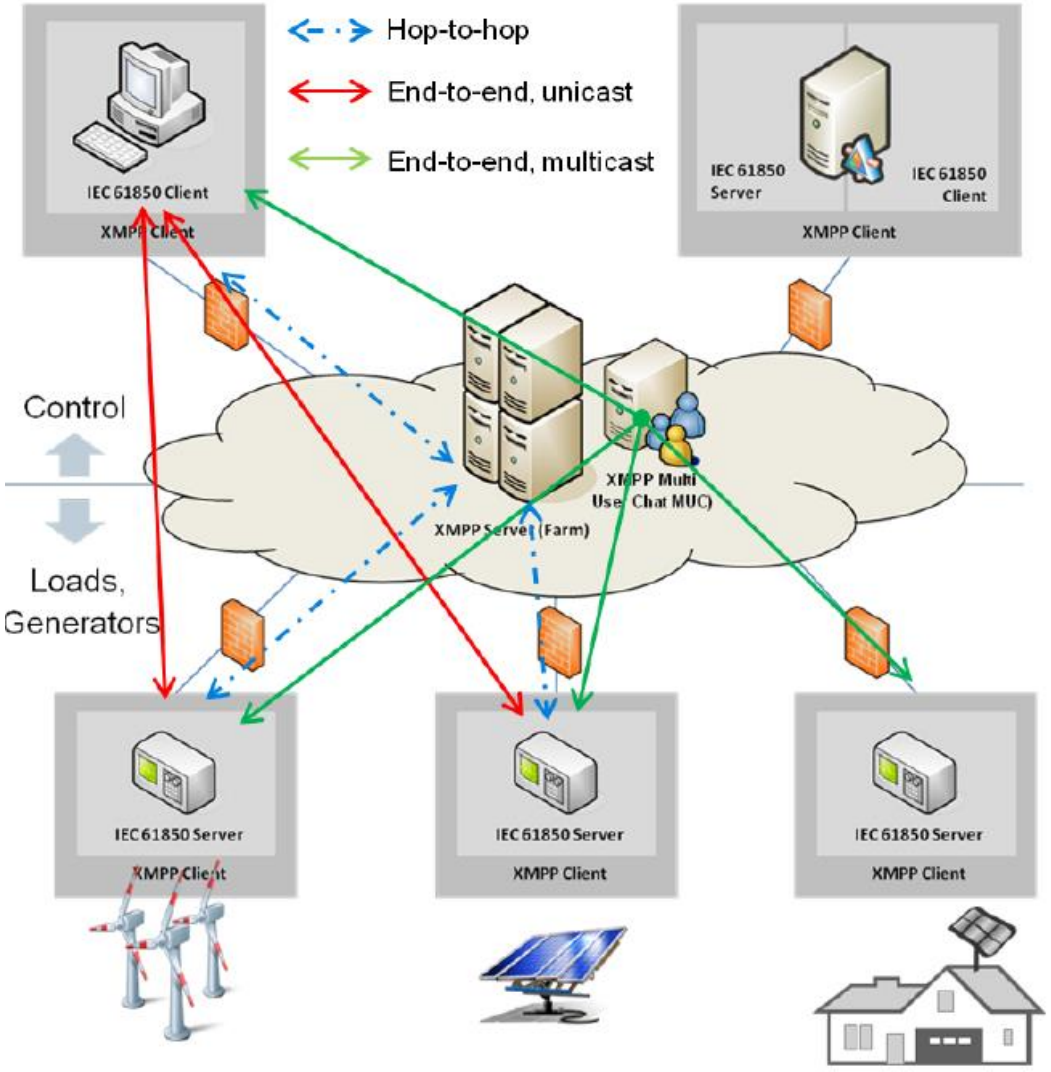
貳 IEC 61850標準應用



資料來源: 綜研所資通室

貳

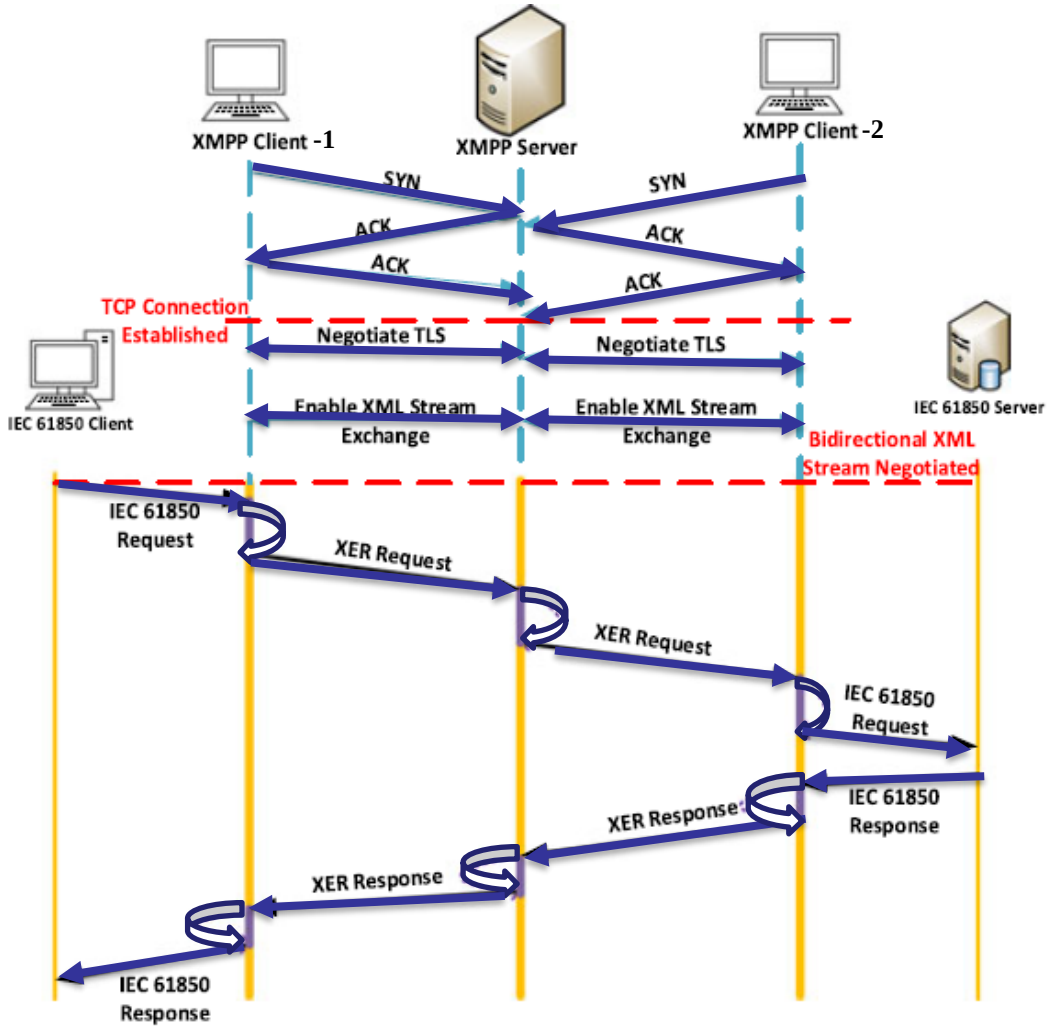
IEC 61850-8-2 XMPP(1/4) 架構說明

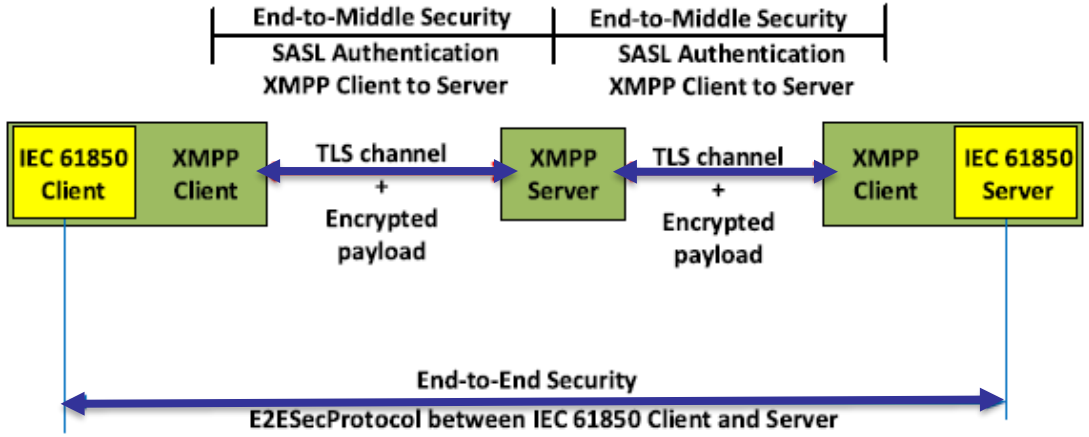


資料來源: IEC 61850-8-2

貳 IEC 61850-8-2 XMPP(2/4)

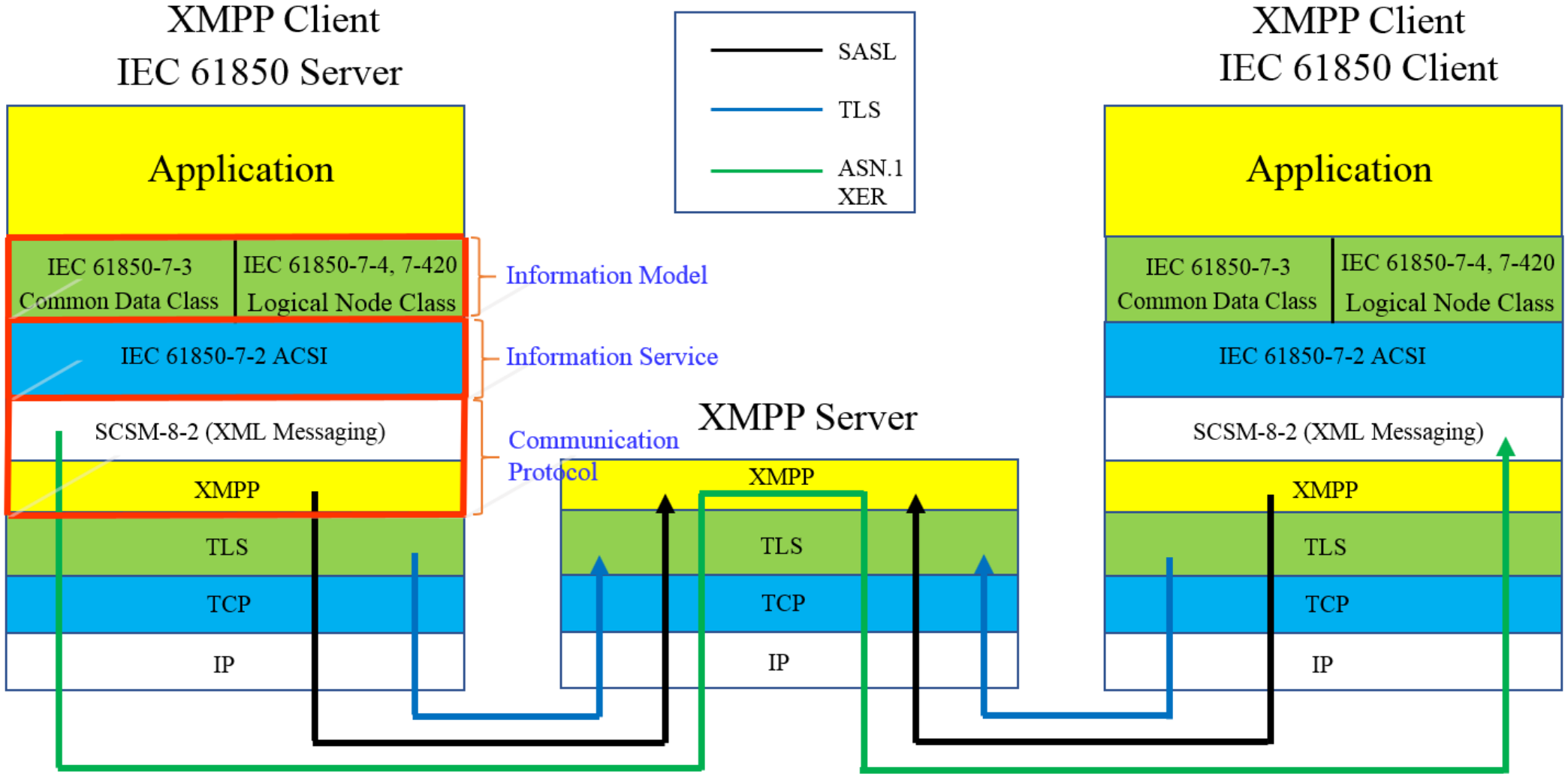
資安強化





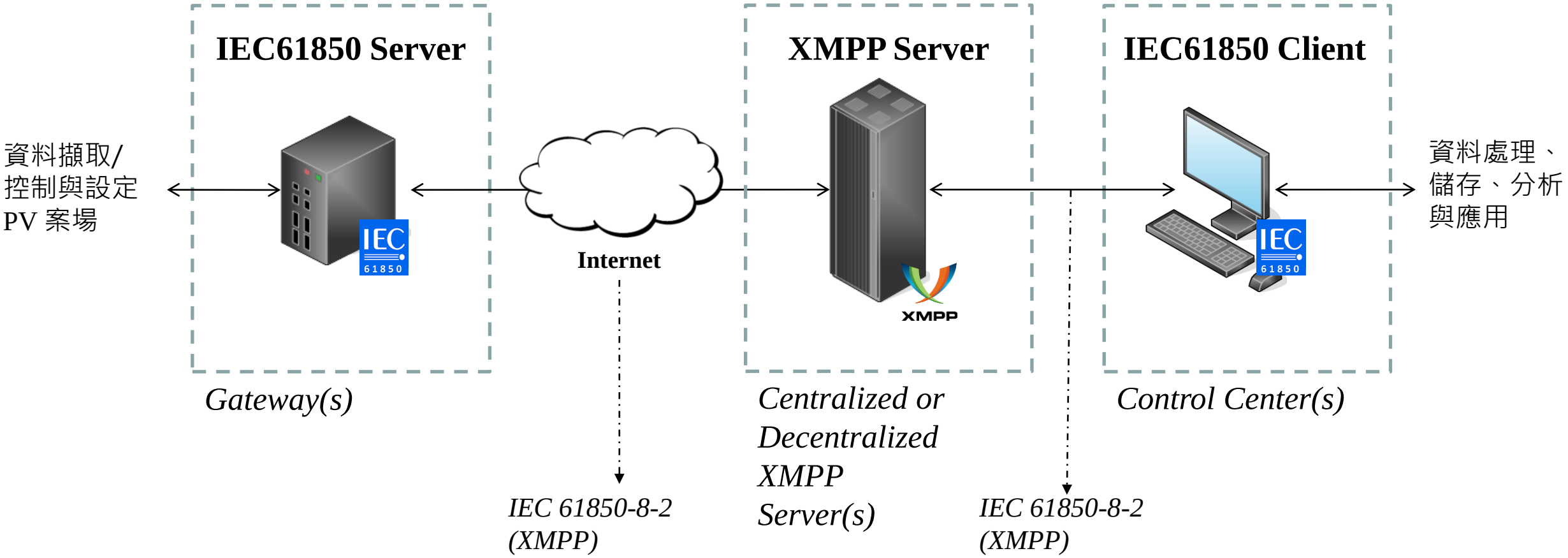
資料來源: IEC 61850 Modeling of DSTATCOM and XMPP Communication for Reactive Power Management in Microgrids, 2018, *IEEE Systems Journal.*

IEC 61850-8-2 XMPP(3/4)

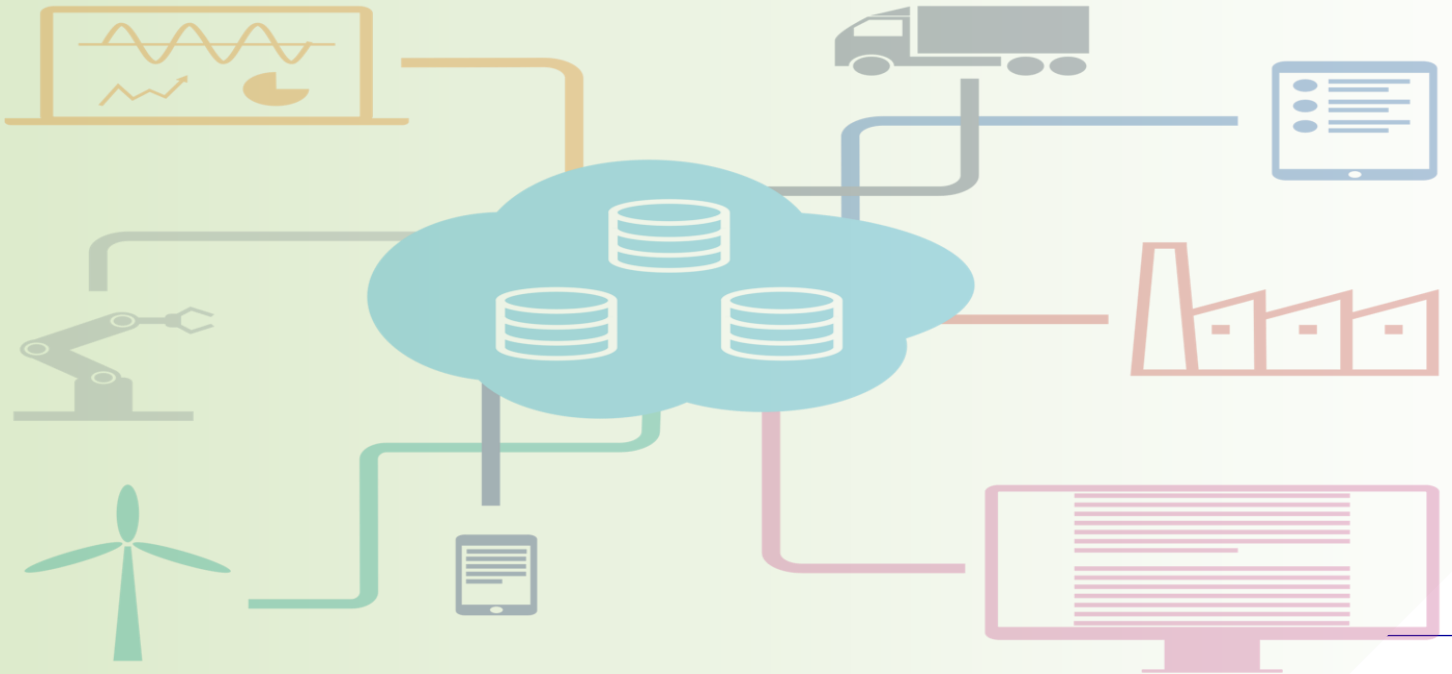


IEC 61850-8-2 XMPP(4/4)

主從式通訊架構



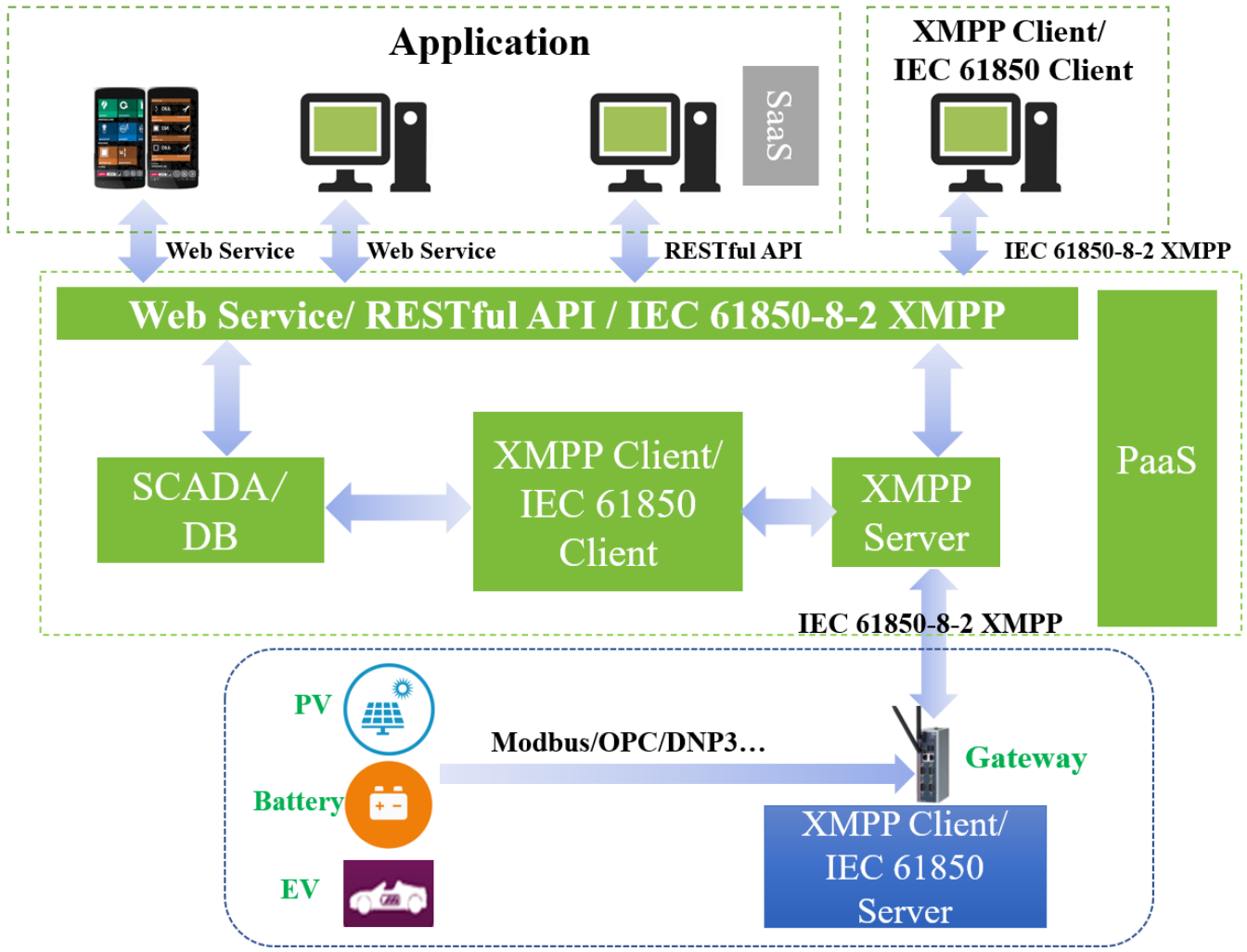
叁 XMPP平台架構說明



參 XMPP平台架構說明1/2

1. 遵循 IEC 62357 智慧電網架構模型。
2. 資訊模型根據 IEC 61850-7-4 與 IEC 61850-7-420。
3. 通訊協定基於 IEC 61850-8-2 XMPP。
4. 雲端管理平台採用工業物聯網架構。
5. 提供DER案場協定轉換，可以達到標準化與即插即用功能。

參 XMPP平台架構說明2/2



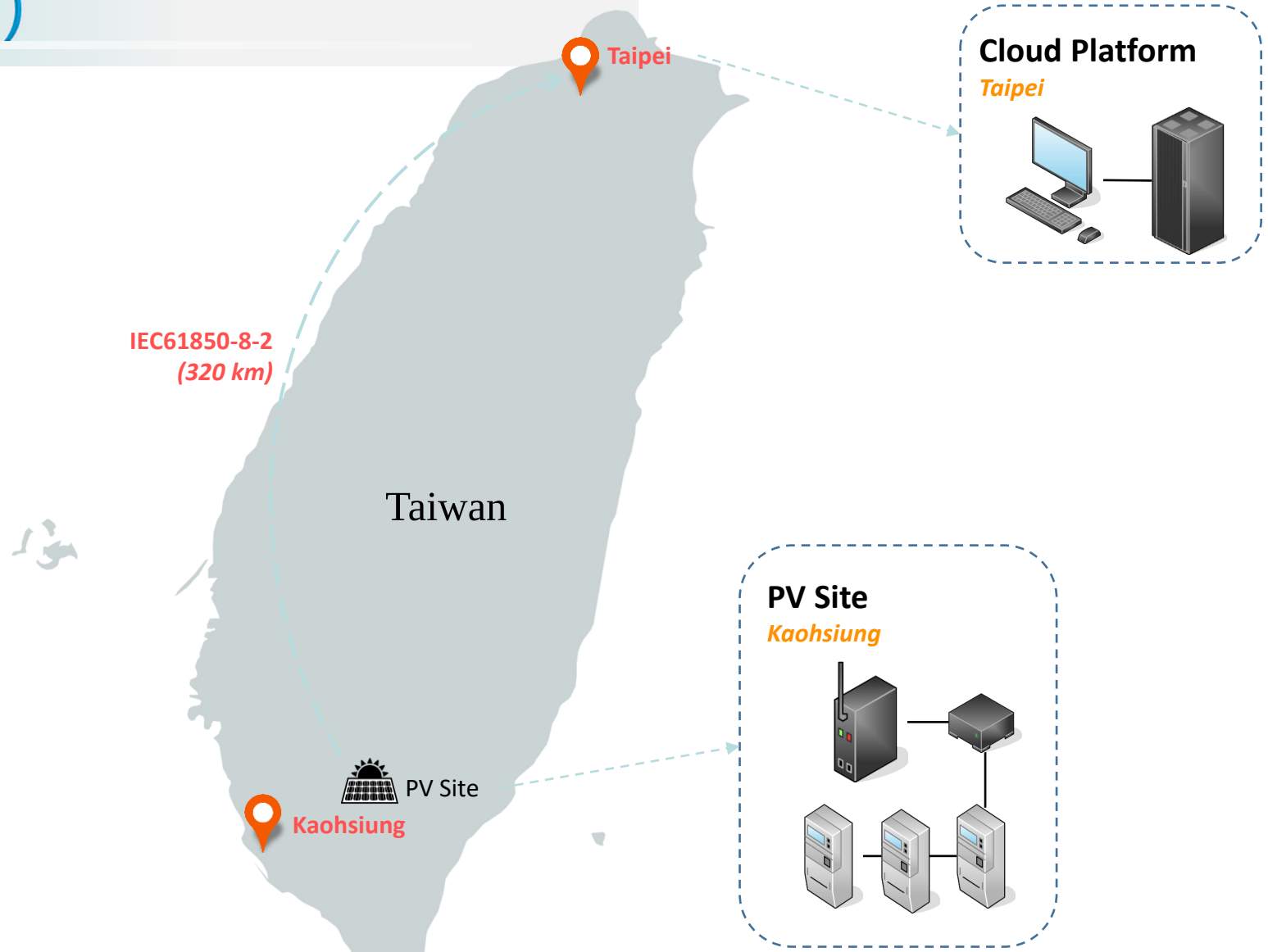
Applications and Services

Cloud Platform

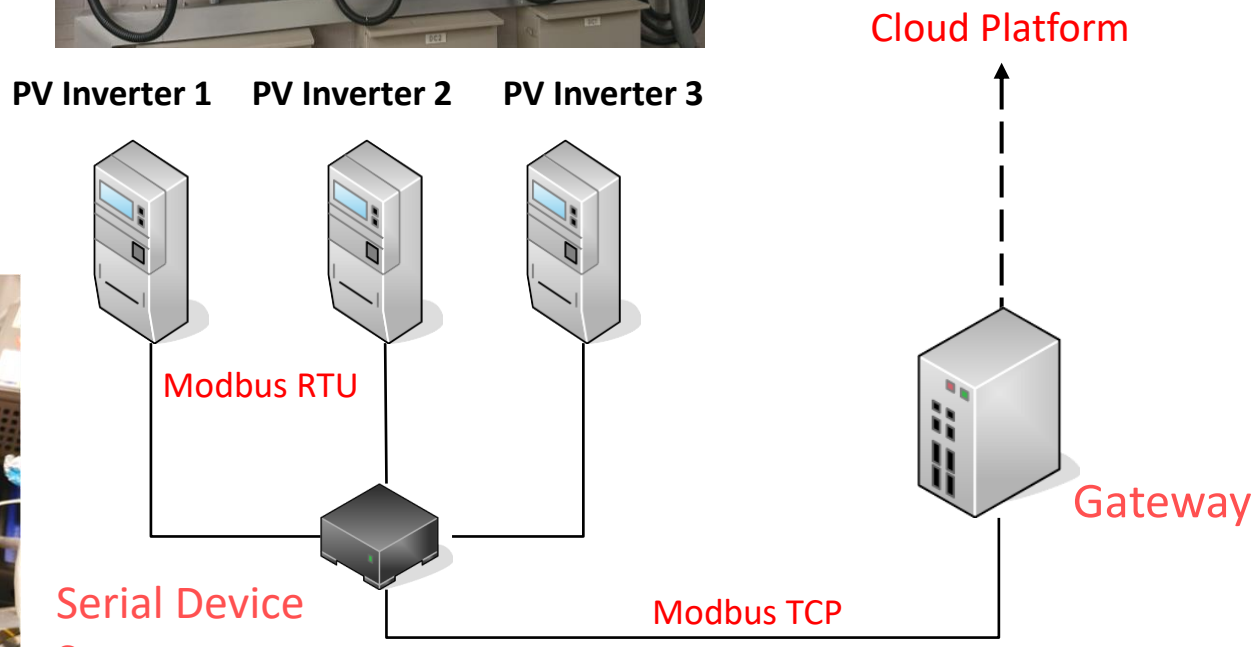
Protocol Conversion

肆 實作與結果

肆 實作(1/3)


Taipei
Cloud Platform
Taipei
IEC61850-8-2
(320 km)
Taiwan
PV Site
Kaohsiung
PV Site
Kaohsiung

肆 實作(2/3)


PV Inverter 1
PV Inverter 2
PV Inverter 3
Modbus RTU
Serial Device Server
Modbus TCP
Cloud Platform
Gateway

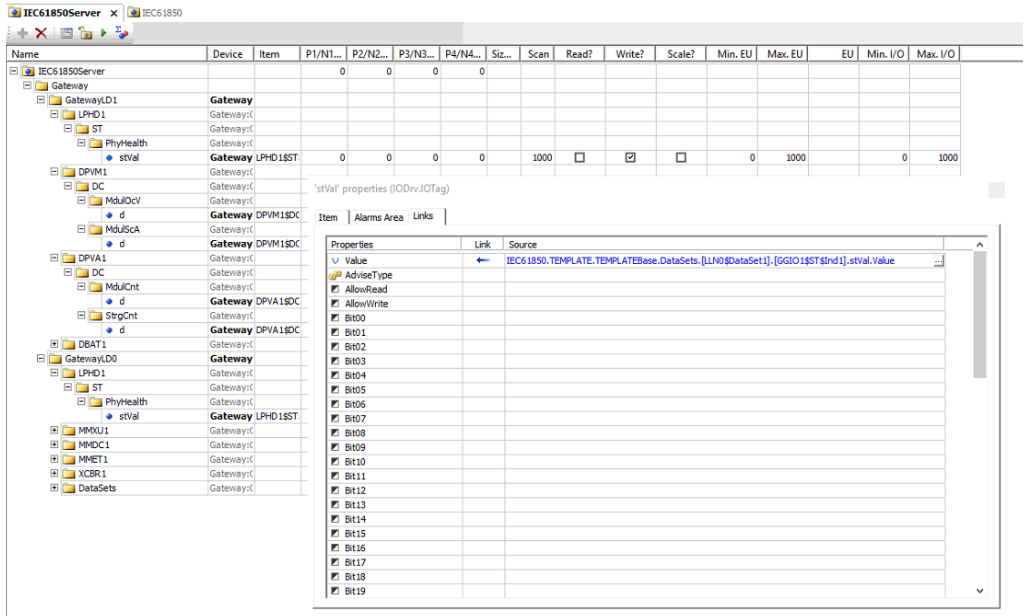
肆 實作(3/3)

(1) Modbus

Modbus Address	Name	Type
0x0148	Generator Current Line 1	uint32
0x004C	Grid Voltage	uint32
0x004E	Grid Frequency	uint32
0x00E8	GRID Output Energy This Hour	uint32

Protocol Conversion

IEC 61850 Information Model



(2) DNP 3

Point Index	Name / Description
8	Inverter active power output - Present real power output level (negative = charging)
9	Inverter reactive output - Present reactive power output level (negative = absorbing)
10	Frequency at the connection point
11	Active power at the connection point
12	Reactive power at connection point
13	Power factor at the connection point
14	Phase A Volts at connection point
15	Phase A Volts angle
16	Phase B Volts at connection point
17	Phase B Volts angle
18	Phase C Volts at connection point
19	Phase C Volts angle
20	DC Inverter input power
21	DC current level available to inverter
22	DC voltage between PV system and inverter

(3) OPC

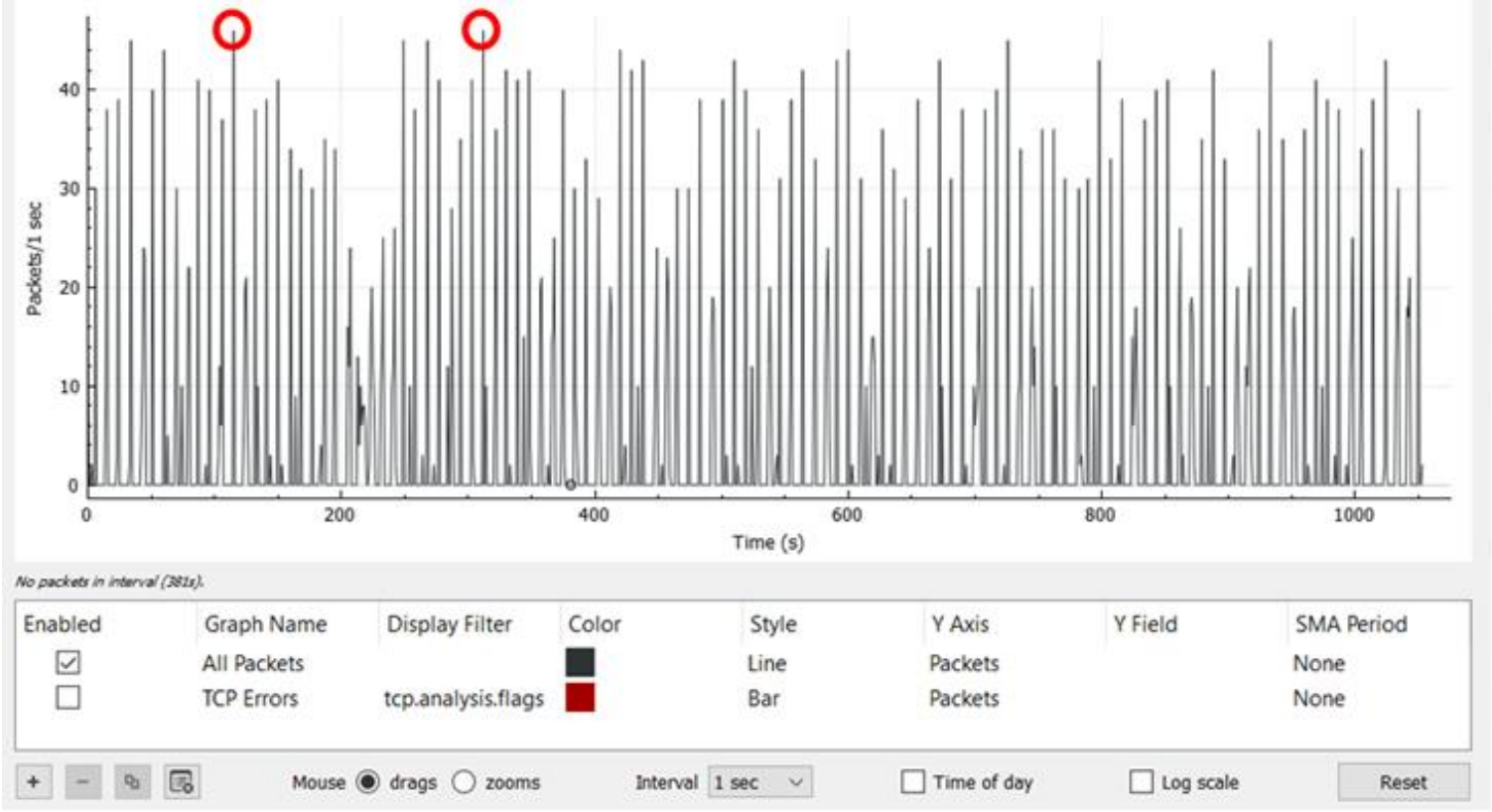
ObjectType	Name
OPCDriver	
OPCGroup	OPCGroup1
OPCTag	OPCGroup1.Ambient_Temp
OPCTag	OPCGroup1.Module_Temp
OPCFolder	OPCGroup1.Inverter
OPCTag	OPCGroup1.Inverter.ac_output_power
OPCTag	OPCGroup1.Inverter.input_power_a
OPCTag	OPCGroup1.Inverter.input_power_b
OPCFolder	OPCGroup1.MP960
OPCTag	OPCGroup1.MP960.Current
OPCTag	OPCGroup1.MP960.Freq
OPCTag	OPCGroup1.MP960.Imp_kWH_Hi
OPCTag	OPCGroup1.MP960.Imp_kWH_Low
OPCTag	OPCGroup1.MP960.Imp_kWH_Mid
OPCTag	OPCGroup1.MP960.kW
OPCTag	OPCGroup1.MP960.PF
OPCTag	OPCGroup1.MP960.Voltage
OPCFolder	OPCGroup1.Solar_Radionation
OPCTag	OPCGroup1.Solar_Radionation.PV

肆 結果(1/3)

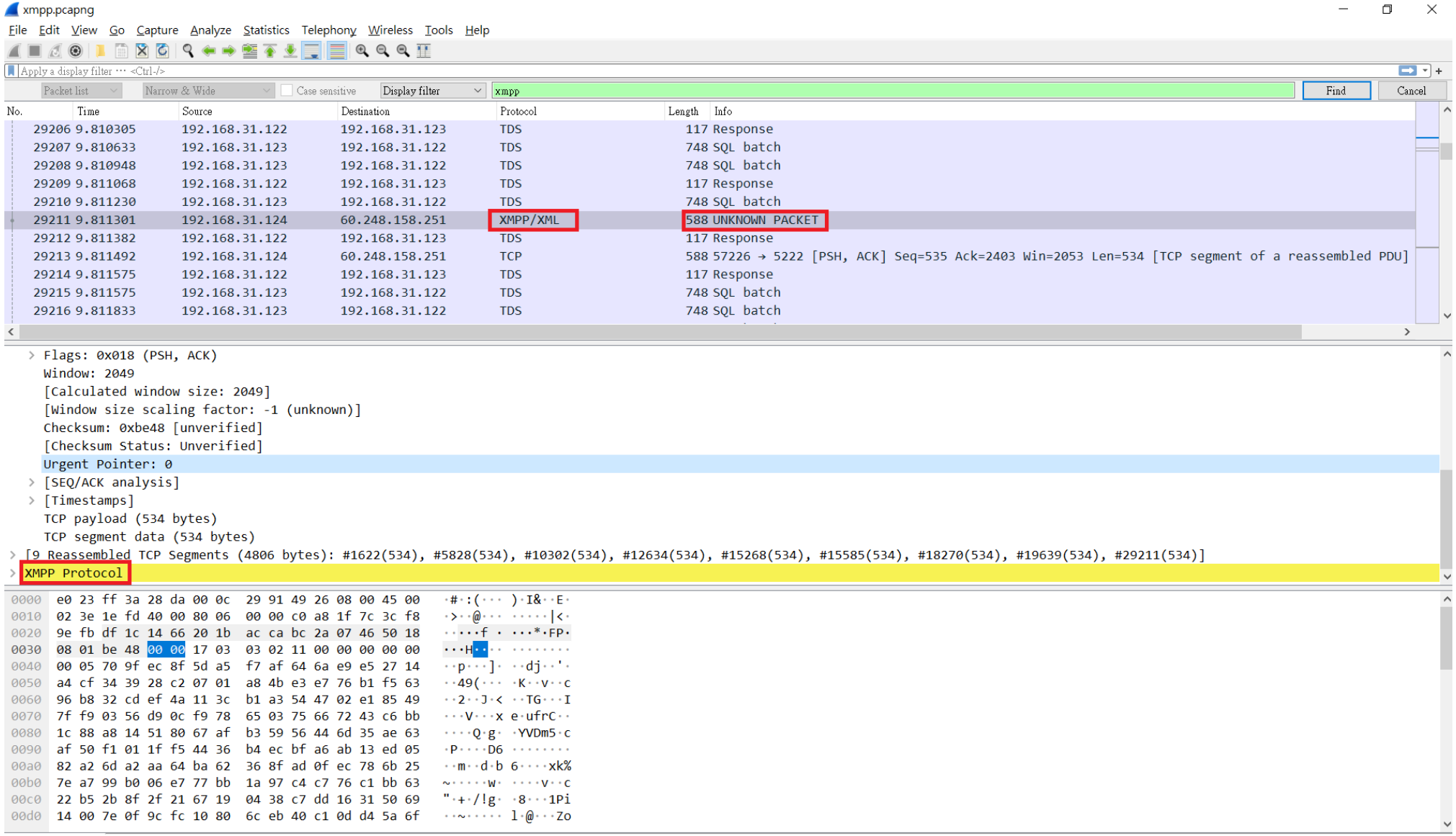
Packet evaluation of XMPP protocol.

The maximum packet is 43 per second.

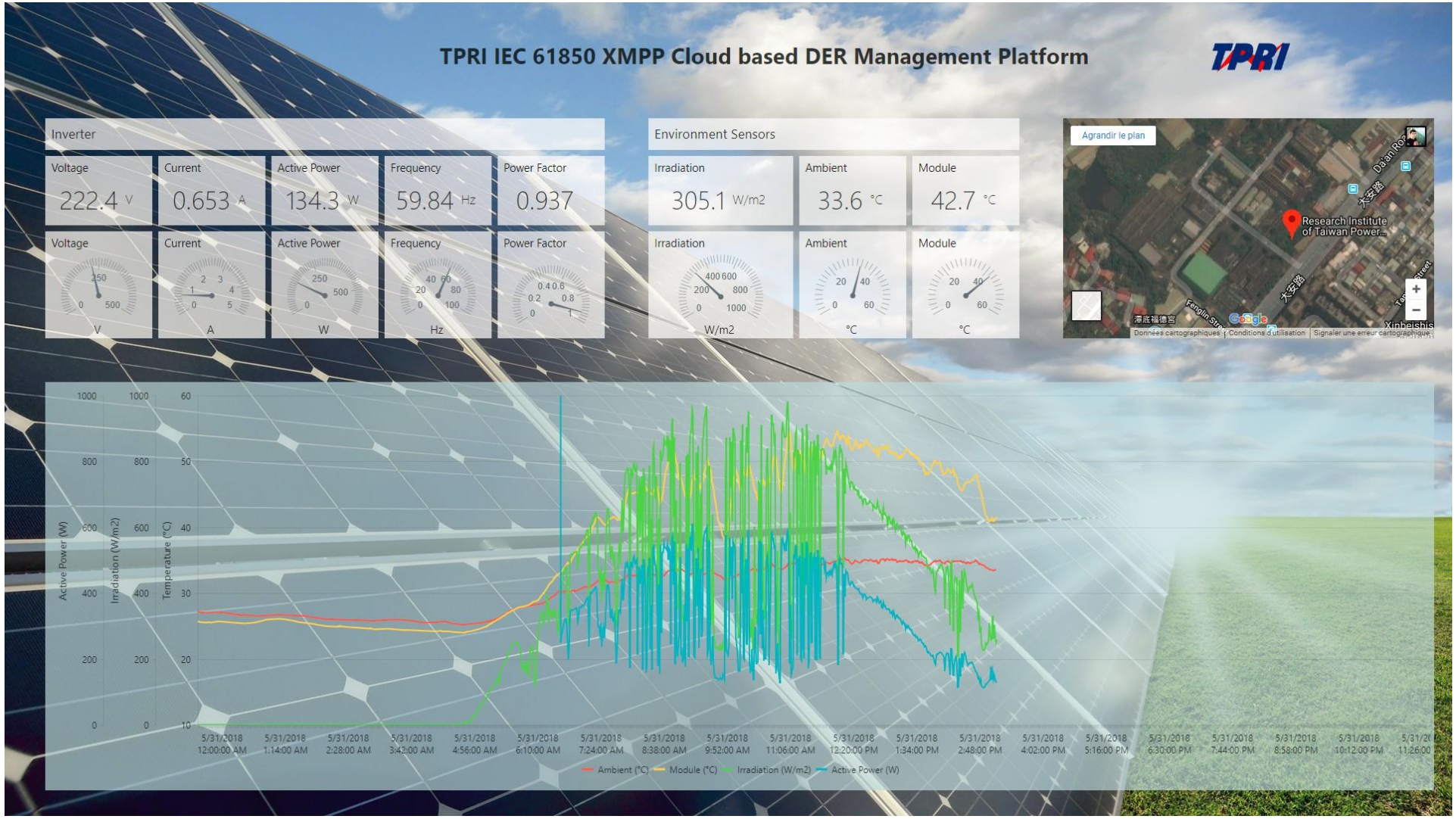
The average bandwidth is 26 Kbps.

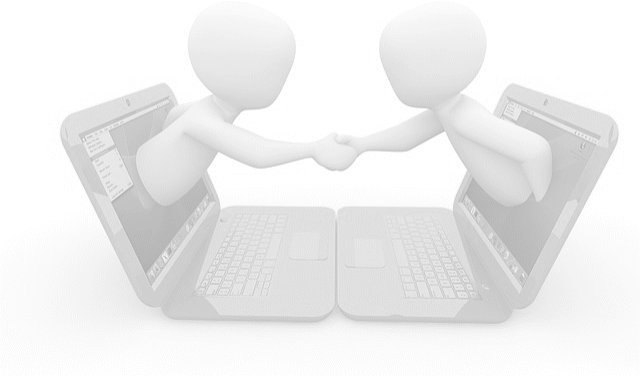


肆 結果(2/3)


xmpp.pcapng
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ··· <Ctrl-/>
Packet list Narrow & Wide Case sensitive Display filter xmpp Find Cancel
No. Time Source Destination Protocol Length Info
29206 9.810305 192.168.31.122 192.168.31.123 TDS 117 Response
29207 9.810633 192.168.31.123 192.168.31.122 TDS 748 SQL batch
29208 9.810948 192.168.31.123 192.168.31.122 TDS 748 SQL batch
29209 9.811068 192.168.31.122 192.168.31.123 TDS 117 Response
29210 9.811230 192.168.31.123 192.168.31.122 TDS 748 SQL batch
29211 9.811301 192.168.31.124 60.248.158.251 XMPP/XML 588 UNKNOWN PACKET
29212 9.811382 192.168.31.122 192.168.31.123 TDS 117 Response
29213 9.811492 192.168.31.124 60.248.158.251 TCP 588 57226 → 5222 [PSH, ACK] Seq=535 Ack=2403 Win=2053 Len=534 [TCP segment of a reassembled PDU]
29214 9.811575 192.168.31.122 192.168.31.123 TDS 117 Response
29215 9.811575 192.168.31.123 192.168.31.122 TDS 748 SQL batch
29216 9.811833 192.168.31.123 192.168.31.122 TDS 748 SQL batch
Flags: 0x018 (PSH, ACK)
Window: 2049
[Calculated window size: 2049]
[Window size scaling factor: -1 (unknown)]
Checksum: 0xbe48 [unverified]
[Checksum Status: Unverified]
Urgent Pointer: 0
[SEQ/ACK analysis]
[Timestamps]
TCP payload (534 bytes)
TCP segment data (534 bytes)
[9 Reassembled TCP Segments (4806 bytes): #1622(534), #5828(534), #10302(534), #12634(534), #15268(534), #15585(534), #18270(534), #19639(534), #29211(534)]
XMPP Protocol
0000 e0 23 ff 3a 28 da 00 0c 29 91 49 26 08 00 45 00
0010 02 3e 1e fd 40 00 80 06 00 00 c0 a8 1f 7c 3c f8
0020 9e fb df 1c 14 66 20 1b ac ca bc 2a 07 46 50 18
0030 08 01 be 48 00 00 17 03 03 02 11 00 00 00 00 00
0040 00 05 70 9f ec 8f 5d a5 f7 af 64 6a e9 e5 27 14
0050 a4 cf 34 39 28 c2 07 01 a8 4b e3 e7 76 b1 f5 63
0060 96 b8 32 cd ef 4a 11 3c b1 a3 54 47 02 e1 85 49
0070 7f f9 03 56 d9 0c f9 78 65 03 75 66 72 43 c6 bb
0080 1c 88 a8 14 51 80 67 af b3 59 56 44 6d 35 ae 63
0090 af 50 f1 01 1f f5 44 36 b4 ec bf a6 ab 13 ed 05
00a0 82 a2 6d a2 aa 64 ba 62 36 8f ad 0f ec 78 6b 25
00b0 7e a7 99 b0 06 e7 77 bb 1a 97 c4 c7 76 c1 bb 63
00c0 22 b5 2b 8f 2f 21 67 19 04 38 c7 dd 16 31 50 69
00d0 14 00 7e 0f 9c fc 10 80 6c eb 40 c1 0d d4 5a 6f

肆 結果(3/3)


TPRI IEC 61850 XMPP Cloud based DER Management Platform
TPRI
Inverter
Voltage
222.4 V
Current
0.653 A
Active Power
134.3 W
Frequency
59.84 Hz
Power Factor
0.937
Environment Sensors
Irradiation
305.1 W/m2
Ambient
33.6 °C
Module
42.7 °C
Agrandir le plan
Research Institute of Taiwan Power...
Active Power (W)
Irradiation (W/m2)
Temperature (°C)
Ambient (°C)
Module (°C)
Irradiation (W/m2)
Active Power (W)



伍 結論

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1. 對於DER而言，若能從來源端即採用國際標準，系統將會得到簡化。
2. DER資訊模型、交換服務、通訊協定若採用國際標準將更具前瞻性與一致性。。
3. 採用XMPP通訊協定可以滿足INTERNET、大量部署、即插即用與安全性。
4. XMPP在DER資料收集和監視方面實現良好效能。

Information
Communication
Technology

報告完畢
敬請指教

One world, One technology, One standard

(本簡報圖片皆取自網路和台電網站)