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A Review of Transaction-Based Energy Management
Technology for Energy Prosumers

Seak Bai Koh*, Sung-Yong Son**

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Abstract The proliferation of distributed power sources such as renewable energy sources drives the changes of consumers to prosumers who actively want to deal with energy. The prosumer is a new type of consumer that can sell surplus energy or additionally generated energy to electric power companies, other energy service providers, or other consumers. To implement such a concept, a new technology and platform that can support the transaction of the prosumers are required. However, the study in the area is limited since it is in the early stage. This work examines the state-of-the-art transaction-based energy management technology through comparative analysis of representative technologies to show the future trends. Although, technologies and standards for transaction based energy are not much matured yet. related new research will be continued via competitions.

Key Words : Energy Prosumer, Energy management, IEC 62325, Transaction, Transactive Control, Transactive Energy

1. 서론

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[1-3].

전

.

. 2012

2   Btu (British Thermal

Unit)   [3]. EIA (Energy Information

Administration)   30

.

[4]. IEC 62325

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.

. . 2
(deregulation) , 3
. . 4

5 .

.

[5]. **2**

(Demand Response, DR)
/ ,
, , , ,

. DR

[5].

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.

. PNNL Transactive Energy(TE)

, [5][6]. TE

(Transaction Based Energy)

.

Transactive Energy
PowerMatcher . PowerMatcher . ,

IEC
, 62325 EU

IEC 62325 .

.

3.

3.1 Transactive Energy

TE   PNNL   2011   5   GWAC(gridwise
architecture council)   TE
                    TE   "

                              "   [6].
TE

            PJM   2014 GWAC   TE
system   .
TE

                        6   [6].

  - TE

  - TE

  - TE

  - TE
(observable)   (auditable)
  - TE

  -              TE

                    TE
                    [7].

  - Architecture:

                              ,
- Extent: TE   ,   ,

                                        TE
    (,   ,   )   .
    TE
- Transacting parties:
                                        AI

- Transaction:
                              ,

- Transacted commodities:

- Temporal variability:

                    ,

- Interoperability: (party)
                                    .

- Value discovery mechanism:

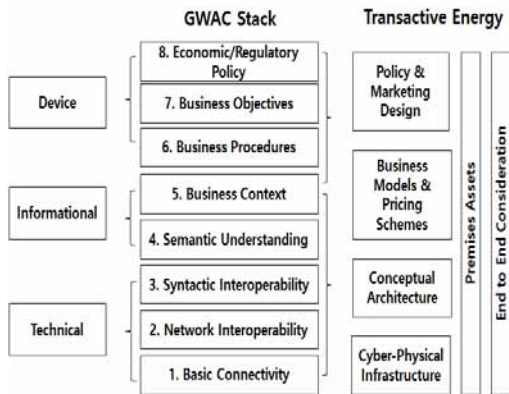   .   ,   ,
- Assignment of value:

- Alignment of objectives:
          win-win   win-lose

- Assuring stability:

1. ransactive Energy element GWAC [5]

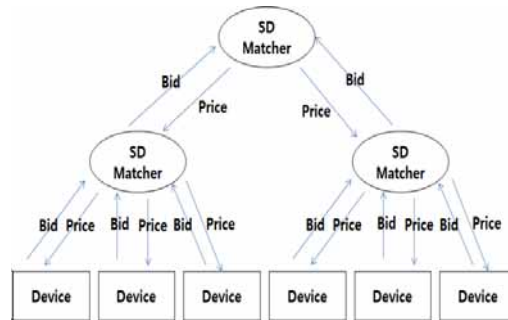Fig. 1. GWAC Interoperability Stack with elements of transactive energy

GWAC 1 GWAC

TE

[5].

(cyber-physical level)

,

, 3

.

3.2 PowerMatcher

, ,

-

[5].

-

.

PowerMatcher

.

2004 PowerMatcher

LMP (Locational Marginal Pricing)

. PowerMatcher

.

/ (device)

(agent)

.

.

2. PowerMatcher -

Fig. 2. Hierarchy of supply & demand matchers in the PowerMatcher

2 - Power Matcher .

SD-Matcher

SD-Matcher

(matching)

SD-Matcher .

SD-Matcher .

SD-Matcher

SD-Matcher

. SD-Matcher

SD-Matcher

. SD-Matcher

.

SD-Matcher

. SD-Matcher

(equilibrium price)

.

- Stochastic operation devices: [7]

.

- Shiftable operation devices:
(,) batch-type .
,

.

- External resource buffering devices:

. on/off

.
(,
) , ( )
, heat buffering device

- Electricity storage devices:
flywheel super capacitor
.

.

- Freely-controllable devices:
( )
.

- User-action devices:
. ,
, ,
stochastic operation device .

.

(constraint)
. (local optimization)

.

(global optimization).
PowerMatcher ESC (The Energy Supply Cooperative)
(Hybrid Energy Grid Management: HEGRID , Lochem)
[9].

3.3 IEC 62325

(protocol)
.
.
EU . IEC 62325

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IEC 62325 ENTSO-E(European Network of Transmission System Operators for

Electricity)
EU　　　　　　　EU　　　　　　TSO
　　　　　　　　　　　. ENTSO-E　　　　　　　　use
case　　　　　　　　CIM (common information
model)
　　　　　. IEC TC 57　　　　　　　　　IEC 62325
　　WG-16 (Deregulated Energy Market)

　　　　　　　　,
　　　　　　CIM　　　　　　　　　　　.
　　　　IEC 62325 series
　　[10]-[17].

- IEC 62325-301: Common information model
(CIM) extensions for markets.　　　　　CIM
extensions　　　　　　　　　　　　object

- IEC 62325-351: CIM European market model
exchange profile. ESMP (European market

profile)　　　　　　　　. European style market
profile (ESMP)

- IEC 62325-45x: Profile and context modelling
rules.

　IEC 62325-301　CIM model
　　　　　　(Market Operations Package)　EU
　　　　　　(Market Management Package)
　[10].　　　　IEC 62325-351
　　　　　　　　　EU　　　　TSO
business process　　　　　　　　　[11].
EU　　　　　　　　　　　　　Bidding
　　　　　　　　　(　)
　　　　　. IEC 62325-351
　　TSO

　　　　　(scheduling),
　(capacity allocation),
　　　　　(settlement)

　　　　　　(acknowledgement)
TSO
　　　　　　　　　　　.
　IEC　62325　　　　　　　TSO
ENSTO-E (European Network of Transmission
System Operators for Electricity)
　　　　　　　　　　　　　EU
　　TSO
　　　　.
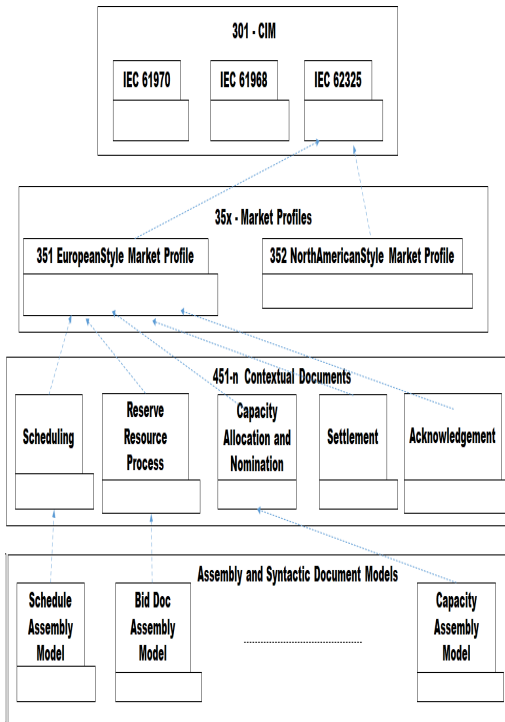
3. IEC 62325　　　　[10]
Fig. 3. IEC 62325 model overview
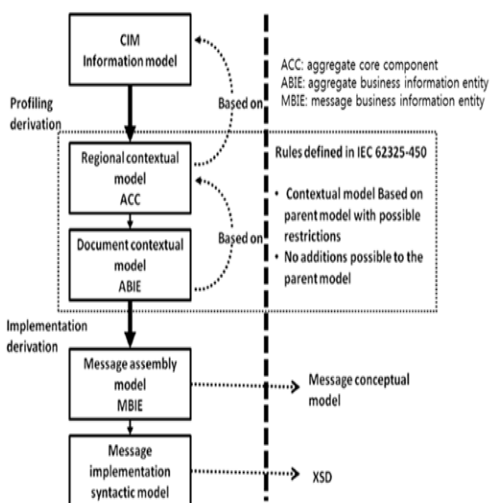
4. IEC 62325-450 framework[11]
Fig. 4. IEC 62325-450 modelling framework

IEC 62325-351   EU
(regional contextual model)

ACCs(aggregate core components)   .
(document contextual model)

ACCs
(contextualisation)   .   ACCs
aggregate business information entities
(ABIEs)

.

(message assembly model)   .
XML   [12].

4.

TE PowerMatcher   IEC 62325
. TE

PowerMatcher

(
)
.

IEC 62325   EU   TSO

.   IEC 62325-301
CIM

DSO/ISO

.

. TE   OASIS   OpenADR

CIM

.

Table 1. Comparison among TE, PowerMatcher and IEC 62325

	TE	PowerMatcher	IEC 62325
Identity	multi-variable optimization mechanism	simulator	standard
Purpose	optimization	power supply-demand matching	TSO BP standardization
Related persons	policy maker, grid operator, market operator, etc.	grid operator, market operator, etc.	TSO
Chara c-teristic	sometimes, market only cannot solve all problems	can be applied to the various sized market	too big for the small, middle market

5.

TE PowerMatcher,

IEC 62325 . IEC
62325 EU CIM
model IEC 62325-351
TSO

TE
. PowerMatcer

.

TE
PowerMatcher

.

prosumer

(local market)
[18].

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TE

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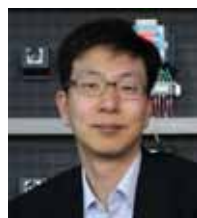
(Seak Bai Koh)   [   ]

• 1991   KAIST

• 2018

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(Sung-Yong Son)   [   ]

• 1990   KAIST
• 1992   KAIST
• 2000   Univ. of Michigan, Ann Arbor

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