I. Introduction
1. Introduction

Using single water source

- Increase of transportation costs
- Unable to deal with emergencies

Simple, unidirectional monitoring

- Unable to deal with accidents in the water source
- Unable to deal with accidents in the pipes

How to Solve?
“Smart” is the main keyword in the 21st century

1. Introduction

Source: Frost & Sullivan
"Smart Grid" is a modernized electrical grid that uses information and communications technology (ICT) to gather and act on information in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity\(^1\).

The concept for "Smart Grid" has been developed to solve the energy crisis. But what about water crisis?

1. Introduction

Smart Water Grid = Water + ICT

“Smart Water Grid” is a new platform for intelligent and integrated water management. It allows high reliability, diversification of water sources, low energy consumption, and cost reduction.
1. Introduction

Smart Water Grid Technologies

- IT Industry
  (Real-time monitoring)
- Utility optimization
- Basis of Smart Power Grid
- Demand estimation from bidirectional management
- Increase of energy efficiency

- Water Industry
  (Natural/Active water resources)
- Diversifying water resources
- Smart drinking
  water/waste/sewerage water management system

- Grid
  - Infrastructure Industry
    (Network for delivering source)
  - Associated infrastructure with Smart green city
  - Solution of basic infrastructure
1. Introduction

Smart Water Grid System

- Dam
- River
- Water treatment
- Water flow
- Data flow
- Control Tower
- Reservoir
- Central reservoir
- Agricultural land
- Ground water
- Desalination
- Urban area
- Waste water Treatment
Smart Water Grid: Why?

- Water management is increasingly influenced by development in Smart Technology.
- Many of the management system heavily rely on the management of large amounts of information and data.
- Smart water grid technologies can lead to a significant contribution in overcoming water management challenges in the 21st century
1. Introduction

Smart Water Grid: Three Main Effects

- **Water Efficiency**
  - Increased Efficiency and Reduced Cost
  - Water loss control, energy saving, automation
  - Decrease in O&M costs

- **Security**
  - Stable and Safe Water Supply
  - Demand response (DR) for water
  - Water supply under emergency situations

- **Welfare**
  - Water for people
  - Equally good public water service to everyone
  - Open access to water information
1. Introduction

Smart Water Grid: What?

Smart water grid may include:

- ICT and disruptive technology
- GIS and Remote Sensing
- Smart Pipes, Smart metering
- Decision Support System
- 3D modeling of geospatial data
- Measuring water demand and supply
- Water footprint, efficient water use
- Climate adaptation

There are some “missing links” between available technologies and smart water grid
II. SWG Research Project in Korea
-『Intelligent Water Grid』Research Project
2. SWG Project

Smart Water Grid Research Group: An Ambitious First Step Toward Innovative Water Management

The Smart Water Grid Research Program started on July 2012. The main organization is the Incheon National University and more than 50 organizations are involved in this project. The final goal of this project is to establish ICT-based water management infrastructure with high efficiency.
## 2. SWG Project

### Research Overview

#### Sub-project 1 Water Supply

<table>
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<tr>
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<th>Micro-grid based <strong>Water Treatment</strong> and Water-loop Application Technology for Sustainable Multiple Water Resources Utilization in New To</th>
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#### Sub-project 2 Water Resources

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#### Sub-project 3 ICT

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<th>Establishment of ICT based <strong>AMI Network</strong> and Water Information Service</th>
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<td>2-2</td>
<td>Development of High-Tech <strong>Sensors</strong> and Smart Multi-functional Measuring Instrument for Water Resources Monitoring and Management</td>
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<td>2-3</td>
<td>Development of <strong>Modeling/Simulation</strong> based Optimized DSS</td>
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Develop, Integrate, and Implement

2. SWG Project

Development of Technologies

- Water Resource (2-1, 2-2)
- Water Treatment (1-1)
- Water Supply (1-2)
- Database (2-3)
- ICT (3-1, 3-2, 3-3)

Integration & Implementation

- Small System Integration (1-3)
- Large System Integration (1-4)
2. SWG Project

SWG Technologies: Innovations in water management

There are a lot of innovative technologies that enable SWG: water treatment for multi-source water; multi-water loop; intelligent and integrated water resource management; smart water meter; advanced metering infrastructure; real time collaboration platform; and smart water simulation. From now on, you will see a few examples of such technologies.
III. SWG Technologies
Smart Water Treatment (1-1): Use of various water resources for various purposes

Conventional water resource + Alternative water resource

River water
Waste water
Wastewater reclamation
Rainwater harvesting
Ground water
Well intake

Water blending
3. SWG Technologies

Smart Water Treatment (1-1) : The Pilot Plant

This is the first pilot plant that has various water treatment combinations using multi-source water.
3. SWG Technologies

Smart Water Treatment (1-1) : Water Treatment

River water and groundwater are used as the source water for the water treatment system. Novel unit processes such as a microbubble system are also considered.
Smart Water Treatment (1-2) : Wastewater Reclamation

Together with collected rainwater, wastewater effluent from secondary treatment is used as the source water. The treated water is intended to be used for industrial purposes.
3. SWG Technologies

Smart Water Treatment (1-2) : Desalination

In this desalination system, brackish water and seawater are used as the source water. A submerged flat-sheet membrane is adopted as the pretreatment for RO.
Multi-water loop consists of conventional water distribution networks and reclaimed water distribution networks. It also has advanced features compared with conventional water network technologies.
Multi-Water Loop (1-2) : Field Test System

Pilot-scale experiments for simulated multi-water are ongoing to determine key parameters to successful its design and operation in full-scale.
Water Resource Information System (2-1)

Water resource information system can visualize the real-time data from various sensors and devices, allowing the optimized use of various water resources.
AMI (3-1)

A smart water meter is usually an electronic device that records consumption of water in intervals of an hour or less and communicates that information for monitoring and billing purposes. An advanced metering infrastructure (AMI) containing smart water meters enables two-way communications with the meter.
3. SWG Technologies

AMI (3-1) : Advanced Metering Infrastructure
3. SWG Technologies

Smart Sensor Network (3-2)

The smart sensor network allows the continuous monitoring of water quality and quantity, leading to better management under various situations.
Smartphone Apps for Smart Water User (3-3)

Water management is increasingly influenced by development in Smart Technology. Many of the management system heavily rely on the management of large amounts of information and data. Smart water grid technologies can lead to a significant contribution in overcoming water management challenges in the 21st century.
3. SWG Technologies

Main Menu

Setting Menu

Water Usage Report
3. SWG Technologies

Water Tariff Report

- Parcel Area: 37,340원
- Site Area: 30,000원

From 2014년 9월 14일 to 30일

Detailed Information

- Customer Number: 123456789
- Meter: 15mm
- Water Usage: 1 meter

- Monthly Water Usage: 38m³ + 1month + 1set = 38m³
- Total Charge: 1,080원 X 1set = 1,080원
- Current Water Charge: (30m³ X 300원 + 8m³ X 700원) X 1set X 1set = 15,200원
- Additional Charge: 14,600원
- Water Use Charge: (38m³ X 170원 X 1set X 1set) = 6,460원
- Total Charge: 16,280원 + 14,600원 + 6,460원 = 37,340원

Alarm Menu

- 14.11.03: Warning to the customer to set the lowest water usage alarm service.
- 14.11.03: Warning to the customer to set the lowest water usage alarm service.
- 14.11.03: Warning to the customer to set the lowest water usage alarm service.
Water Decision Support System

A Decision Support System (DSS) is a computer-based information system that supports business or organizational decision-making activities. The water DSS serves the design, management, and operations of water infrastructures and help to make decisions.
3. SWG Technologies

Smart Water Grid in Different Scales

Macrogrid
(city, big town, etc.)

Mesogrid
(mid-size town, etc.)

Small-scale (1-3)

Microgrid
(building, small town)

Large-scale (1-4)
3. SWG Technologies

Design, Development, and Operation of Demo Plant (1-3)

A demo plant is a system for evaluating the TRLs of the technologies. It will provide a platform for system integration and performance evaluation. Moreover, the demo plant will be a “reference” for small-scale smart water grid systems.
3. SWG Technologies

Type 1: SWG System focused on water treatment

* In-depth analysis of available water resource
* Multi-source water treatment
* Intelligent management
* Integrated DB
* Smartphone apps

Water supply:
- Seawater
- Brackish water
- Surface water
- Rainwater

Information:
- AMI
- *Leakage prevention

Consumer:
- *Smart Meter

* SWG technologies
3. SWG Technologies

Type 2: SWG System focused on water service

- Water Quality
- Water Treatment
- Monitoring
- Control
- *Smartphone apps
- *Smart Water
- Quantity information
- Leakage prevention
- Quality information
- Consumer
- *Intelligent management
- *Integrated DB
- *Smart sensor
- *SWG technologies
Design of Test Bed System (1-4)

A test bed is a platform for experimentation of large development projects. As one of the final results of the smart water grid research, test bed systems are designed to provide essential information for practical implementation of smart water grid system.
3. SWG Technologies

Test Bed System (1-4): Expected Effects

- Cost reduction by **10 billion** won
- Decentralized water supply up to **50%**
- Increase in Customer Satisfaction Index by **20%**

Total cost (1,000 million won)
Const. O&M
IV. Future
Applications of Smart Water Grid

- Smart Combined Sewer Overflows
- Smart Irrigation and Agriculture
- Smart Ultrapure Water
- Smart Wastewater Management
- Smart Water Supply Management
- Smart Water Distribution Management

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4. Future

Expected Benefits of Smart Water Grid

Solution for Major Water Issues including:
- Water Quantity
- Water Security
- Water Quality
- Water Safety
- Water Tariff

Water welfare & Waternomics
4. Future

Key Restraints against Smart Water Grid

▪ Political
  - Low government push
  - Unsustainable subsidies

▪ Organisational
  - Business Case
  - Integration
  - Risk averse
  - Silos

▪ Market
  - Fractured / Consolidating
  - Low turnkey opportunity

▪ Technological
  - Hardware v Software
  - Simplification
  - Integration
  - Longevity
  - Proprietary v Open

▪ Social
  - Privacy
  - Health
  - Buy in
  - Low incentive

Source: Frost and Sullivan
4. Future

Technology Roadmap for Smart Water Grid

2012~2013
- Development of unit technologies

2014
- Pilot-scale implementation
- Development of advanced technologies

2015
- Demo-scale implementation
- Integration of technologies
- Basic design of test bed

2016 ~
- Operation of demo plant
- Development of packaged systems
Smart Water Grid: Future of Water

Smart water grid can make better future for our children by providing technologies for sustainable water resources. There are infinite possibilities from combinations of water technologies and ICT. Our “Smart Water Grid Research Group” will do our best to develop and implement the technologies.
THANK YOU