Wide Area Situation Awareness (WASA) Demonstration System Utilizing the CIM in Japan

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Background – WASA demonstration system

• Against a background of increasing renewable energy, the emergence of the smart grid initiative
  • may have posed new challenges to task of solving wide-area power system operation issues.

• Wide Area Situation Awareness (WASA)
  • can offer power system engineers and operators an effective means to meet the goals of developing reliable, efficient, secure, robust, economical and environmentally neutral power systems.

• In Japan, a project entitled
  • “Research for Promoting International Standardization on the Technology of WASA for Trunk Power System” has been launched.

• WASA demonstration system is prototyping to show its effectiveness in the project.
Background – How to use the CIM

• WASA architecture on how to use the CIM effectively is one of the key issues facing power system engineers.

• A framework for the communication between WASA brain (CE: Central Equipment) and nervous system of power system (PMU/PDC) is required for the WASA
  • which can respond flexibly to changes in power system situations (make maximal use of power system capability)
  • and will not become obsolete (will evolve itself).

• In the interoperability between CE and PMU/PDC, the framework can be built by the information model through the CIM for the harmonization of IEC 61850 and 61970.
Scope

• A concept of WASA brain utilizing the CIM in Japan
  • WASA demonstration system provides a skeleton of WASA architecture utilizing the CIM.

• A novel information handling of WASA brain is based on Semantic Web technology
  • in which the CIM model can be converted by a general procedure into power system models for SCADA-EMS applications.

• To provide a novel plug-and-play application platform
  • Since the information handling of WASA brain can link power system models in real-time database and the information models of PMU/PDC and legacy I/F,
  • it can enable the interoperability between applications and both IEC 61850 compliant and legacy devices.

• To provide a next-generation WASA & Control environment with no vendor lock-in
  • where the portability of existing applications and
  • the ease of installation of new applications can be promoted.
WASA Demonstration System

- WASA demonstration system provides
  - A skeleton of WASA architecture utilizing the CIM as a prototype to show its effectiveness.

WASA brain utilizing the CIM

Whole system of WASA: No standards can be applied.
WASA Demonstration System

- WASA brain utilizing the CIM provides
  - Power system model and its snapshot
  - Power system analysis and its results
  - Situation awareness and design of control actions
Use Case: WAMPAC/IEC61850-90-5(TC57 WG10) (Wide Area Monitoring, Protection and Control)

- Phenomenon assumption type WAMPAC
  - Based on a pre-fault calculation using on-line power system information
- When a very severe fault occurs,
  - the complete loss of an important power corridor,
  - generators may lose synchronization with the power network.
- WAMPAC executes generator shedding or load shedding
  - in order to avoid these types of unstable system conditions.

It may also cause overload of transmission lines or transformers. Imbalance between generation and consumption can occur.
#0 WASA Brain Utilizing the CIM

- Points on the concept

**Power System**

- Power System + PDCs/PMUs/IEDs

- Legacy

- Uplink information

- Downlink information

**#1 I/F Between WASA Brain and Power System**

- #2 CIM I/F based on Semantic Web Technology

- Data Merging Process to provide a power system object

**#0 WASA Brain utilizing the CIM**

- Power System Snapshot

- CE Applications

- #3 Application Class in WASA Brain

- Situation Awareness Design of control actions

- #4 Control Action Class

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#0 WASA Brain Utilizing the CIM

- The framework of WASA can be built by the information model through the CIM for the harmonization of IEC61850 and 61970.
  - There is no problems for distant future systems and zero-based review.
  - The ease of installation of “new applications” can be promoted.
- However,
  - it takes a long time to change from all “legacy type interfaces” to IEC61850 compliance.
  - “Existing applications” are indispensable for operating power systems.
- The issues based on the current situation are as follows;
  - Provide a WASA architecture to enable a coexistence with the CIM compliance and legacy type I/F.
  - Provide a flexible WASA architecture to promote the portability of existing applications.
**#1 I/F Between WASA Brain and Power System**

- WASA brain requires a snapshot varying from hour to hour which is a set of data reflecting the situation of power system.
  - The snapshot requires a data merging process to integrate the CIM, PMU/IED/PDC and legacy device information.

- WASA brain provides control actions based on a situation awareness based on results of applications.
  - The control action requires a control action class to update its control actions in power systems.
#2 CIM I/F based on Semantic Web Technology

- Power system analysis should be required a variety of information such as CIM, phasors, dynamic models and legacy devices.
- This transaction needs to merge the above information into power system object for analyzing power systems.
#2 CIM I/F based on Semantic Web Technology

- Information model of I/F with any external systems
  - The CIM added an I/F with external systems can link the external systems such as PDC/PMU/IED to the CIM.

- Data Merging Process based on Semantic Web Technology
  - RDF conversion can copy the necessary information from CIM DB.
  - Model Script can assemble power equipment in power system models.
  - Data merging process can provide a snapshot which can reflect data from PDC and legacy devices.

![Diagram of CIM I/F with external systems](image)
“Existing applications” are indispensable for analyzing and operating power systems.

Power system analysis consists of a lot of types of applications (use cases), such as security assessment, operation optimization and design control actions.
#3 Application Class in WASA Brain

- The definition of functions of applications based on accumulating use cases is necessary to provide a plug-and-play application platform.
#4 Control Action Class in the CIM

- WASA brain provides control actions based on a situation awareness.

- However, there is no downlink information class in the CIM to power systems.

- The control action requires a control action class to update its control actions.
  - To provide a novel plug-and-play application platform
  - To provide a next-generation WASA & Control environment with no vendor lock-in
Conclusions

• WASA Brain Utilizing the CIM
  • I/F Between WASA Brain and Power System
    • It is necessary to provide
      ✓ a WASA architecture to enable a coexistence with the CIM compliance and legacy type I/F, and
      ✓ a flexible WASA architecture to promote the portability of existing applications.
  • Application Class in WASA Brain and Control Action Class
    • These are necessary to provide a plug-and-play application platform.

• The technology of WASA utilizing the CIM can provide
  • a next-generation WASA & Control environment with no vendor lock-in
  • where the portability of existing applications and the ease of installation of new applications can be promoted.
Thank you for your attention!
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TEPCO really appreciate your kind support!