Smart Grid Common Standard Development for Cross Taiwan Strait

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Overview of DA Status in Taiwan and Mainland

- DA is essential to the reduction of SAIDI and SAIFI; DA is cost effective from utility viewpoint.
- In Taiwan, 35 automated feeders made by Japanese mfr in 1995; 138 automated feeders made by US mfr in 2002, both for trial-run purposes.
- Since then, DA has been progressively installed by local mfrs; FA in Taiwan is based on DNP 3.0 communication protocol.
- Taipower has finished 53% of feeders with FDIR (Fault Detection, Isolation and Service Restoration) function in year 2012.
- Mainland China has been vastly expanding DA programs since 2009 by following IEC standards.

Overview of DA Status in Taiwan and Mainland

- Feeders in Mainland are categorized into 6 levels, referring to A+ and A~E, according to consumers' demand for power supply reliability and load importance, further taking load density (MW/km2) as metric index for selecting appropriate FA systems which include centralized and distributed automations, FDIR based on recloser and distributed intelligence, fault indicator etc.

Overview of SG User Interface Status in Taiwan and Mainland

- SG user interface here refers to the electricity consumption systems or devices interconnected to SG, which include AMI, automated demand response (ADR), electric vehicles (EV's) and EV charging stations, microgrid, smart homes and buildings etc.
- Under Taiwan's smart grid Master Plan issued in 2012, Taipower has installed smart meters for all high-voltage (h.v.)and extra h.v. consumers and is presently expanding advanced meters for low-voltage consumers.

Overview of SG User Interface Status in Taiwan and Mainland

- Taiwan Government has been sponsoring a series of R&D projects under National Energy Program (NEP) since 2010 on AMI, ADR, microgrid, EV, smart home(building) etc., which include a VPP (virtual power plant) project under the NEP-phase II projects for implementation in 2014-2017.
- Mainland has conducted a large number of demonstration projects on smart communities/buildings, ADR, microgrid, EV etc., e.g., having field-run EV charging in 48 major cities, with more than 1500 charging stations and 238,000 charging poles to be run by 2015.

Background for Development of Common Standards

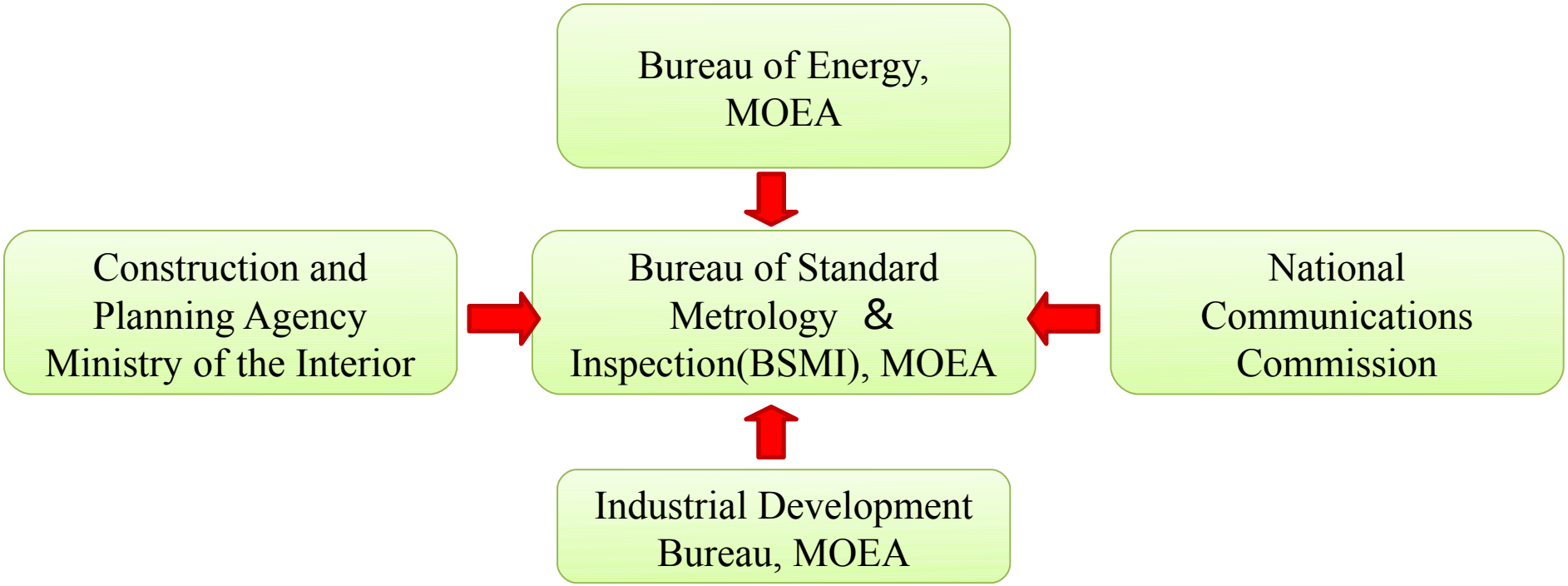
- Taiwan is good at ICT products manufacturing but lacks the market of products; in contrast, Mainland China has the leading role in both the market and the IEC participation.
- In 2011, a memorandum was signed in Beijing by China Institute of Electrical Engineering jointly with Taiwan SG Industry Association on the collaboration of SG data exchange.

Background for Development of Common Standards

- On basis of that memorandum, in 2012, a task force (1st) meeting was held in Shanghai to formulate the working group on the common standards in area of SG user interface; then 2nd meeting (July 2013) in Taipei and 3rd meeting (November 2013) in Chengdu.
- In Chengdu meeting, the common standards were selected in the area of : (1) The communication standards on ADR and HEMS (home energy management system); (2) The application of IEC 61850 to FA and distributed generation sources accessed to the feeder; (3) The interface between FA and distribution management system (DMS).

SG Standards Development Organization in Taiwan

SG Standards Jurisdictional Bodies



Utility Standards(G/T/D/C), Communication Standards, Electric Vehicle, Building Automation, Home Automation, Microgrid etc.

SG Standards Development Organization in Taiwan

Present Status

Generation, Transmission, Distribution, Customers, e.g., Advanced Meter Infrastructure(AMI), DA, WAMS etc. → Taipower's Procurement Specifications

Chargers for Electric Vehicle, PV Installation, AMI, etc. → National Standards(made by Industrial Development Bureau, BSMI, etc.)

- **Microgrid**
- **Smart Home**
- **Building Automation**

SG Standards Development Organization in Mainland China

- State Grid Corporation of China (SGCC) has developed a " Smart Grid Technical Standards System" as the roadmap for China's smart grid standardization which covers 8 domains and 28 technical subjects such as DA, ADR, Smart Communities/Buildings etc.
- A series of user interface standards are being developed under IEC PC118 which, after approval by IEC SMB, was established in 2012 at Tianjin, having its Secretariat set up at China Electric Power Research Institute (CEPRI).

General Description of SG standards in Areas of User Interface

(併) IEEE 1547 、 (風) IEC61400-2 、 (光) CNS15118 、 IEC 61730 、 IEEE 929 、 IEC 61727 、 (儲) UL1741 、 IEEE P2030.2 、 (通)IEC 61850 、 DNP3.0

Cyber Sercurity

To ensure the security of digital and communication systems

IEC 62351 、 NIST IR7628

Micro Grid for more renewable energy penetration and better power quality

Micro Grid

PIEV

To enhance environment and serve as energy storage device

SAE J1772 、 IEC 62196 、 JE VS G105

Smart Home (Building)

IEEE 1901 、 G.hn 、 SEP 2.0

AMI&ADR

Meter is the interface between customer loads and energy management systems and the grid

IEC 62050 、 ANSI C12.19 、 Open ADR-V1 、 V2

Auto demand response can automatically shed load under utility-customer contract

Improve of building energy efficiency and public energy saving conscious

Source ： Lin, Faa-Jeng ， EPA-Intelligent Grid and Advanced Metering Infrastructure General Project ,NSC

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Reasons for Selecting DA and ADR Related Standards

- There are a variety of SG standards to be evaluated in both the user interface systems and the utility systems.
- The reasons for selecting DA and ADR related standards are as follows:
  - Taiwan has experiences on the installation and operation of both DMS and FA, and Mainland China has experiences on the adaptation of IEC 61850 to FA.
  - ADR will be necessitated due to the future shortage of both power generation and network capacity in both Mainland China and Taiwan. The shortage in Mainland is mainly due to the high economic growth rate, and that of Taiwan mainly due to the future phasing out of nuclear power generation.

Key Elements in The Development of Common Standards

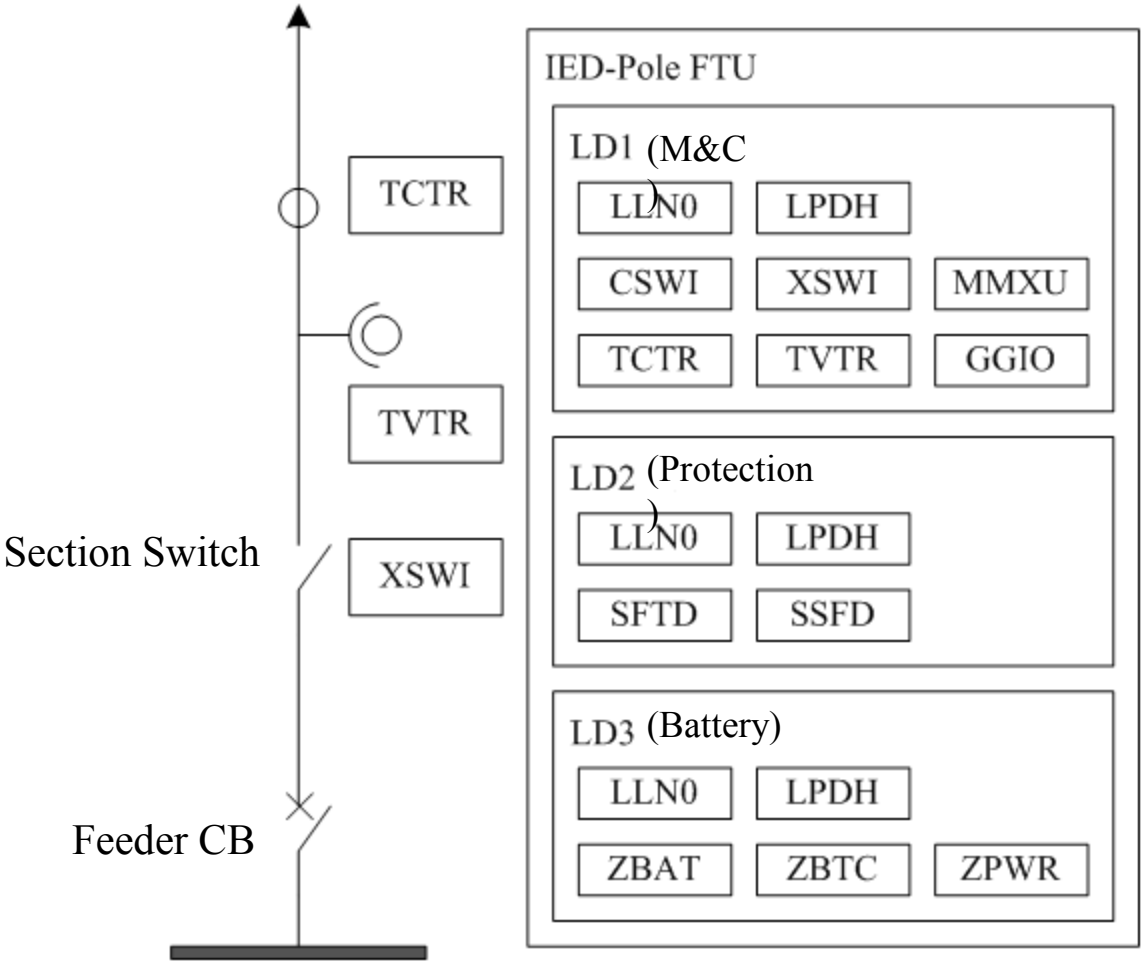
- Application of IEC 61850 to FA with DER Interconnected to Feeders
- Interface between FA and DMS
- Application of OpenADR and SEP to Smart Communities / Buildings

Application of IEC 61850 to FA with DER Interconnected to Feeder

- IEC TC 57 has been extending the application area of IEC 61850 to FA under Working Group (WG)17.
- WG17 has about 90 members where 3 are from China.
- The problems to be solved for application of IEC 61850 to FA
  - Conventional FTU lacks: self-description capability, interoperability, thus unable to plug and play
  - FTU hence requires data model standardization, abstract common services interface (ACSI), self-description and finding/registration
  - The existing logic nodes (LNs) can be applied and some new LNs to be defined

XSWI: section switch	CSWI: switch controller
MMXI: SCADA measurement data	MMAI: harmonics and interharmonics
MSQI: sequence and unbalance factor	SFPI: Fault indication

Message Model Proposed for FTU

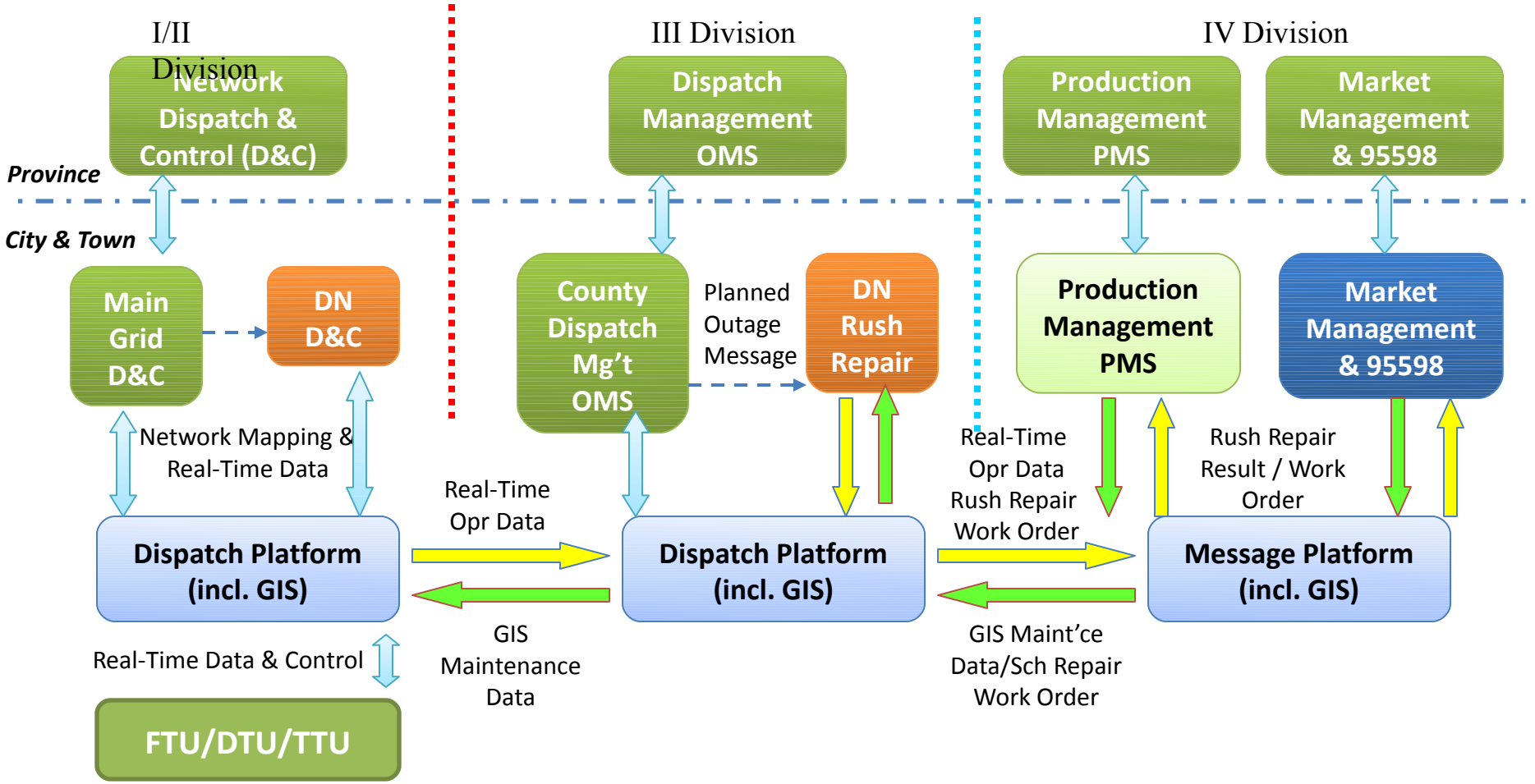


Data Source: Technical Report of WG17, Application of IEC 61850 to Distribution Automation

Interface between FA and DMS

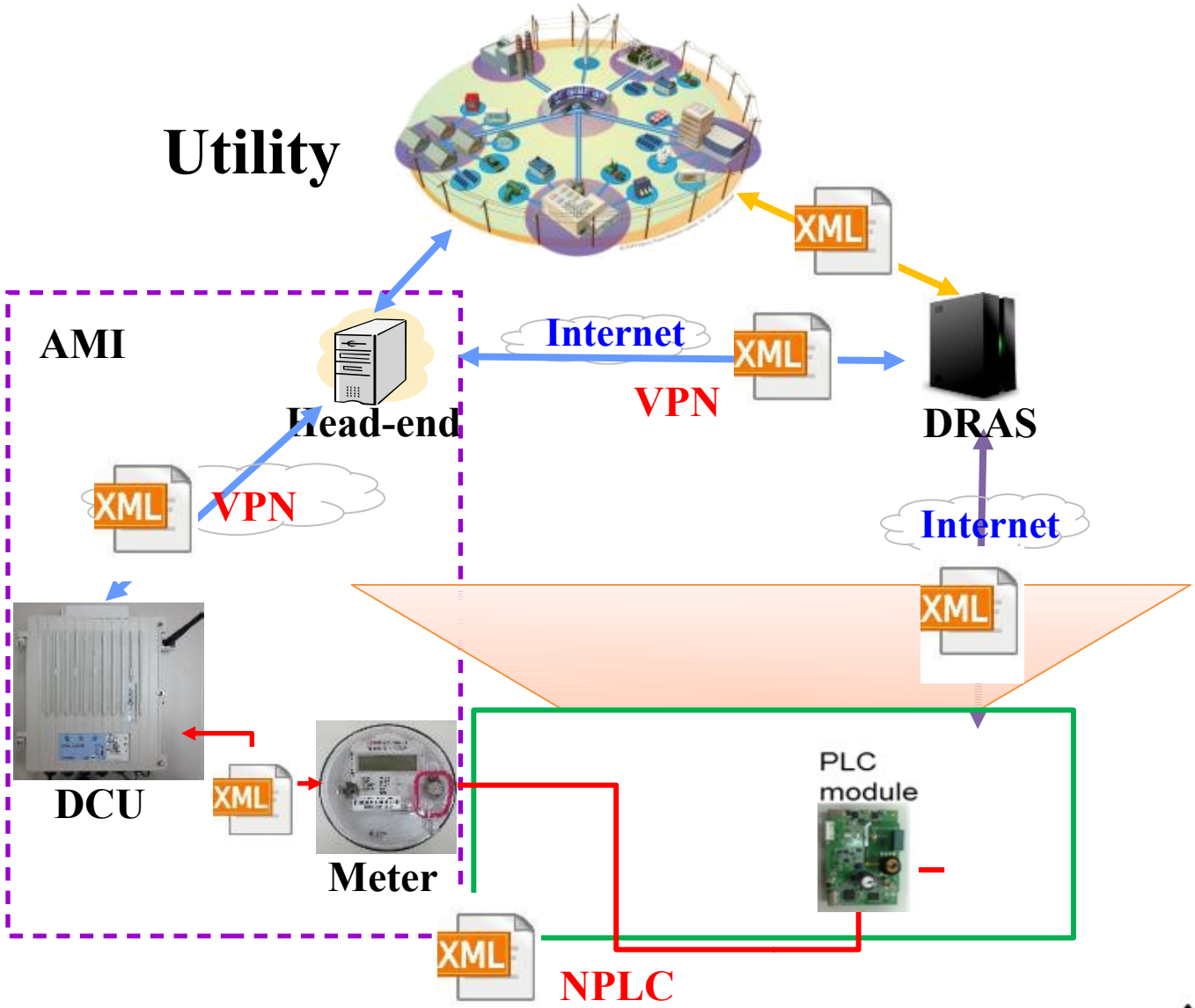
- Mainland China follows IEC 61968 as of the core standards for DMS/DA, which include a series of national and industry standards as well as corporation specifications, such as RTU for DA (DL/T 721-2013), Function Specification of DA System (DL/T 814-2013), DA Technical Guide (Q/GDW 382) etc.
- In 2012, SGCC standardized the distribution system information platform so to enhance the integration of network information and the unification of resource dispatch for both planned maintenance and rush-repair.
- Because of the various complexities on both DMS and FA (e.g., category A+ and A~D in Mainland China), the standardization on interfaces between DMS and FA should take into account these complexities.

Master Station and Unified Rush-Repair Dispatch



Data Source: 沈兵兵，配电自动化标准及新技术发展交流， 2013 年中国电机工程学会年会

One Application Scenario of OpenADR



One Demonstration Project in Taiwan

In-Home Display

Coordinator

Home Gateway

Zigbee Devices

AMI Meter

DCU

DRAS: set up by III to simulate Taipower's DRAS

Internet (HTTPS)

NPL

Zigbee

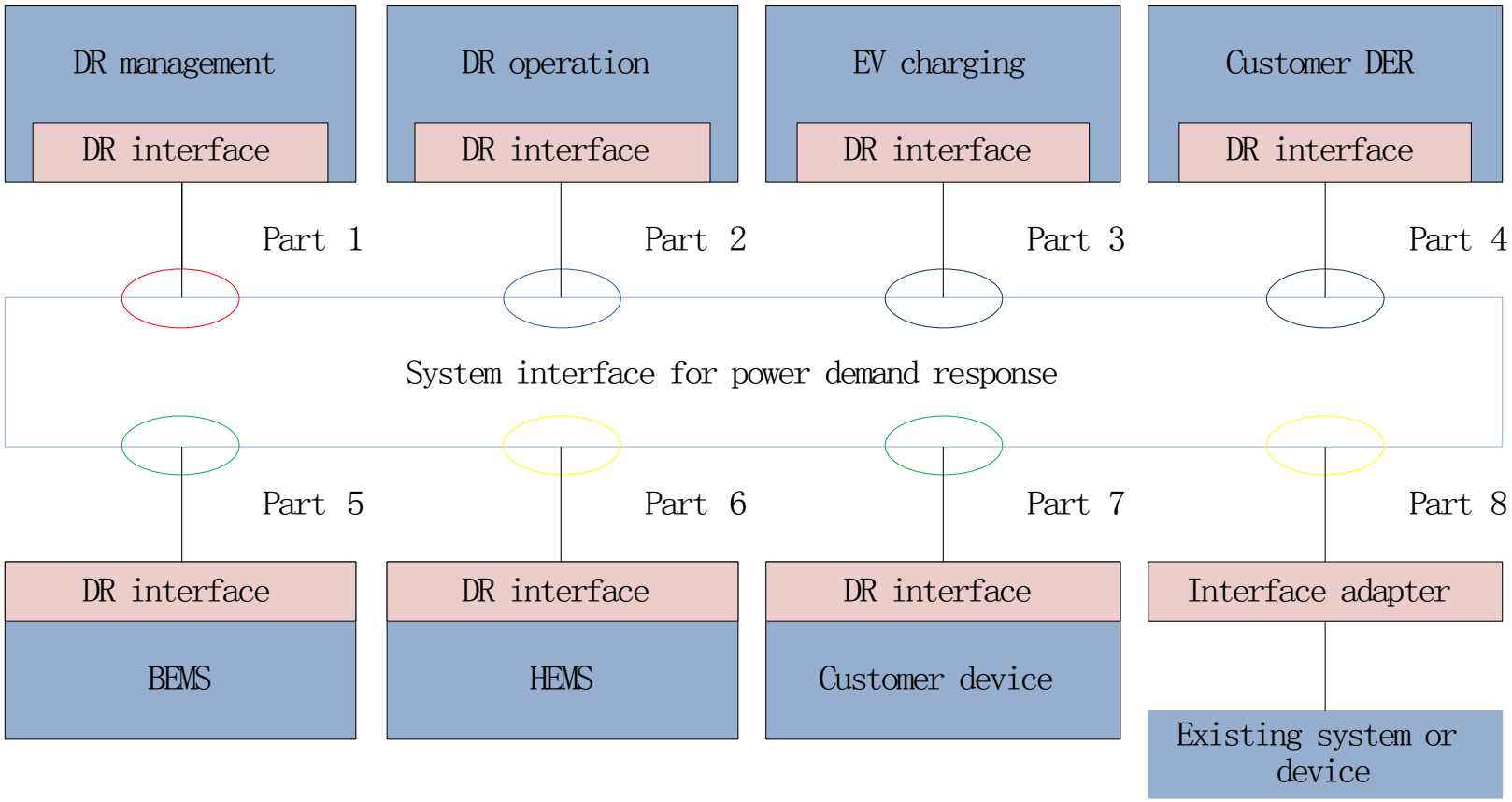
VPN

OpenADR and SEP

OpenADR will also need to interoperate directly or interwork indirectly with other popular protocols now used for energy management, including **BACnet** (www.bacnet.org), **LonMark** (www.lonmark.org) and the **Smart Energy Profile** (www.zigbee.org).

Source: The OpenADR Primer, 2011/08/18
http://www.openadr.org/assets/docs/openadr_primer.pdf

Framework for DR Interface Standards



Data Source: WG2 OF IEC PC118

Key to The Development of Common Standards on ADR

- Based on OpenADR and complied with the principles of PC118 and CIM for DR.
- Based on SEP2.0 and complied with the principle of PC118 for HEMS, BEMS and FEMS.
- The common standard should take into account the different needs between Taiwan and Mainland.
- Conduct site test to find out the system/products which require standardization.

Concluding Remarks

- To meet the market and high-reliability power supply requirements of both Taiwan and Mainland China, DA and ADR related standards have been selected for development of cross-strait common standards.
- Three task-force meetings were held and three SG subjects were selected for development of common standards.
- The first common standard under development is the application of

IEC 61850 to FA where FTU requires capabilities such as data model standardization, ACSI, self-description as well as finding/registration etc.

Concluding Remarks

- The second common standard under development is the interface between FA and DMS, where the complexities on various automation levels in Mainland, which also exist in Taiwan, need to be taken into account.
- The third common standard under development is the application of OpenADR and SEP standards to DR where the different needs between Taiwan and Mainland are to be considered.
- Site tests are to be conducted and various scenario on the test cases are to be evaluated.