

## A Study on the Integrated Operation and the Development of Smart Water Grid Monitoring Systems

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**Abstract.** Recent shifts in water resource management paradigm and information and communication technologies (ICT) call for platform-based integrated operation management technology, which has the multidimensional approach of two-way communication. To prepare domestically for such paradigm changes, research on Smart Water Grid, which is intelligent water management that combines water resource management with ICT, remains ongoing. This study proposes a framework of using the components of a variety of program modules to build an intelligent water management integrated operation system appropriate for Smart Water Grid, and suggests the system development environment and the integrated operation system implementation plan for using the framework of Core-Platform

**Keywords:** Smart water grid, Integrated management system, Core-platform, ICT.

### 1 Introduction

The existing water resource management system is unreliable due to lack of real-time data, and the weak ICT integrated system and program development is evident in the lack of water disaster warning system and in water resource-related data infrastructure. Furthermore, the lack of standardization among water resource ICT management system and system development has led to various companies to develop such, making program integration and data integration difficult, and limits water management system efforts towards effectiveness. In order to address these problems, on the water resource-front, Smart Water Grid places critical importance on building the next generation of water resource system and infrastructure by using multiple water sources to overcome existing water resource management system's limitations; Smart Water Grid further emphasizes the need for the supply and information management for stable water supply through technological innovation and intelligence by combining water resource management and ICT technology to address the continually increasing water demand in the context of rapid changes to water resource environment and rapidly changing global water industry. Smart Water Grid cannot be a one-time development, but must be sustainably in operation by allowing for easy maintenance for continuous inspection and optimization; furthermore, for the

commercialization and to keep with global trends, the system must be developed as a single platform which allows for managing a variety of programs.

## 2 The Configuration and Development Method of Smart Water Grid Monitoring System

### 2.1 The Configuration of the Monitoring System

The Smart Water Grid monitoring system for intelligent water management package construction is as Figure 1. With Core-Platform as the basis, it provides the database foundation for the seven programs – water treatment combination program, water loop operation program, select water intake program, business support program, water shortage assessment program, available water quantity calculation program, and AMI network program – to be integrated or interlinked; it furthermore provides a representative component for seamless linkage with SWG integrated DB by allowing database usage or by defining the interface standards.

All programs configured with such package is capable of integrated management of each program’s real-time monitoring and alerts of the program’s operation status, server status, and user status.

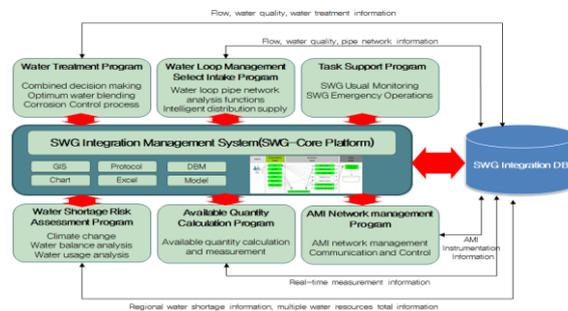


Fig. 1 System configuration

### 2.2 Monitoring System Development Method

For the purposes of packaging, within the server-client (C/S) architecture, each program developed in the Smart Water Grid is configured to be the client while the database serves as the server; and they are developed with the object-oriented language C#. Furthermore, the programs developed by Smart Water Grid are developed with framework-including platform as its basis as per Figure 2, and since the platform and frameworks are configured as library and components, uses Component-Based Development (CBD) method of MARM I methodology

### 3 Monitoring System Development and Integrated Operations

#### 3.1 Monitoring System Integrated Operation Scenario

In order for all programs developed with Core-Platform foundation to operate as a single program in Smart Water Grid, all input and output data of each program are cross-referenced. And, the data develops a monitoring system as per Figure 3 for effective water management. Data production and storage within Smart Water Grid starts with the multiple water source water level estimation to be built into the integrated data. Real-time measurements of the multiple water source and real-time water consumption rates are calculated and stored as data, and this data is re-calculated using water shortage threat assessment program and stored. The reserve level of the multiple water sources is then calculated to determine to the current water supply of the multiple water sources, and allows for optimal water intake level for combined water treatment. The scenario was developed such that water treated through the combined treatment process is distributed and supplied through water loop.

#### 3.2 Intelligent Monitoring System Development

Smart Water Grid integrated operation system was developed as per the development method described in Chapter 2.2 and the proposed implementation scenario described in Chapter 3.1. The main login screen required for monitoring system administrator to enter the system's main page.

In order to operate each of the programs of Smart Water Grid as a single program, input and output data from multiple water source real-time measurement to water loop distribution and supply are cross-referenced.



Fig. 3. Normal of operation

To manage these data in an integrated manner, the monitoring system's main page is constructed to show the real-time monitoring and alerts of each programs within the Smart Water Grid package's program status, server status, and user status. Furthermore, the operation status of each program is based on the server database, and

includes monitoring of relevant DB table, and evaluated for program errors based on hourly monitoring of the measurement data from multiple water source and water reservoir with program's input and output data. In the case of program error, the error is indicated in the program main page for the specific program that has the error, as per Figure 2, and the incidence is communicated to the operating personnel via SMS and E-mail.

#### 4 Conclusion

This study proposed a scenario where in which programs with Core-Platform can be packaged to make effective water management possible, in pursuit of developing an intelligent water management monitoring system applicable for Smart Water Grid; and proposed system development environment and implementation plan.

The monitoring system was developed by using a Core-Platform foundation for each program's library and components, and configured for convenient system unit development, assembly, and maintenance. This system allows for effective water supply to regions by using real-time data measurements from multiple water sources to water loop distribution and supply input and output data, and using the proposed scenario implemented the system proposed through this study. The integrated operation system is envisioned to be capable of integrated operating and monitoring each program, and in the case of error, be addressable by operating personnel.

After the system is applied in the field, further detailed research will be needed for optimal system establishment and stability by analyzing user requests from operating personnel and developers.

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