



# **Implementation of Cybersecurity testbed and Overseas Export Strategy for Smart Grid**

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# I . Introduction to Implementation of Cybersecurity testbed(1/2)

- **Project : Installment and demonstration of Cybersecurity testbed in smart grid**
- **Current status and motivation**
  - ▲ Researched Cybersecurity system (year 2010~2012) and Developed key cybersecurity (year 2011~2015) in smart grid
  - ▲ A lack of experience needs to testbed on site in order to launch the commercial services
  - ▲ Implementation of cybersecurity Technology for Construction New Market Creation and expansion market in smart grid
- **lead agency : NSRI**
- **Participation agencies : 13 institutions (KEPCO, KSGI, KISA, KEPCO-KDN etc)**
- **duration**
  - ▲ 1<sup>st</sup> year(2015) : May ~ Dec(8 months)
- **Total Project Cost : ₩5.09 billion**

# I . Introduction to Implementation of Cybersecurity testbed(2/2)

## ■ Implementation details and Participation agencies' role

	(Lead Agency)NSRI	KEPRI	
Vulnerability Analysis & Testbed	<ul style="list-style-type: none"> <li>- Vulnerability Analysis &amp; Implementation Cyber-security testbed (AMI, DR, ESS, Weakness Analysis)</li> <li>- Weakness Analysis &amp; Attack Scenario Implementation</li> <li>- Plan for SG security vulnerability</li> </ul>	<ul style="list-style-type: none"> <li>- Vulnerability Analysis &amp; Implementation Cyber-security testbed(EVCI)</li> <li>- Vulnerability Analysis based binary code</li> </ul>	
Test bed of Cryptography/ Authentication Technology	<ul style="list-style-type: none"> <li>- Construction of Cryptography and authentication Testbed</li> <li>- Test of Cryptography and authentication</li> <li>- Design of Testbed for Security Tech Development</li> <li>- Support Cryptography Authentication on-site demonstration</li> </ul>	<div style="border: 2px dashed red; padding: 5px;"> <p><b>KEPCO KDN</b></p> <ul style="list-style-type: none"> <li>- Testbed of Cryptography and authentication (AMI,DR,ESS,EV,PKI)</li> </ul> </div> <p><b>KSGI</b></p> <ul style="list-style-type: none"> <li>- Testbed of Cryptography and authentication(AMI,EVInJeju)</li> </ul>	Participants
Policy Development	<ul style="list-style-type: none"> <li>- Development of Security guideline</li> <li>- Construction and Operation of SG Security Demonstration site.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction and Operation of SG Security Demonstration site.</li> </ul>	KISA
			<ul style="list-style-type: none"> <li>- Personal Information Protection Guideline</li> <li>- Strategies of SG Security Standardization</li> </ul>



# II. Certification technology in Smart Grid(1/7)

## ■ Objectives

### Implement Certification testbed

- Construct Certification testbed room at Jeju interoperability test center
- Design and Build cybersecurity devices of PKI for AMI, DR, ESS, EV Charger

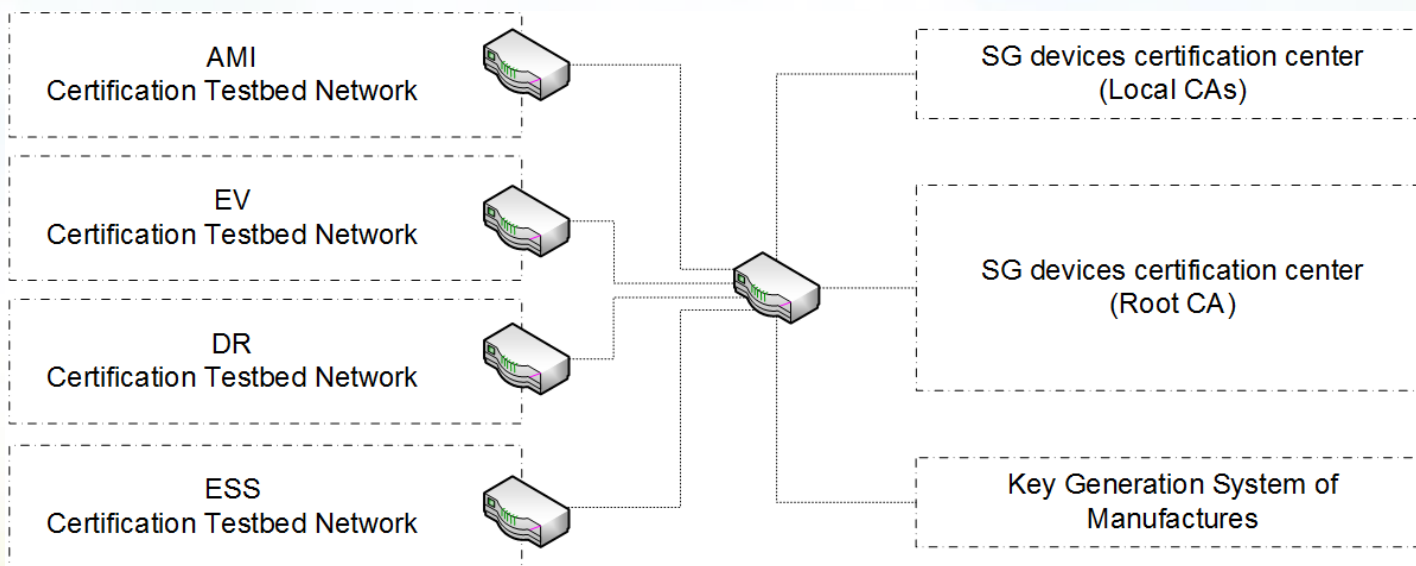
### Implementation Certification On site

- Construct testbed sites and Install cybersecurity devices in KEPCO-KDN Daejeon-chungnam branch office and Jeju interoperability test center
- Implement on-site testbed devices such as developed AMI, DR, ESS, EV Charger with PKI system

# II. Certification technology in Smart Grid(2/7)

## ■ Construct Certification testbed environment

- Construct Certification testbed room and SG PKI system at Jeju interoperability test center
  - details : Implement on-site testbed devices such as developed AMI, DR, ESS, EV Charger with PKI system

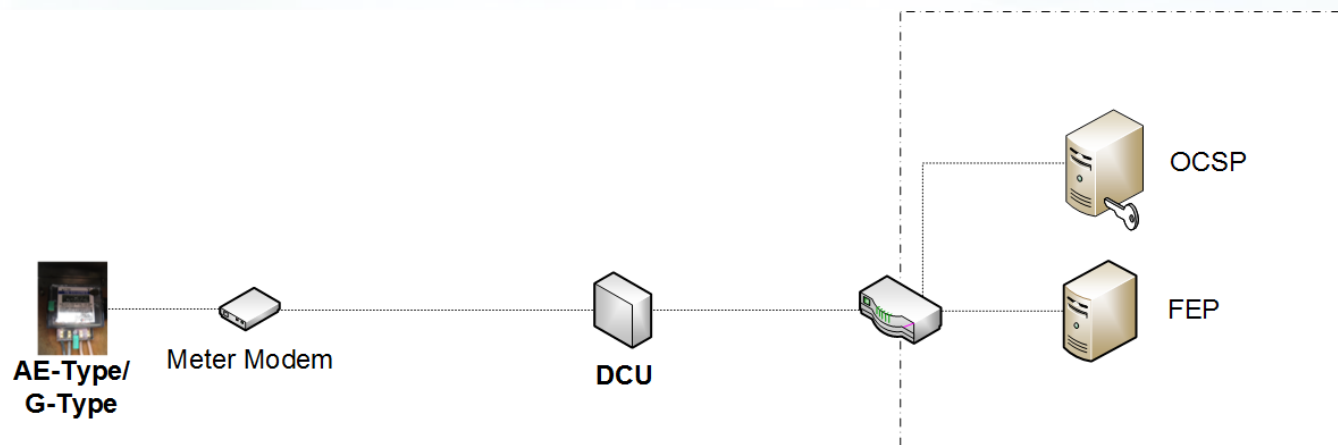


An overview of Certification testbed room Architecture

## II. Certification technology in Smart Grid(3/7)

### ■ Implement encryption and authentication Test-bed

- functional and performance test for AMI security
  - PKI based Field Application of AMI system using SW and HW cyber security module

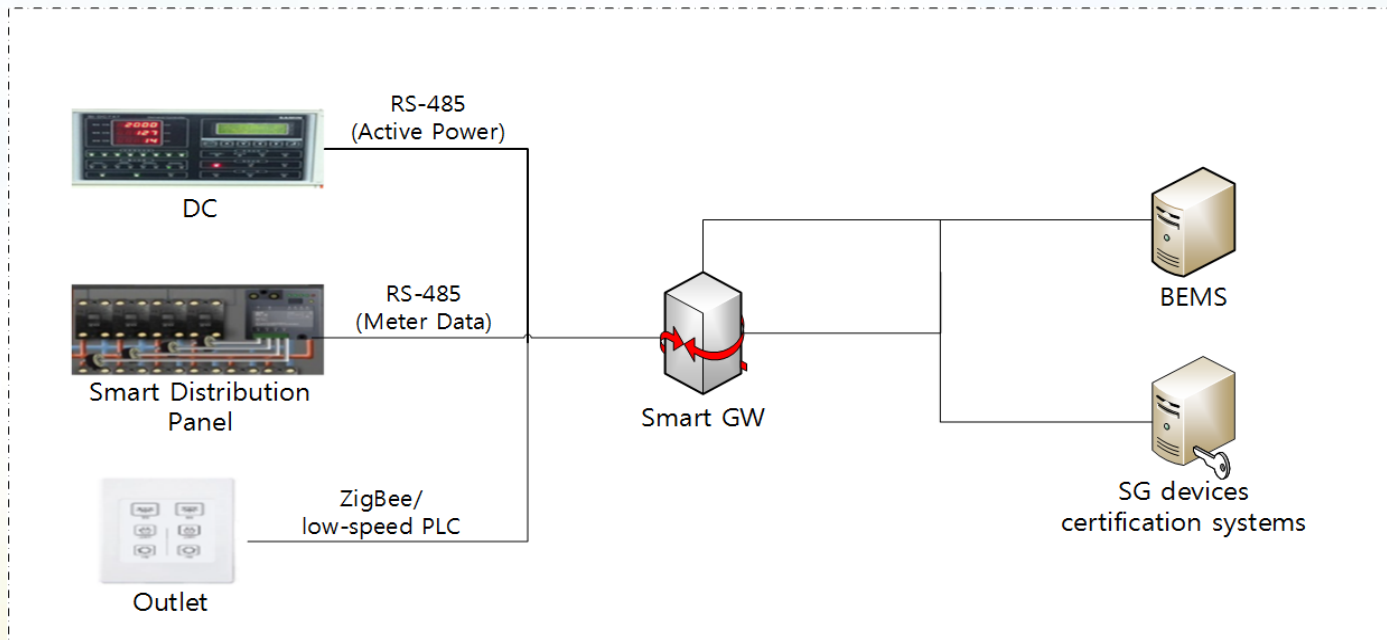


## II. Certification technology in Smart Grid(4/7)

### ■ Implement encryption and authentication Test-bed

#### ● functional and performance test for DR security

- PKI based Field Application of DR system using SW and HW cyber security module



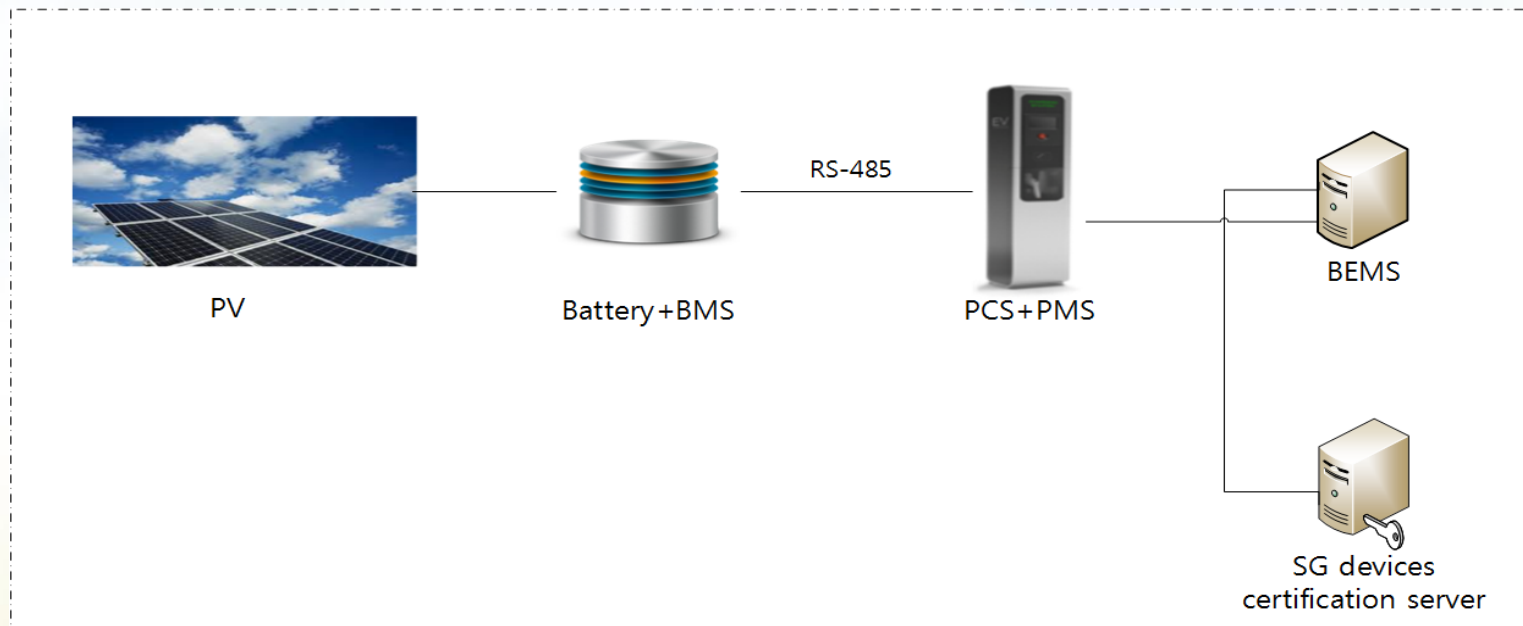


# II. Certification technology in Smart Grid(5/7)

## ■ Implement encryption and authentication Test-bed

### ● functional and performance test for ESS security

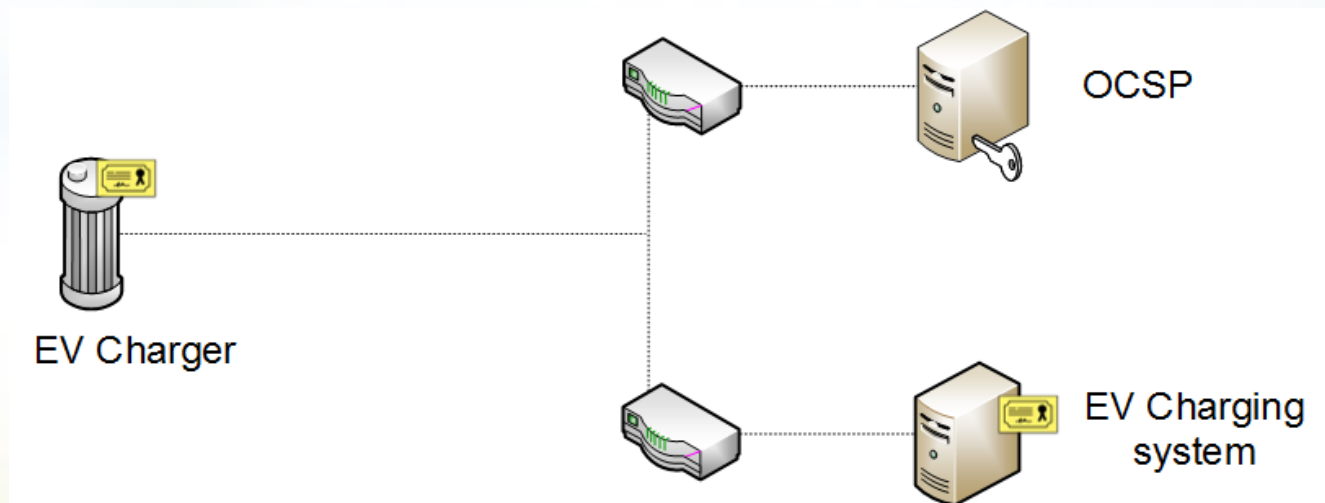
- PKI based Field Application of ESS system using SW and HW cyber security module



## II. Certification technology in Smart Grid(6/7)

### ■ Implement encryption and authentication Test-bed

- functional and performance test for EV charger security
  - PKI based Field Application of EV charging system using SW and HW cyber security module



# II. Certification technology in Smart Grid(7/7)

## Schedule



## Strategy and Methodology

- Construct Systematic cooperation with among Policy agencies(KISA, KSGI), Service agency(KEPCO), Research Institute(NSRI), and Business Company(KEPCO-KDN, PSTEK, Ioncommunications etc.) for becoming a success business in smart grid
- On-site testbed Validation of Smart Grid Cybersecurity by vulnerability analysis, encryption and authorization, security policy
- Conduct Step-by-step scheduling on the project and active publicity campaign for project result
- publish open architecture technologies as open standards, relation with local and overseas standardization organization

# Ⅲ. Public Key Infrastructure(1/6)

## ■ Implement encryption and authentication Test-bed

- functional and performance test for PKI system
  - Certification Field Application of PKI system that installed on site
  - Locations Jeju
    - Root CA, Local CA - interoperability test center
    - Smart device : DR, ESS, EV - interoperability test center
    - AMI - interoperability Smart Place test center
  - Location KEPCO-KDN Daejeon-Chungnam branch office
    - Standalone CA
    - DR, PV+ESS, EV





# III. Public Key Infrastructure(2/6)

## ■ PKI(Public Key Infrastructure)

- ▲ Definition : The sum total of the hardware, software, people, processes, and policies that, together, using the technology of asymmetric cryptography, facilitate the creation of a verifiable association between a public key (the public component of an asymmetric key pair) and the identity (and/or other attributes) of the holder of the corresponding private key (the private component of that pair) for uses such as **authenticating** the identity of a specific entity, ensuring the **integrity** of information, providing support for **nonrepudiation**, and establishing an **encrypted** communications section
- ▲ PKI Terminology and Concepts : Hashing functions, Symmetric encryption and decryption(Session key), Asymmetric encryption and decryption(Key pair), Digital signature, Digital certificate(X.509), Certification Authorities (CA), Registration Authorities (RA), Hierarchy of trust

# III. Public Key Infrastructure(3/6)

## Who Uses PKI?



Sources : Perry Tancredi , VeriSign, Inc.

# III. Public Key Infrastructure(4/6)

## ■ Key & Certificate Management

### ▲ Key/Certificate Life Cycle Management

*Identity ≠ Key. Focus on Key!*

### ▲ Stages

- Initialization :

Key pair Generation (*private key+public key*)

- Issued (active) :

Issuance

- Certificate Creation

- Distribution(*Certificate + private key*)

[Usage]

- Cancellation :

Certificate Expiration & Revocation



# III. Public Key Infrastructure(5/6)

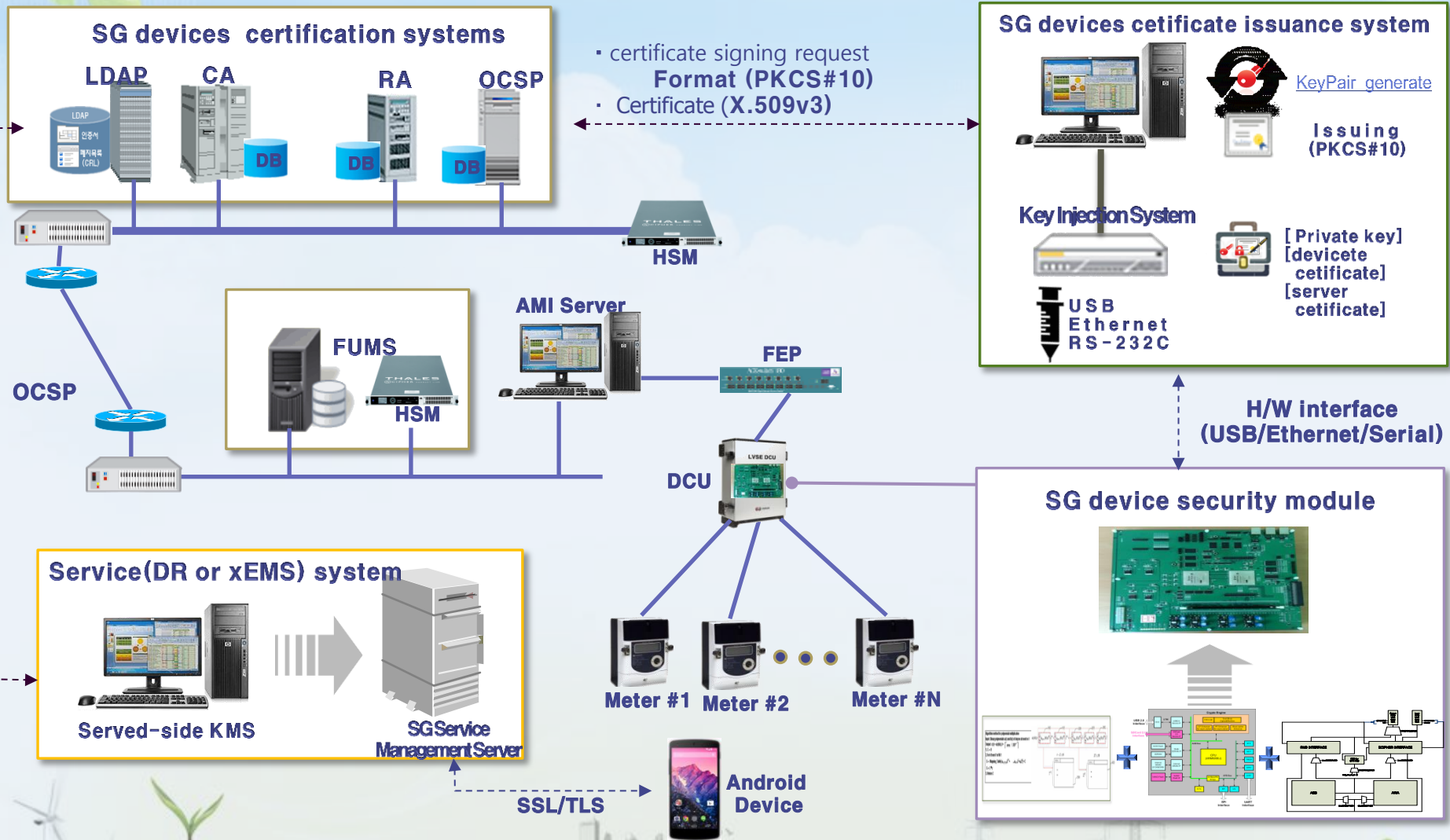
## ■ Smart Grid PKI Standards related

- ▲ NIST 7628 Guidelines for Smart Grid Cybersecurity Rev1 (2014.9)
- ▲ IEC 62351-5 Security for IEC 60870-5 and Derivatives (i.e. DNP3)
- ▲ IEEE Std. 1815-2012 Electric Power Systems Communications-Distributed Network Protocol (DNP3)
- ▲ IEC 62056 Electricity metering data exchange (DLMS/COSEM)
- ▲ DLMS User Association, DLMS/COSEM Architecture and Protocols v8, 2014.7





# III. Public Key Infrastructure(6/6)



# IV. Overseas Export Strategy for Smart Grid(1/4)

## ■ Smart Grid Cybersecurity Business Model

- ▲ EMS business : HEMS, BEMS, FEMS
- ▲ Construction, operation and control of Microgrid
- ▲ Construction of EV charging system
- ▲ Construction, operation and control of Renewable Energy system :  
PV, wind plant, ESS
- ▲ Construction, operation of AMI, AMR
- ▲ Construction, operation of SCADA
- ▲ Construction, operation of power generation
- ▲ DR and VPP (including DER) business
- ▲ Construction, operation of utility network

# IV. Overseas Export Strategy for Smart Grid(2/4)

## ■ Export strategy

- ▲ Find out target market
  - highly-specialized
  - differentiation
  - segmentation
- ▲ Selection and Concentration
  - successful business, avoidance risk of danger
- ▲ Cooperation with a leading smart grid technology company
  - AMI case – Meter + DCU + utility company
  - small and medium-sized enterprises have the opportunity to participate
- ▲ Form a domestic or foreign business group or consulting group
  - collect and exchange information
  - cooperate in business
- ▲ Participate from consulting project
  - consulting->main project
  - consulting can be reduce risk

# IV. Overseas Export Strategy for Smart Grid(3/4)

## ■ Infrastructure of smart grid cybersecurity

- ▲ Open standard
- ▲ Compliance with national standards of various countries
  - devices side
  - security side
- ▲ Software and hardware security modules
  - some cases of IOT
- ▲ PKI system
  - Cryptographic Module Validation Program(CMVP)
- ▲ Countermeasure for cyber and physical attacks
  - depend from attacks and tamper-proof





# IV. Overseas Export Strategy for Smart Grid(4/4)

## ■ Propose to expand Export in smart grid security

- ▲ Collect export project information
  - transmit to highly-specialized enterprises
- ▲ Drive toward international cooperative testbed study
  - have opportunity to find out overseas market
  - small and medium-sized enterprises have the opportunity to participate
- ▲ Strengthen cooperation with foreign consultative networks
  - Collect and Exchange sybersecurity information and standards
  - Find out the technology changes
- ▲ Secure advanced cybersecurity technology
  - undertake a nationwide proliferation project in smart grid for spreading cybersecurity market and depending national security infrastructure

The background of the slide is a composite image. The top half shows a bright blue sky with large, fluffy white clouds. In the bottom left corner, there are green leaves and a small sunburst. The bottom half of the image shows a green field with several wind turbines on the left, a small solar panel array in the center, and a city skyline with several skyscrapers in the distance. To the right of the city, there are several high-voltage power line towers. The overall scene is bright and positive, suggesting a focus on clean energy and sustainable development.

# Thank you!

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