分散式能源雲端管理平台
XMPP應用案例

[PartII]

卓啟翔(Chi-Shiang Cho)
Ph.D.
TPRI, TPC
October 24, 2018

報告內容

一.分散式能源雲端管理平台XMPP技術說明

二.TPRI分散式能源雲端管理平台架構與建置

三.案場導入與效能測試

四.國際案例與應用

五.結論

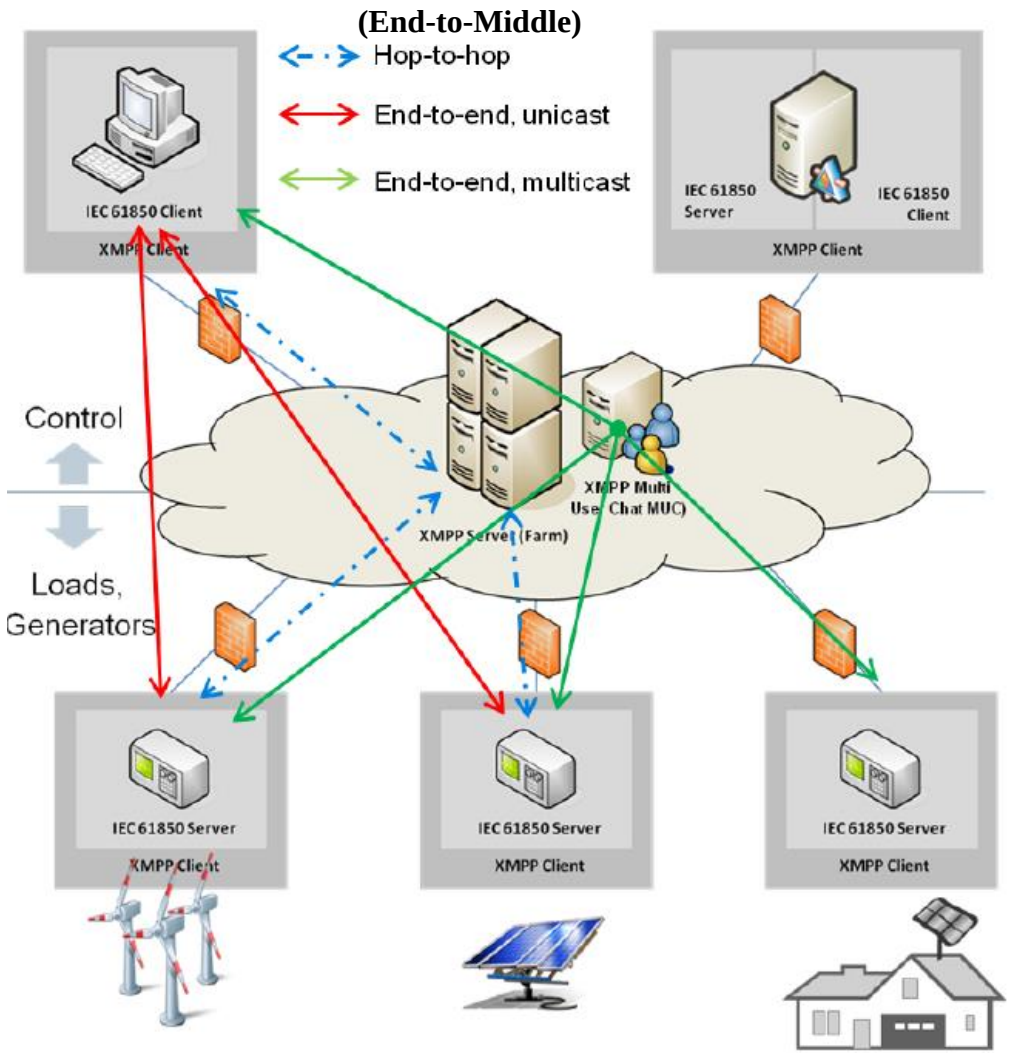
六.參考資料

一、分散式能源雲端管理平台XMPP技術說明

架構與技術說明

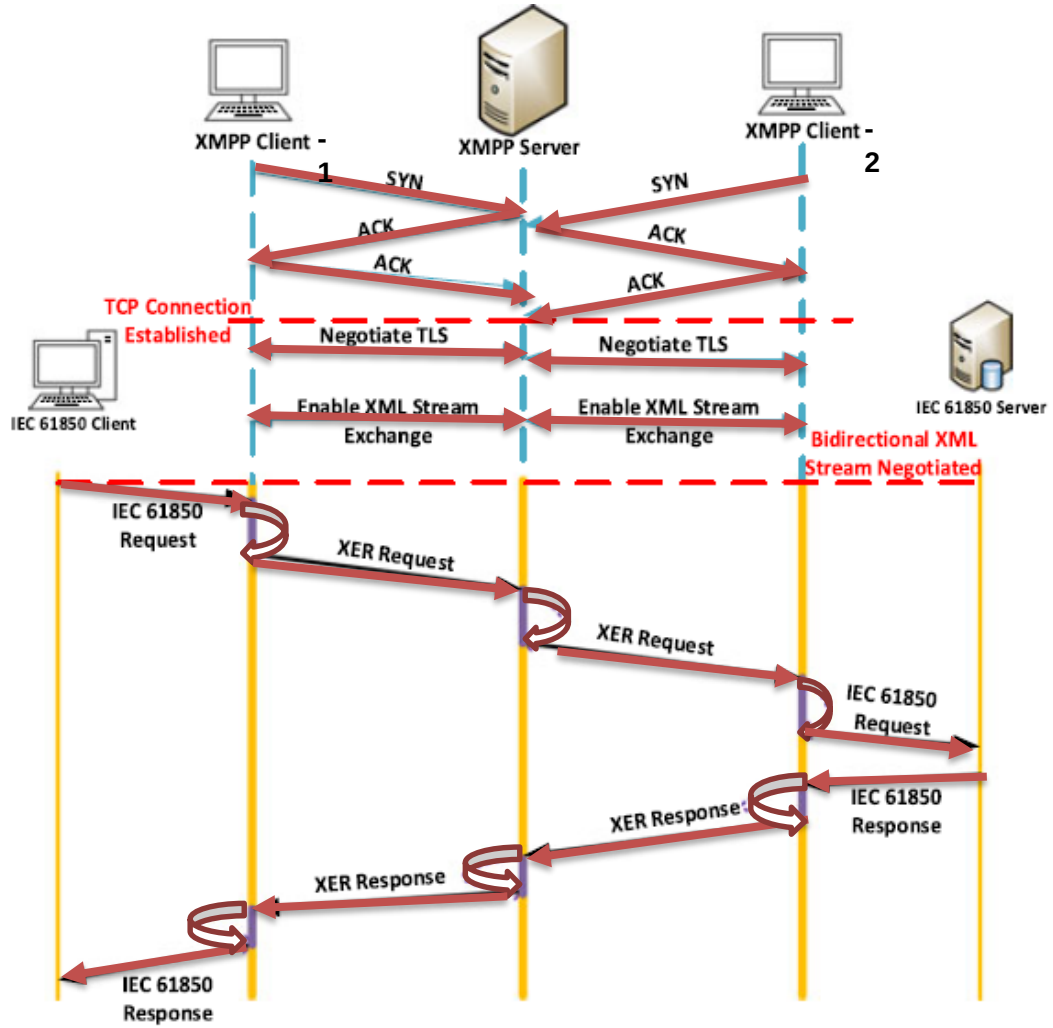
- 依IEC 62357 智慧電網架構模型(Smart Grid Architecture Model)建置。
- 依照IEC 61850-7-4與7-420 建立標準再生能源資訊模型。
- 採用IEC 61850-8-2 XMPP 通訊協定建構於雲端平台。
  - ·串流協商與通道建立 (TLS)
  - ·用戶授權認證管理(SASL)
  - ·資料加密(ASN.1 XER)
- 採用工業物聯網參考架構，導入雲端管理平台。
- 提供PV站之通訊協定轉換器: 標準化，建模與隨插即用功能。

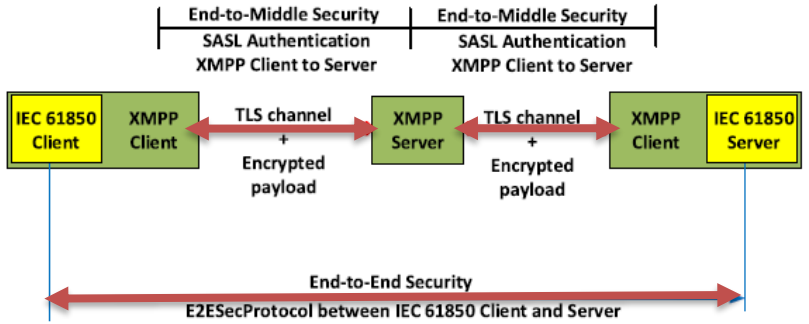
Security in IEC 61850-8-2 using XMPP



資料來源：IEC 61850-8-2 FDIS

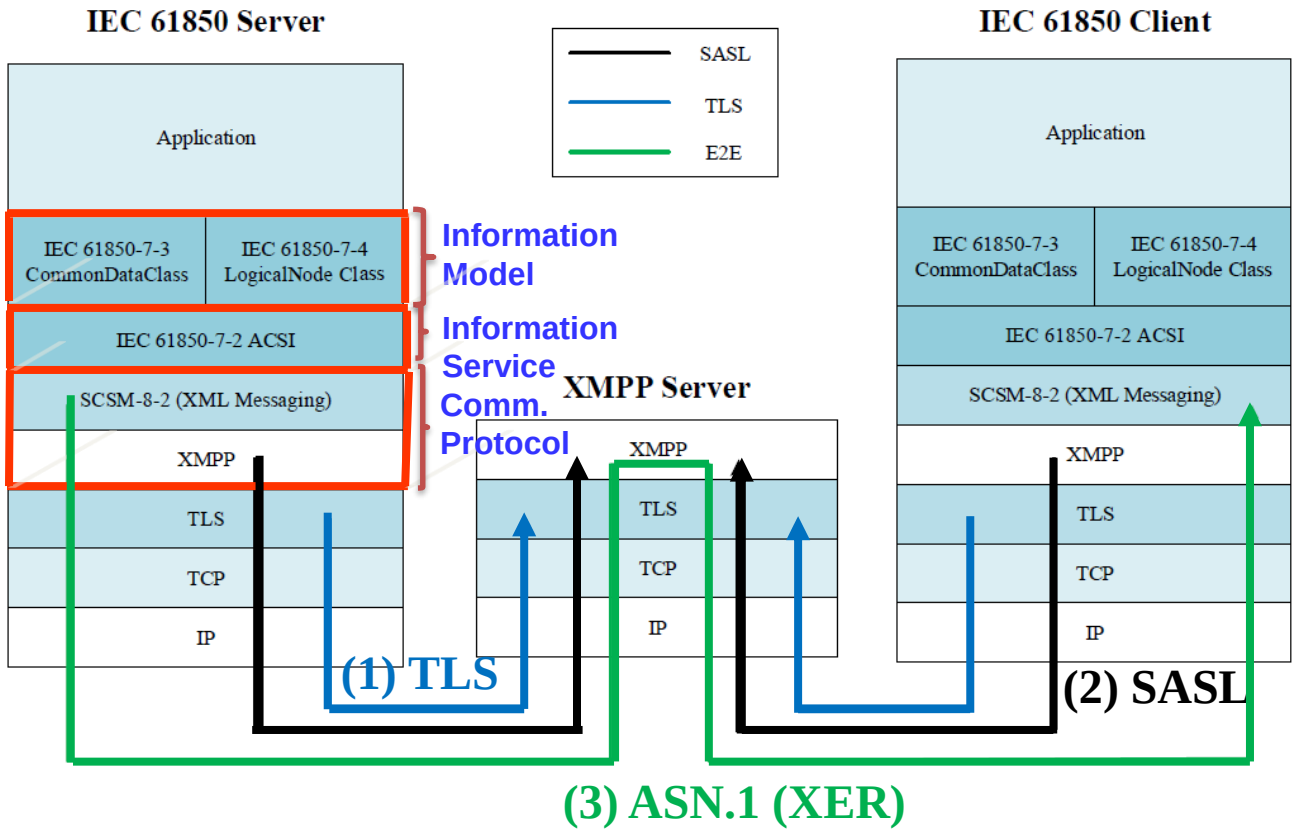
Security in IEC 61850-8-2 using XMPP





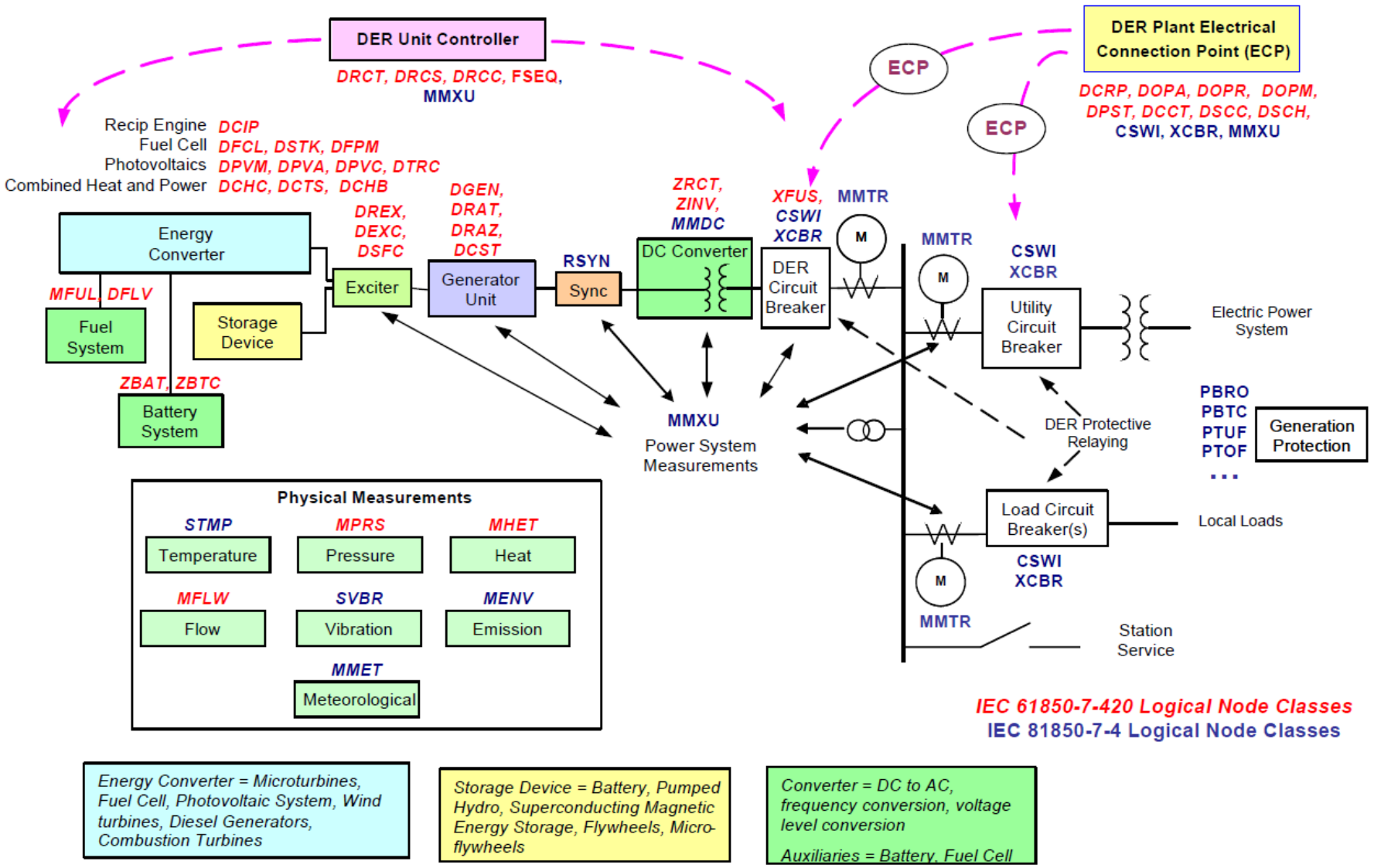
Source： IEC 61850 Modeling of DSTATCOM and XMPP Communication for Reactive Power Management in Microgrids, to appear *in IEEE Systems Journal.*

Security in IEC 61850-8-2 using XMPP



Source：IEC 61850-8-2 FDIS

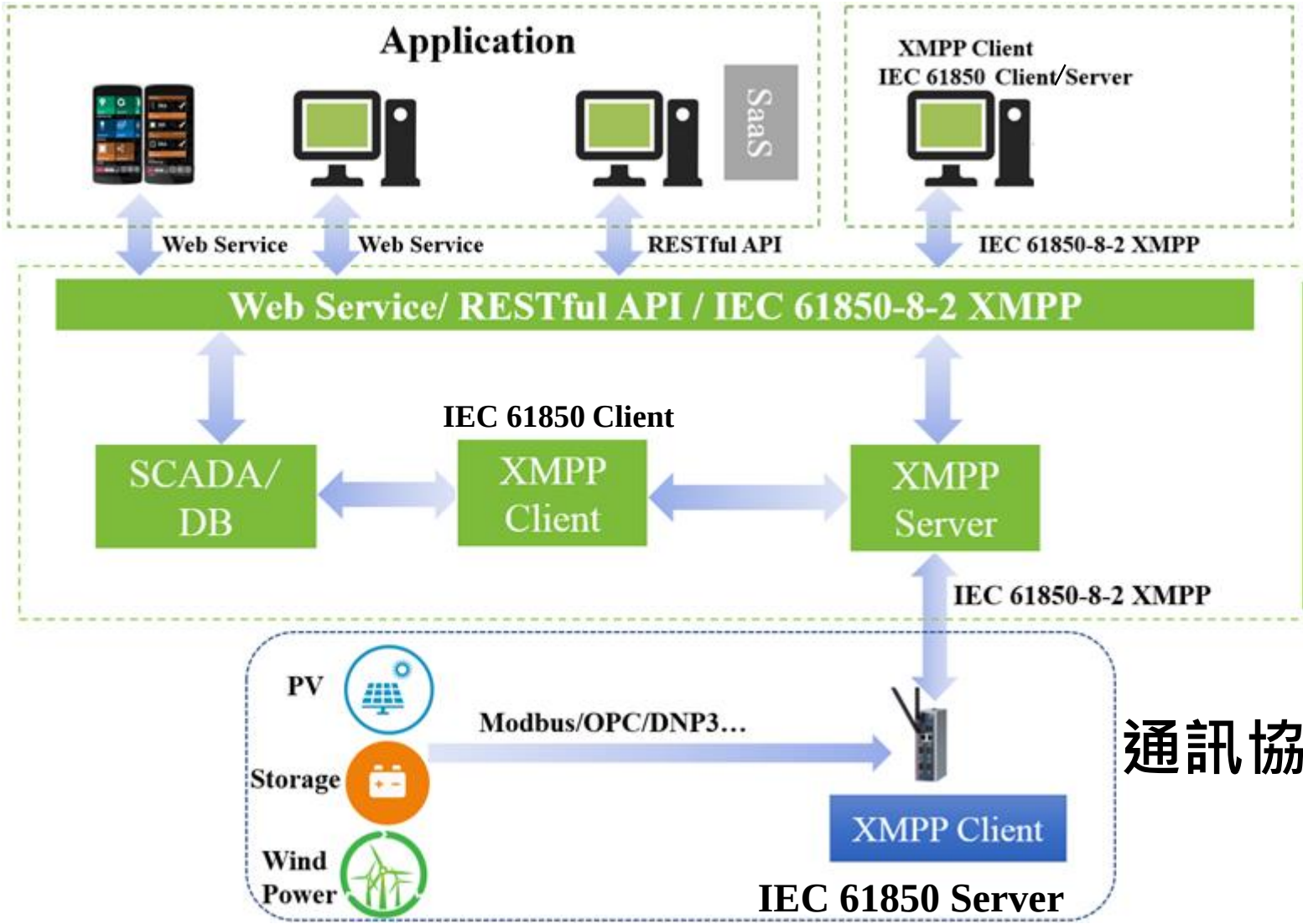
IEC 61850 物件(資訊)模型



資料來源： IEC 61850-7-4
IEC 61850-7-420

二、TPRI分散式能源雲端管理平台架構與建置

TPRI分散式能源雲端管理平台架構

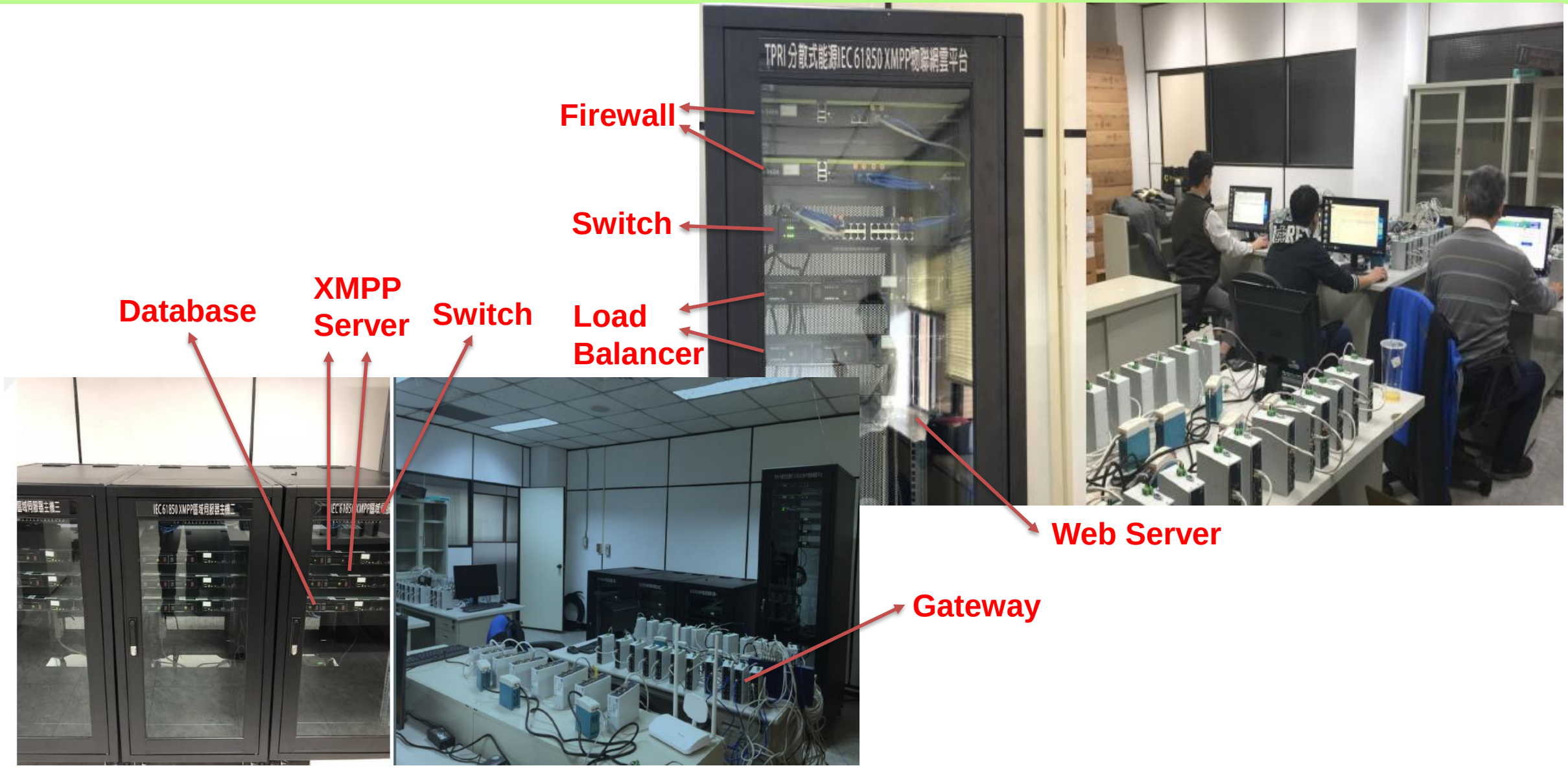


資訊管理與應用系統

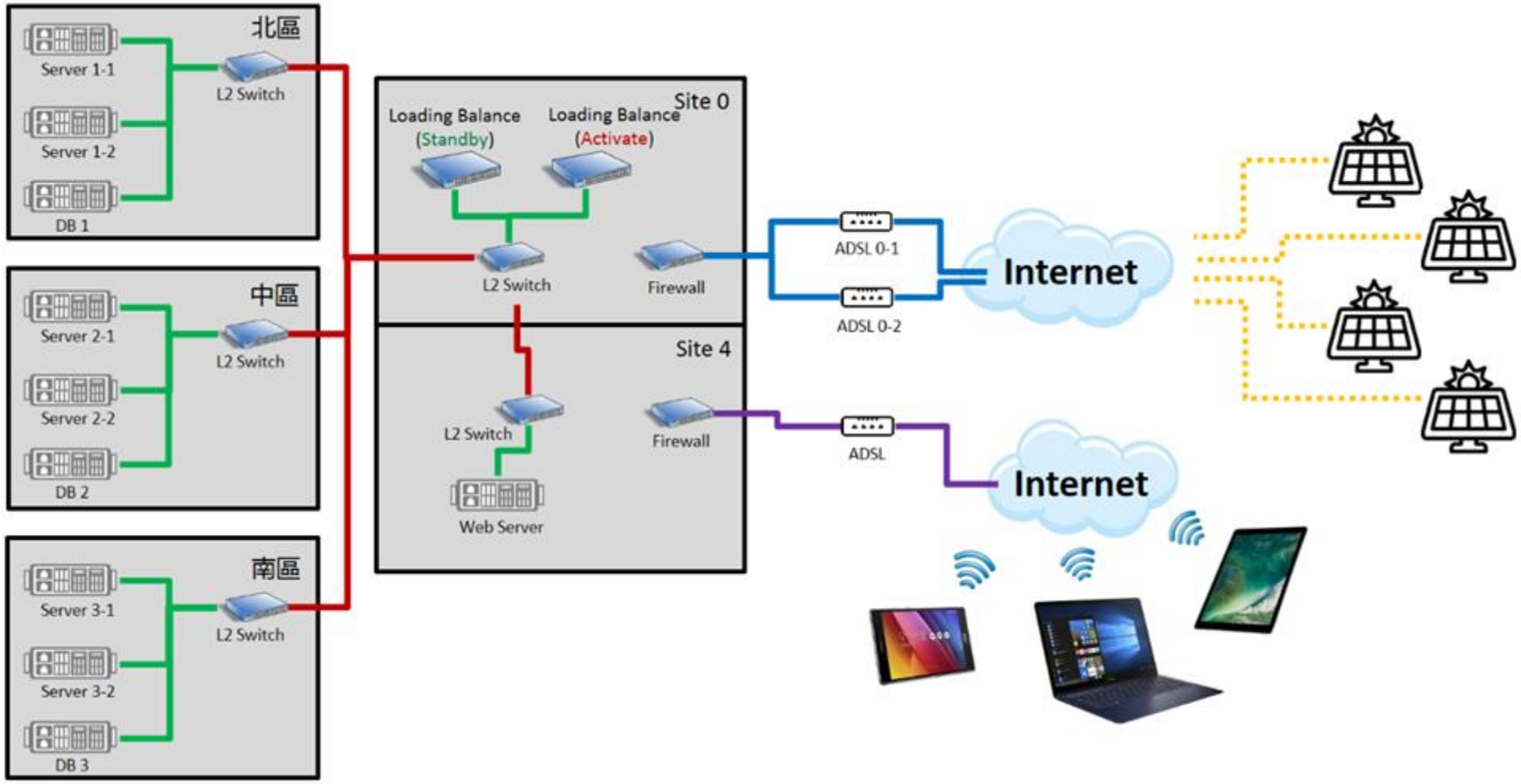
雲端管理平台

通訊協定轉換

分散式雲端平台建置情形



分散式雲端平台


北區
Server 1-1
Server 1-2
DB 1
L2 Switch
中區
Server 2-1
Server 2-2
DB 2
L2 Switch
南區
Server 3-1
Server 3-2
DB 3
L2 Switch
Site 0
Loading Balance
(Standby)
Loading Balance
(Activate)
L2 Switch
Firewall
Site 4
L2 Switch
Web Server
Firewall
ADSL 0-1
ADSL 0-2
ADSL
Internet
Internet

三、案場導入與效能測試

目前案場導入

- 台電PV案場

TPRI - PV案場1(3kW) - 1台變流器

TPRI - PV案場2(48kW) - 2台變流器

大潭發電廠 - PV案場(651kW)

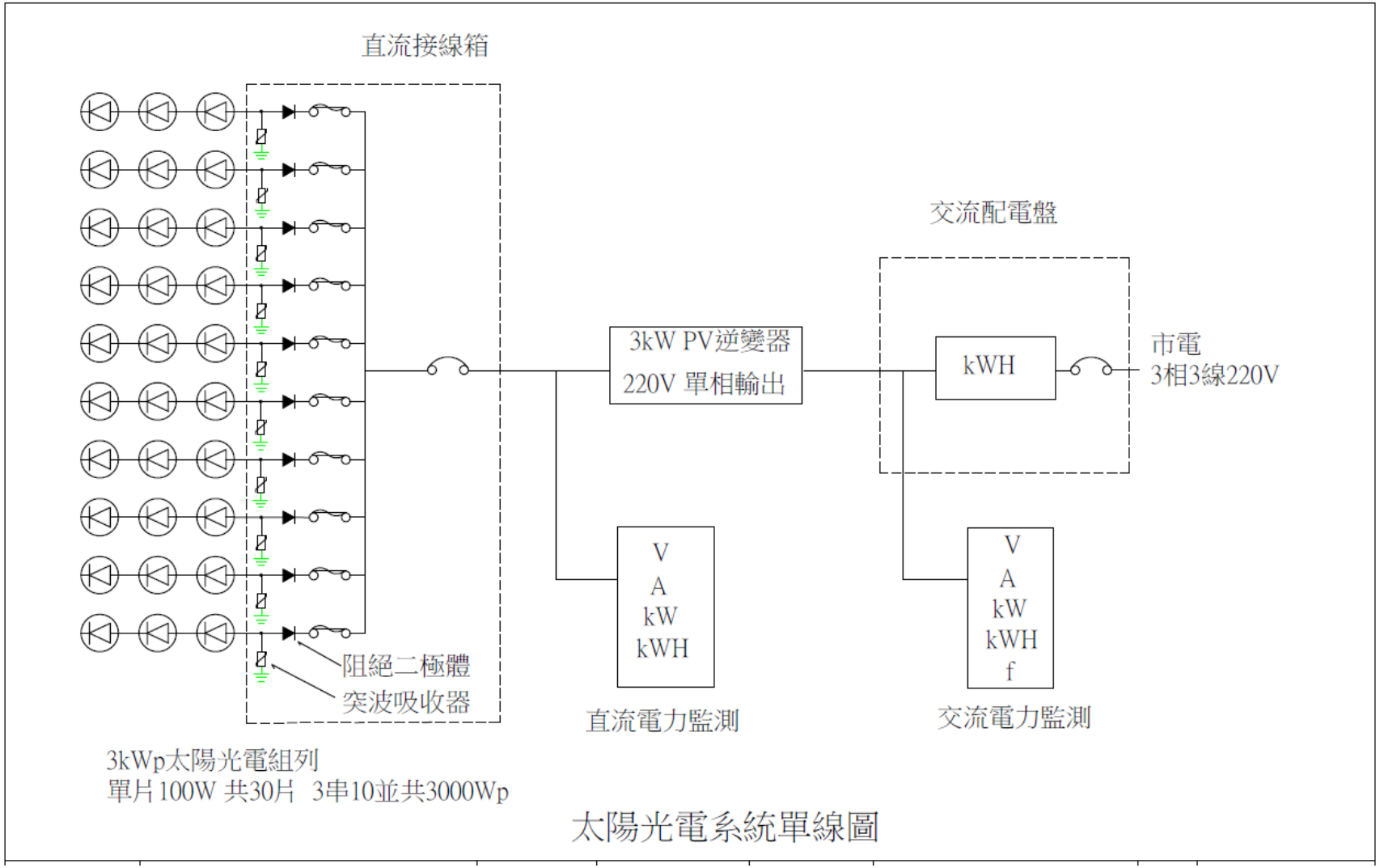
- 民間PV案場

旗美高中 - PV案場 - 21台變流器(400kW)

潮洲果菜市場 - PV案場 - 120台變流器(480kW)

莒光國小 - PV案場 - 23台變流器(420kW)

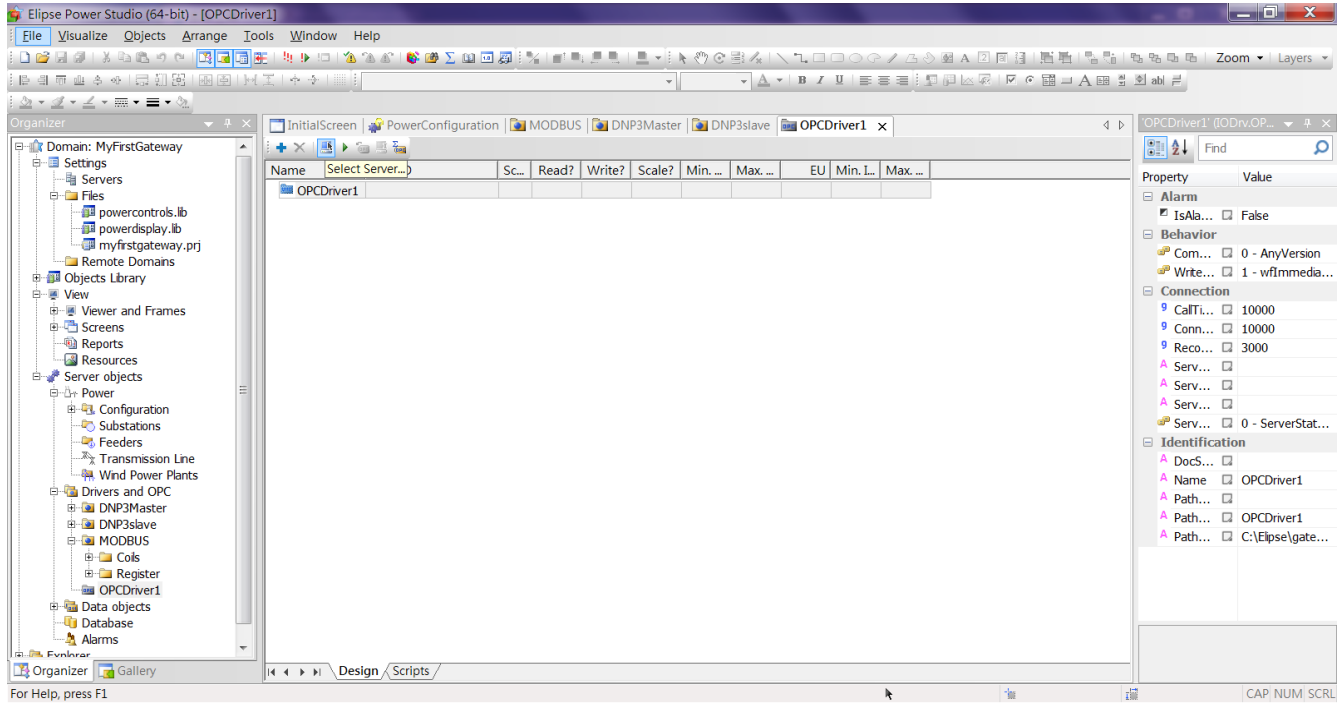
綜研所樹林所區PV案場導入(3kW單線圖)



太陽光電系統單線圖

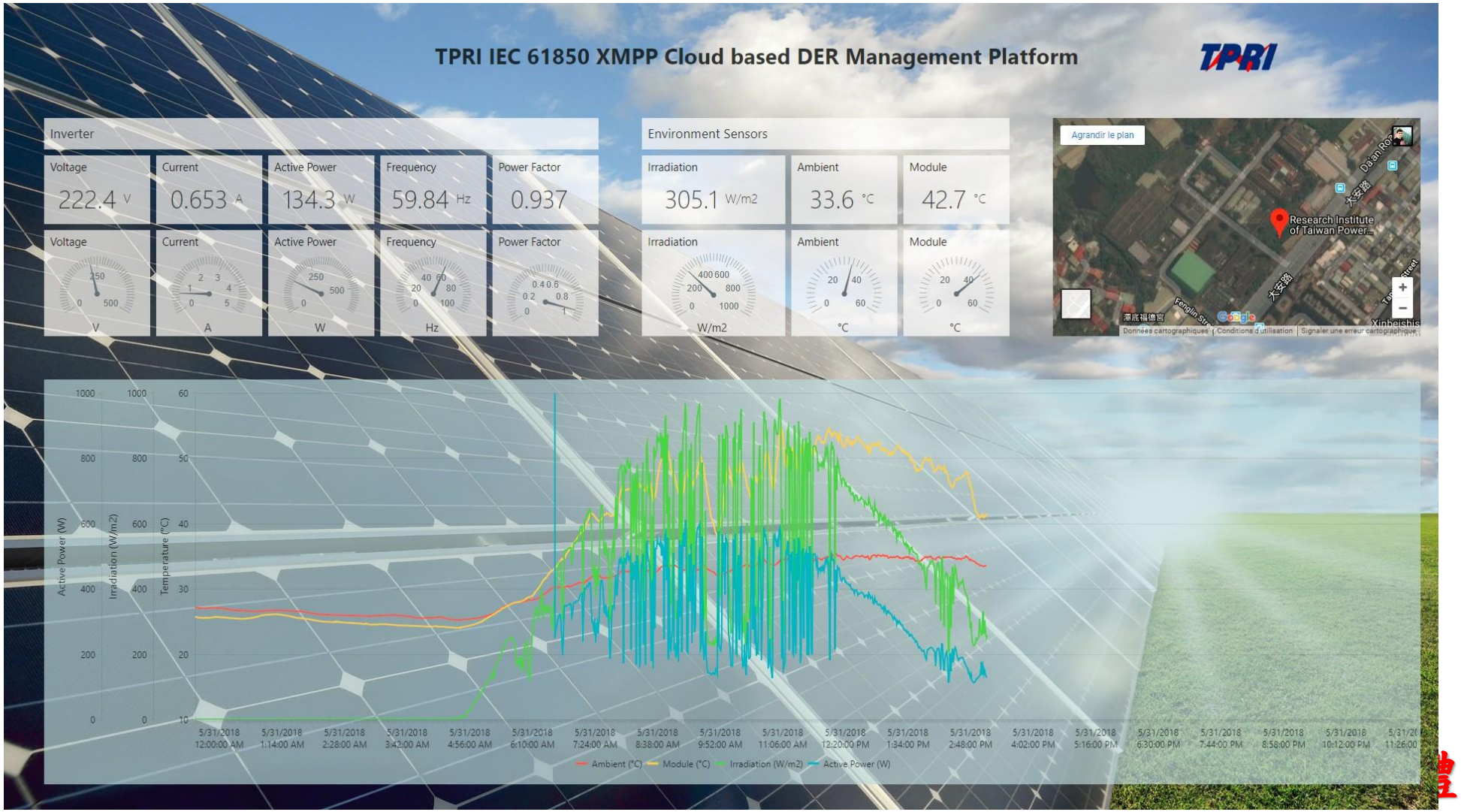
OPC Server I/O 對照表與轉換

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



綜研所樹林所區PV案場建置照片

樹林PV案場即時發電資訊



大潭PV案場即時發電資訊

環境溫度

33.391

環境溫度

AI TTemp 1B 溫度

32.407

AI TTemp 2B 溫度

35.156

R相電流
CURRENT A

38.1 A

S相電流
CURRENT B

37.23 A

T相電流
CURRENT C

37.41 A

R相電壓
VOLTAGE A

283.5 V

S相電壓
VOLTAGE B

281.9 V

T相電壓
VOLTAGE C

282.3 V

電能

825,687.75

有效功率(實功)

31.83kW

無效功率(虛功)

1.02kVAR

高雄民間PV案場導入(莒光國小420kW)

Vac	有效電力	頻率	總產生電能
234.3	376	59.94	53,885

Iac	有效電力	頻率	運作時間
15.94			7,809

日產生電能
0

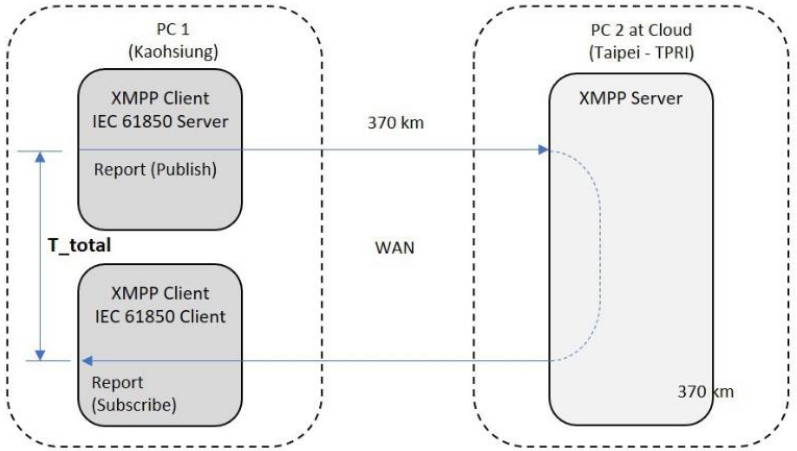
變流器狀態

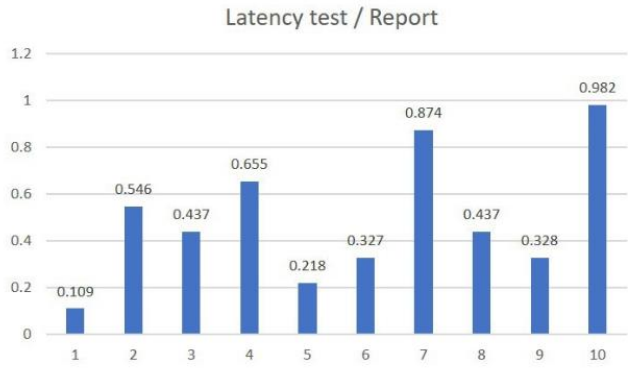
變流器內部溫度	工作模式
46	3

變流器內部溫度

系統效能測試

IEC 61850-8-2 XMPP Latency test in WAN - Report





	IEC61850 Server		IEC61850 Client		Results (sec)
	Value	Timestamp	Value	Timestamp	Latency
#1	14	2018-09-17 18:00:13.482	14	2018-09-17 18:00:13.591	0.109
#2	16.07	2018-09-17 18:01:41.060	16.07	2018-09-17 18:01:41.606	0.546
#3	18.55	2018-09-17 18:02:57.173	18.55	2018-09-17 18:02:57.610	0.437
#4	22.8	2018-09-17 18:05:09.960	22.8	2018-09-17 18:05:10.615	0.655
#5	21.01	2018-09-17 18:06:48.459	21.01	2018-09-17 18:06:48.677	0.218
#6	19.19	2018-09-17 18:08:30.343	19.19	2018-09-17 18:08:30.670	0.327
#7	17.39	2018-09-17 18:10:08.747	17:39	2018-09-17 18:10:09.621	0.874
#8	9.43	2018-09-17 18:12:39.241	9.43	2018-09-17 18:12:39.678	0.437
#9	5.21	2018-09-17 18:13:57.319	5.21	2018-09-17 18:13:57.647	0.328
#10	3.37	2018-09-17 18:15:16.708	3.37	2018-09-17 18:15:17.690	0.982
				Average	0.4913

IEC 61850-90-12
Wide area network engineering guidelines

Table 3 – Latency classes for WANs

WAN latency class	IEC 61850-5 latency class	Latency	Use
TL1000	TT1	≤ 1000 ms	All other messages
TL300	(TT2)	≤ 300 ms	Operator commands
TL100	TT3	≤ 100 ms	Slow automatic interactions
TL30	(TT4)	≤ 30 ms	Fast automatic interactions
TL10	TT5	≤ 10 ms	Teleprotection
TL3	TT6	≤ 3 ms	Differential protection

四、國際案例與應用

典型作法

Szenario 2

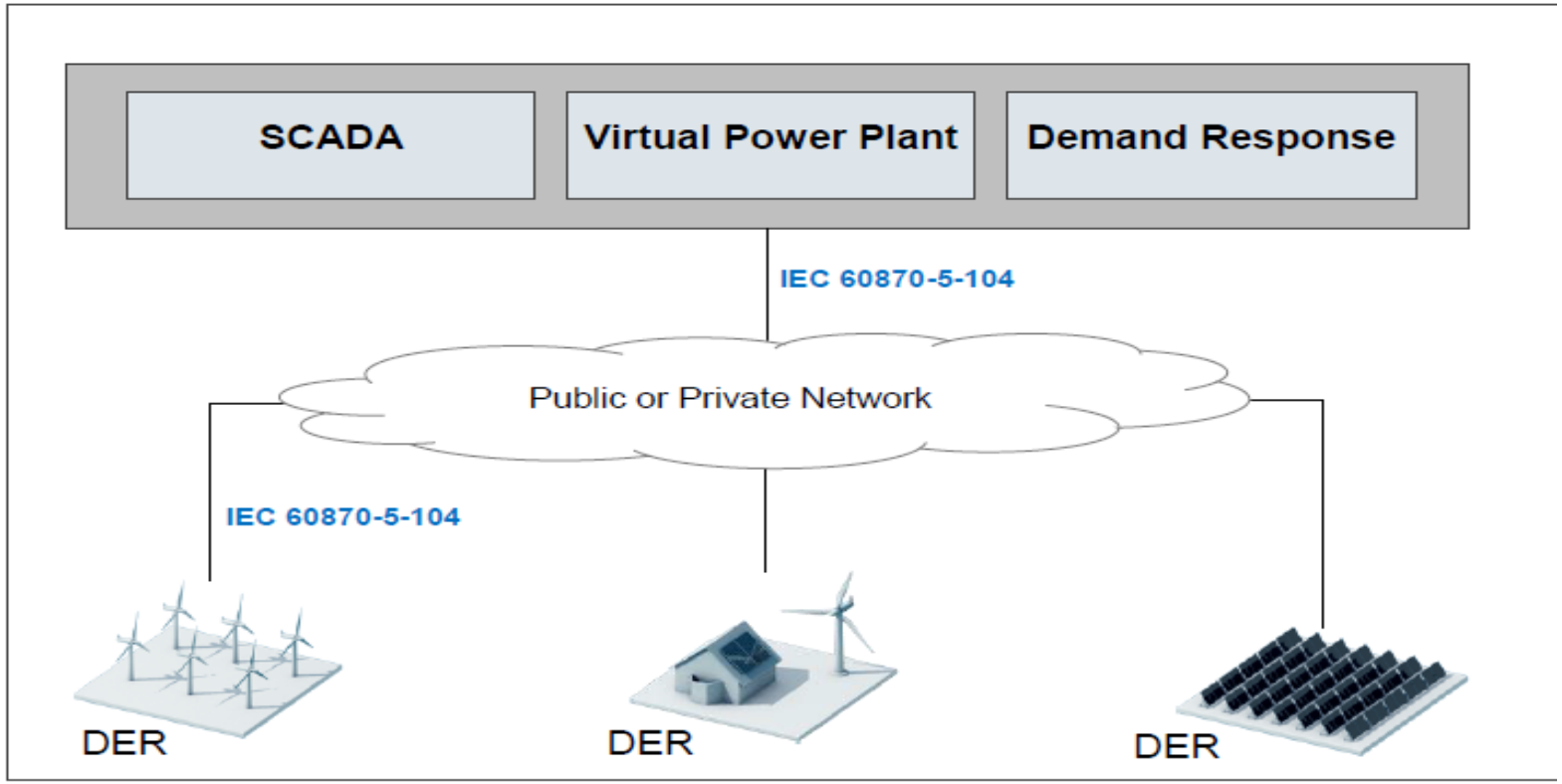
SIEMENS

Integration of Distributed Energy Resources (DER)

Typical Set-Up for DER

- Prosumer connecting resources and loads to the electrical grid via public or private network
- Usage of IEC 60870-5-104 for communication

- Security is often provided by using IPSec based VPNs connecting the network domains



Dr. Volker Distelrath, Siemens AG

SIEMENS 新作法DER應用XMPP 案例

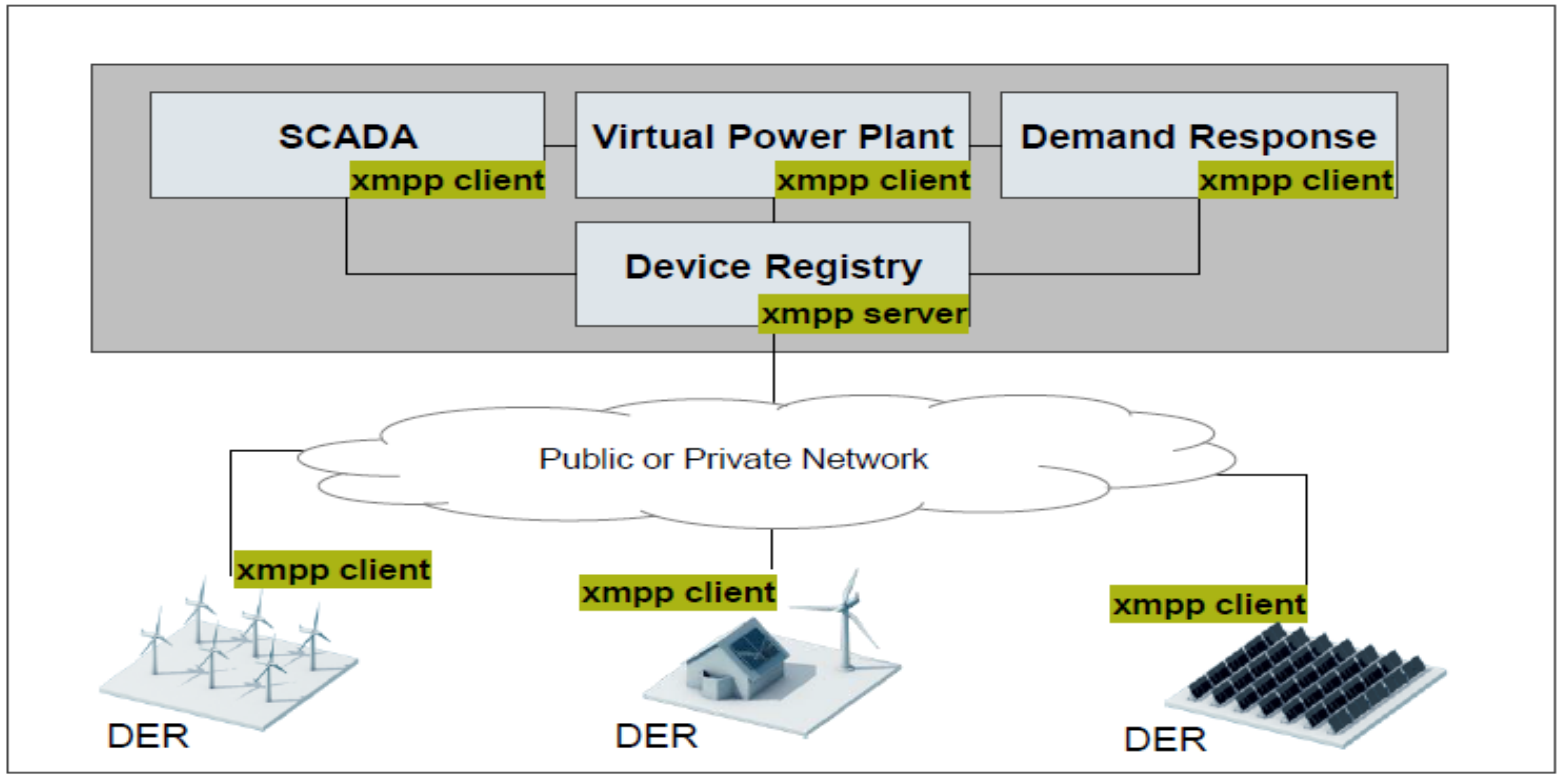
Szenario 2

Application of IEC 62351 on Integration of Distributed Energy Resources (DER)

SIEMENS

Future Set-Up for DER

- XMPP (RFC 6120) is a middleware messaging and presence protocol supporting decentralized architectures
- Usage of IEC 61850-8-2 MMS over XMPP
- End-to-end authentication and integrity can be achieved by applying the IEC 62351-4 ed.2 MMS secure session concept



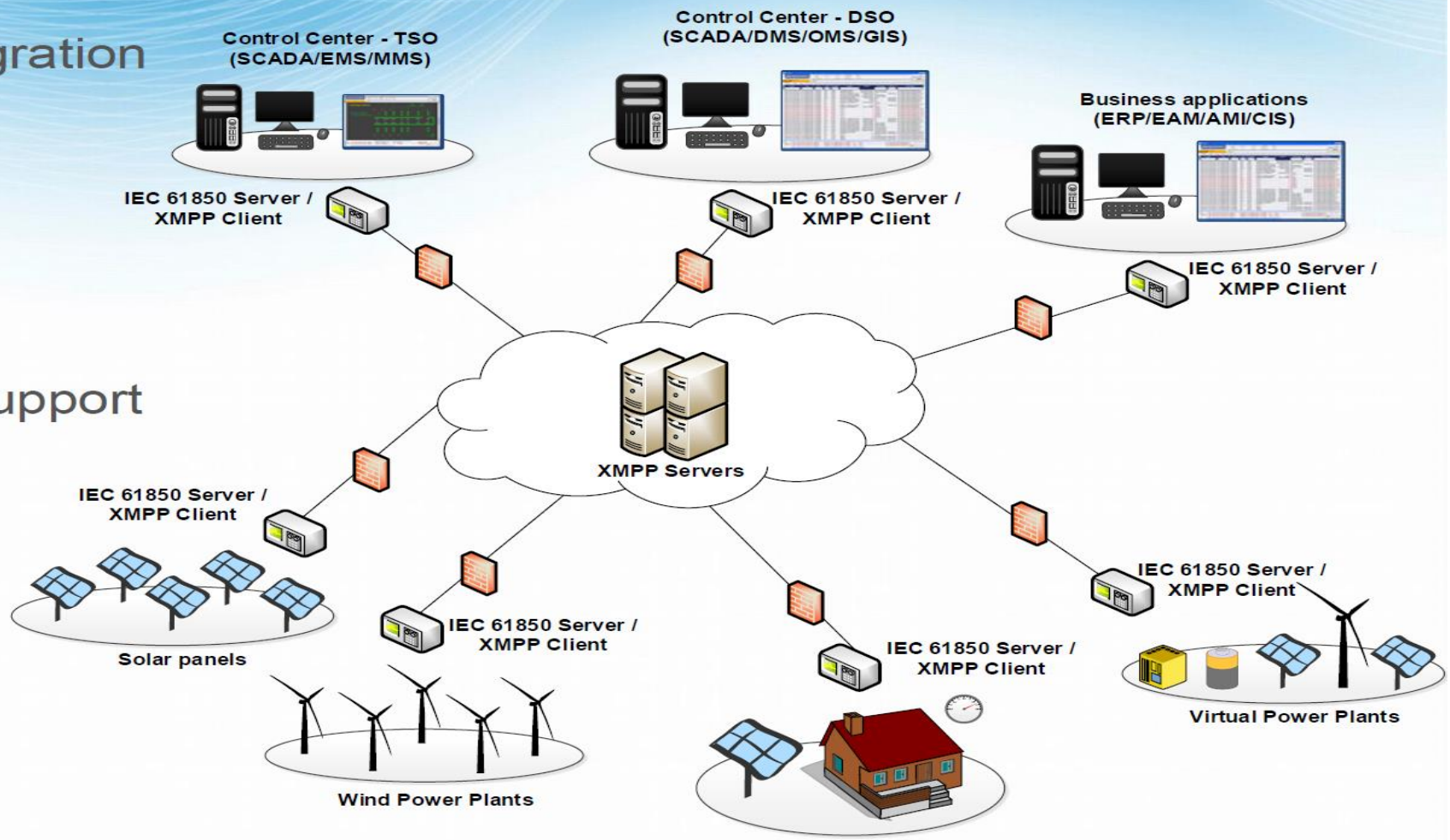
Dr. Volker Distelrath, Siemens AG

DER應用XMPP案例- KONČAR

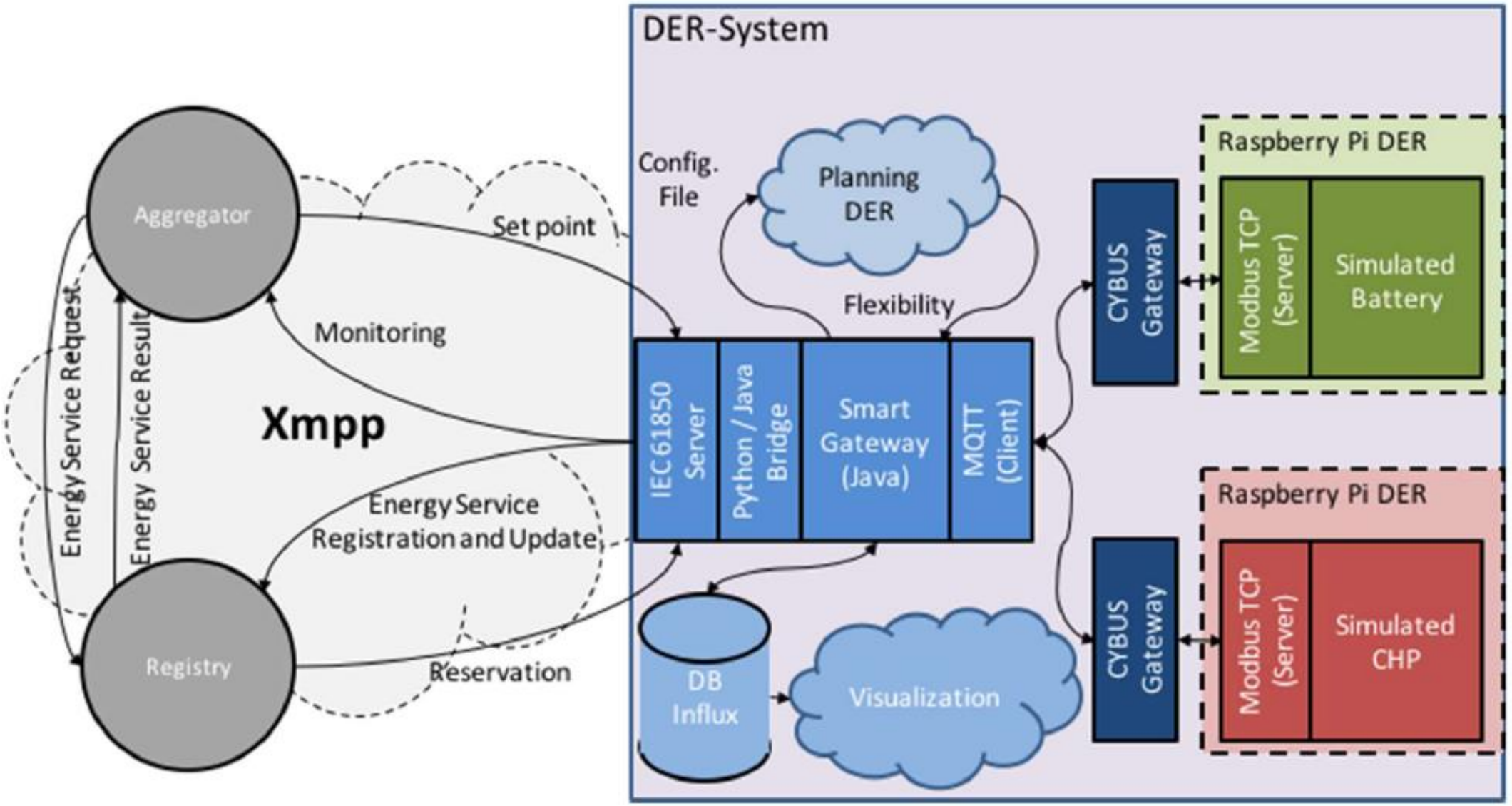
Partners	Abbreviation	Nationality
Forschungsgemeinschaft für Elektrische Anlagen und Stromwirtschaft e.V.	FGH e.V.	
Hamburg University of Applied Science	HUAS	
Hypertech IT Solutions	Hypertech	
It4power	IT4	
KONČAR-Power Plant and Electric Traction Engineering Inc.	KONCAR	
Stedin	STEDIN	
Fundación Tecnalia Research and Innovation	Tecnalia	
The Netherlands Organisation for Applied Scientific Research	TNO	
T-Systems Multimedia Solutions GmbH	T-Systems MMS	

OS4ES –Project partners

- Secure DER integration
- Authentication
- Integrity
- Confidentiality
- Mandatory TLS support
- IEC 62351 ed.2



DER應用XMPP案例- OS4ES



日本智慧社區聯盟在未來能源系統應用XMPP

[International Standardization]

MEIDEN REVIEW Series No.169 2017 No.1 | 39

International Standardization for Next-Generation Energy System

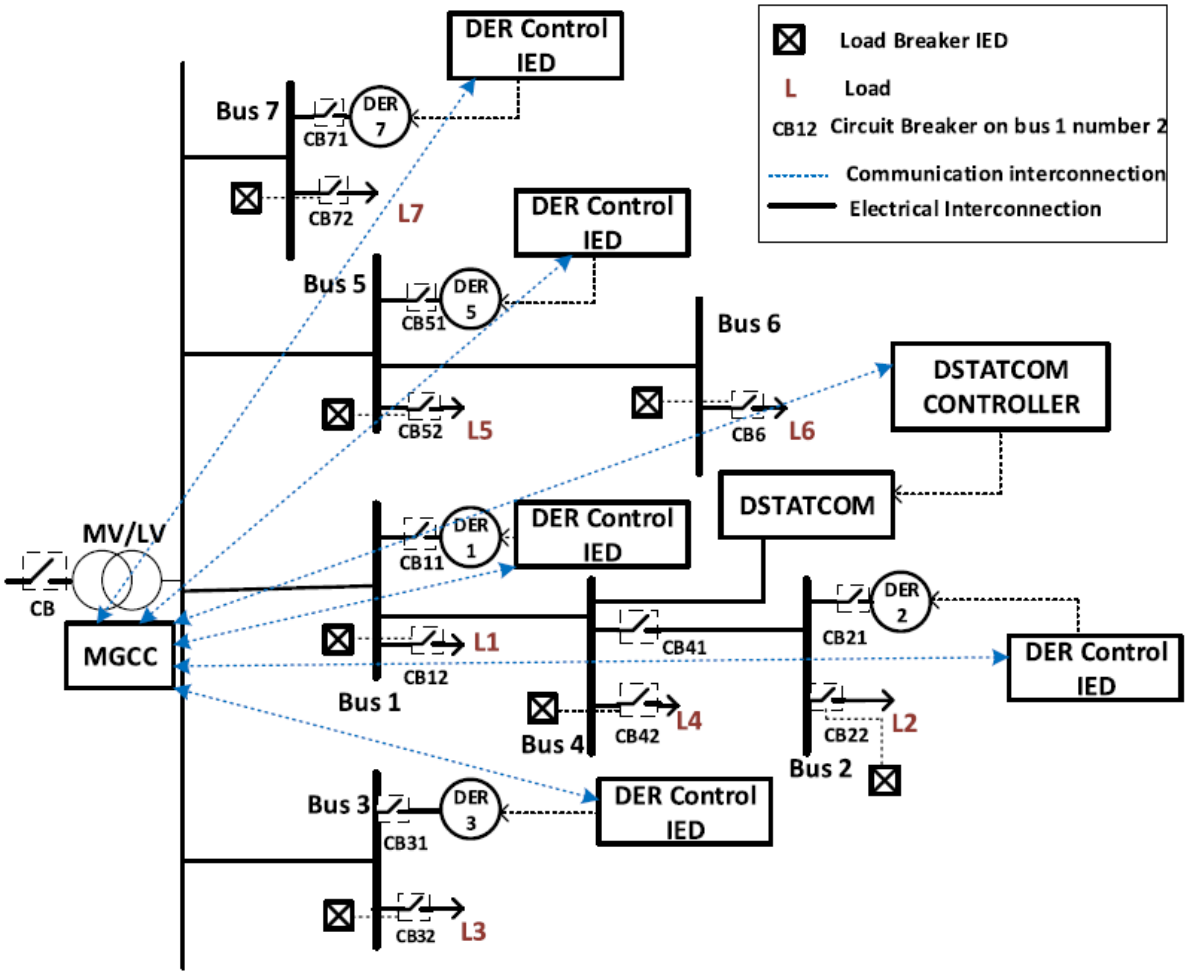
Yutaka Arai,
Yasuyuki Hoshi,
Ken'ichi Ito

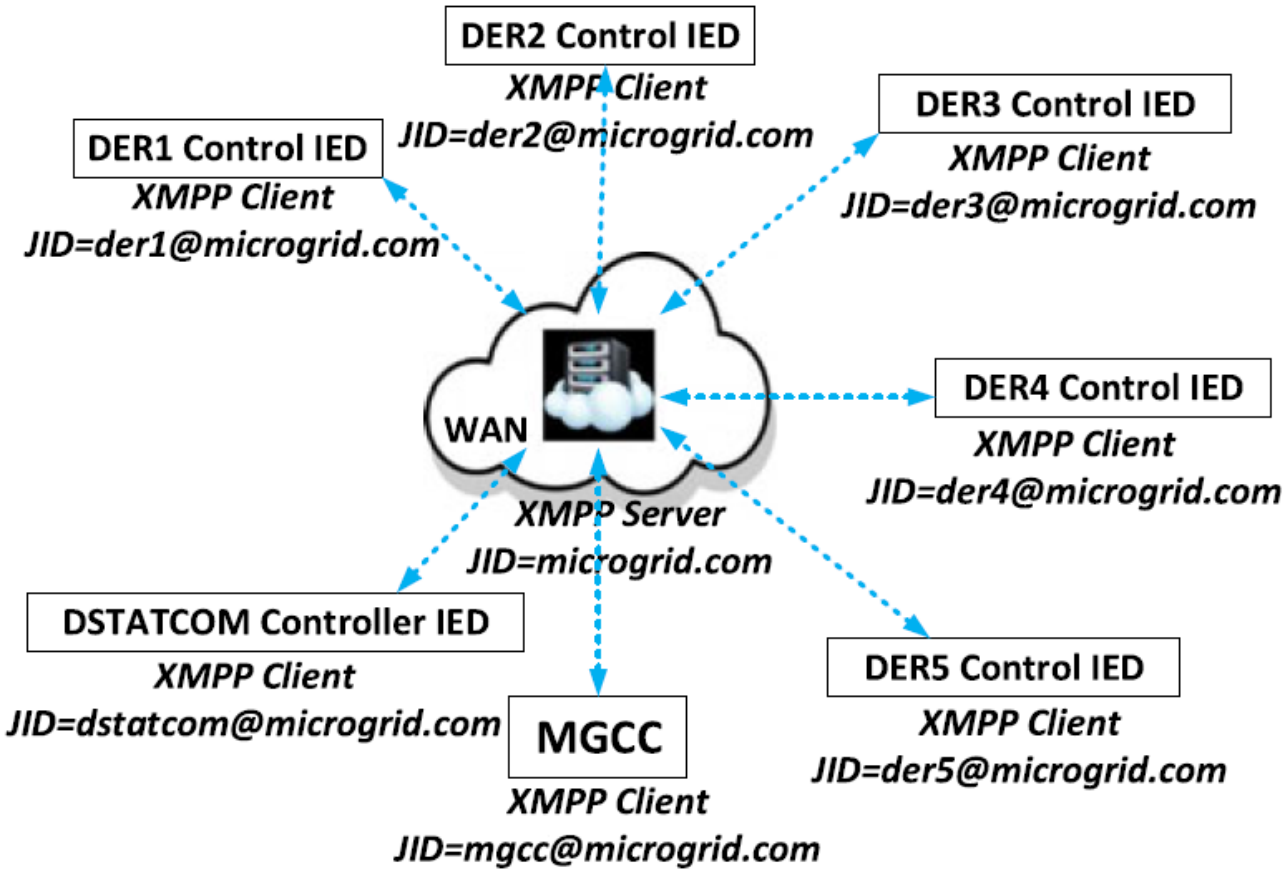
Keywords Smart grid, Microgrid, BEMS, CEMS, IEC61850, OpenADR2.0b, Dispersed power source

Abstract

Recently, need for microgrids, smart grids, and such next-generation energy systems has increased, as well as need for inter-connections with various power grid facilities by multiple power retail vendors and their management. This reflects the scale expansion and diversity of distributed energy resources and the introduction of Demand Response (DR). Under such circumstances, the significance of international standardization in relation to communication with next-generation energy systems is increasing. According to the trends analysis of the European CEN-CENELEC-ETSI Smart Grid Coordination Group (SG-CG) and American National Institute of Standards and Technology (NIST) they are positively promoting international standardization. IEC is organizing for international standardization and Japanese Japan Smart Community Alliance (JSCA) is catching up to the global trends. Given above, it is possible to identify current situations of each country and their trends. We have recently begun to integrate various kinds of communication protocols based on the XMPP. The XMPP is being investigated for adoption into the transport layer protocol in multiple international communication standards. So far, we have gained the confidence to be able to realize a common communication platform without relying on applications.

DER應用XMPP案例-印度(微電網)





資料來源： 參考[5]

IEC 61850-8-2 (IS)將公布

TC 57 Power systems management and associated information exchange

Scope | Structure | Projects / Publications | Documents | Votes | Meetings | Collaboration Tools

Work programme > Project: IEC 61850-8-2 ED1

Log in | En | Fr

Detail

Committee	Working Groups	Project Leader	Current Status	Frcst Pub Date	Stability Date
TC 57	WG 17	B. Bony	BPUB	2018-10	2020

History

Stage	Document	Downloads	Decision Date	Target Date
PNW	57/1181/NP	434 kB	2011-10-07	
ANW	57/1221/RVN	234 kB	2012-03-09	2012-02
1CD	57/1583/CD	5019 kB	2015-06-05	2015-02
ACDV	57/1642/CC	319 kB	2015-11-06	2015-10
TCDV			2017-01-13	2016-11
CCDV	57/1833/CDV	4080 kB	2017-03-03	2017-03
PRVC			2017-05-26	2017-05
AFDIS	57/1903/RVC	507 kB 64 kB	2017-07-21	2017-09
TFDIS			2018-04-12	2017-12
DECFDIS			2018-05-24	2018-05
RFDIS			2018-06-04	2018-06
CFDIS	57/2020/FDIS		2018-07-13	2018-08
PRVD			2018-08-24	2018-08
APUB	57/2039/RVD	276 kB	2018-08-31	2018-09
BPUB			2018-08-31	2018-09
PPUB				2018-10

Project

IEC 61850-8-2 ED1

Communication networks and systems for power utility automation - Part 8-2: Specific communication service mapping (SCSM) - Mapping to Extensible Messaging Presence Protocol (XMPP)

Associated Documents:

57/1585/INF
1561 kB
57/1584/DTR
2952 kB
SMB/5970/DL
471 kB
SMB/5347/DL
221 kB
SMB/5256/DL
186 kB
SMB/4881/DL
348 kB

IEC 61850-8-2有助於分散式能源資訊廣泛應用在電力管理及需量反映上。此部分(Part)標準誕生後，將加速再生能源資通訊在多領域複雜的智慧電網系統上應用之實現。

五、結論

- 分散式能源運用若從來源端就採用國際標準，可將系統單純化。
- 採用XMPP通訊協定滿足INTERNET、大量佈建或移除、PLUG &PLAY及資安等特性。
- 分散式能源資訊內涵(資訊之封裝或格式)、取用方法(服務或功能)、以及其透過網路傳輸之協定通訊，採用國際標準較能有未來性及一致性。
- XMPP可以搭配其他協定(如R-GOOSE)，以期達到能即時控制分散式能源(如儲能充放電等)之目的，最終目標為整體調度與控制以達到系統穩定兼顧提高綠能占比。

六、參考資料

- 綜研所廖副研究員IEC 61850教材。
- IEC 61850 Communications networks and systems for power utility automation.
- IEEE std 1547-2018 IEEE Standards for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces.
- Open System for Energy Services, OS4ES, 2017.
- S. M. Suhail Hussain et. "IEC 61850 Modeling of DSTATCOM and XMPP Communication for Reactive Power Management in Microgrids," to appear in IEEE Systems Journal .

報告完畢

謝謝聆聽 敬請 指正