ICT based water leakage control
- In the era of the 4th Industrial Revolution

USOL
Total U-city solutions

The leakages on the water pipes

- **Korea has lost almost 3 billion USD for 5 years due to water pipes leaks.**

- **It also has safety issue.**
  → **They can make big sink holes and it will be threat of civil safety.**

- **This is not a problem of only Korea.**
  → **All the cities around the world with water pipes have leakage problem.**



< Sep. 22. 2016, Yonhap News – We lost a lot of water >

What we did to resolve the problem?

Replace Old Pipes

▶ To replace the old pipes?
- replace the 30% of the all pipes in this year &
- replace the 5% of the all pipes every year. (Is it possible?)

Block System
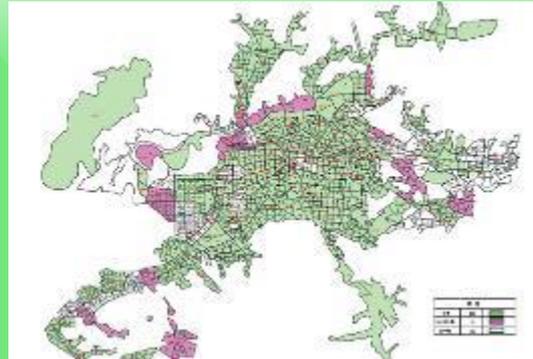
▶ Block isolation, water flow monitoring
- needs long time and big budget.
- Still needs leak investigation

Leak Investigation

▶ Random leak investigation
- Use sound stick
- They can not find leaks immediately.

Water leak ratio of Korea : 10.8% (2010) ⇒ 10.9% (2015)

Main Idea : Leak is inevitable. Find it immediately & Fix it ASAP

The problem of leak investigation

- **Leak investigators have to patrol all around of the city every night.**

- **They don't know the leak points, so random search is the only way to find the point.**

- **The investigation must be done at night, but it's not so easy.**

  ⇒ **They can not invest all the pipes everyday, so leaks last long.**

6 months ~ more than 1 year later

Area "A"   **Leak !**   **Area "A"**

Leak lasts long time

So we must have water leak monitoring system.

What we had to make?

Purpose : Automatic leak monitoring without visiting

Conventional leak detectors

- **Handheld, portable, & movable devices**

→ **They are useless without investigators.**

Our missions

- **Automatic monitoring without patrollers.**

- **Automatic data collection, result display, and share the data in remote site.**

- **Must be cheap enough to install on all pipes.**

Auto leak detection | Wireless, Battery powered | Low cost
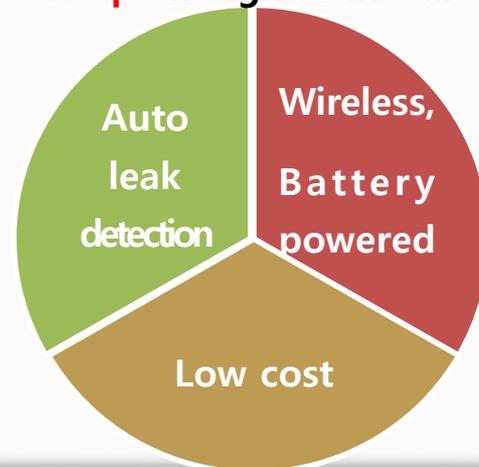
Water pipes leak monitoring system

🔴 **Beside of a water meters, we install leak detection sensors.**

**The sensors monitor leak sound on the pipe and report every day.**

System shows leaking pipe on internet map. → We know where leaking pipes are in the city.

If a leak occurred yesterday, we know it this morning, we can repair it this afternoon!!

leak detection sensor Installed beside of water meter	Leak monitoring and reporting Everyday (RF & Internet)	System shows leaking pipe on internet map	AMI With a digital water meter
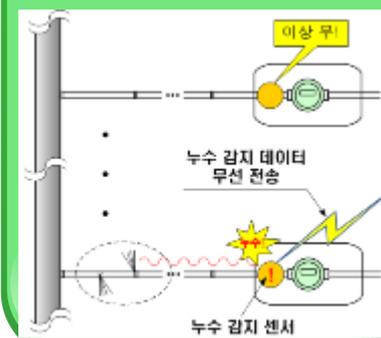
We can monitor all the pipes EVERYDAY!

How does this system work?

service pipe leaks
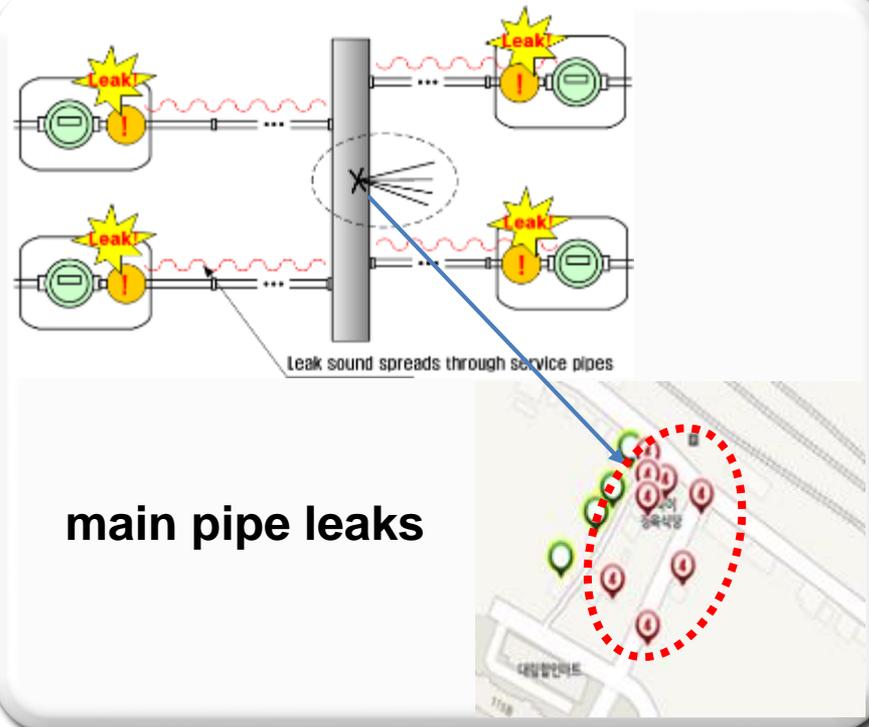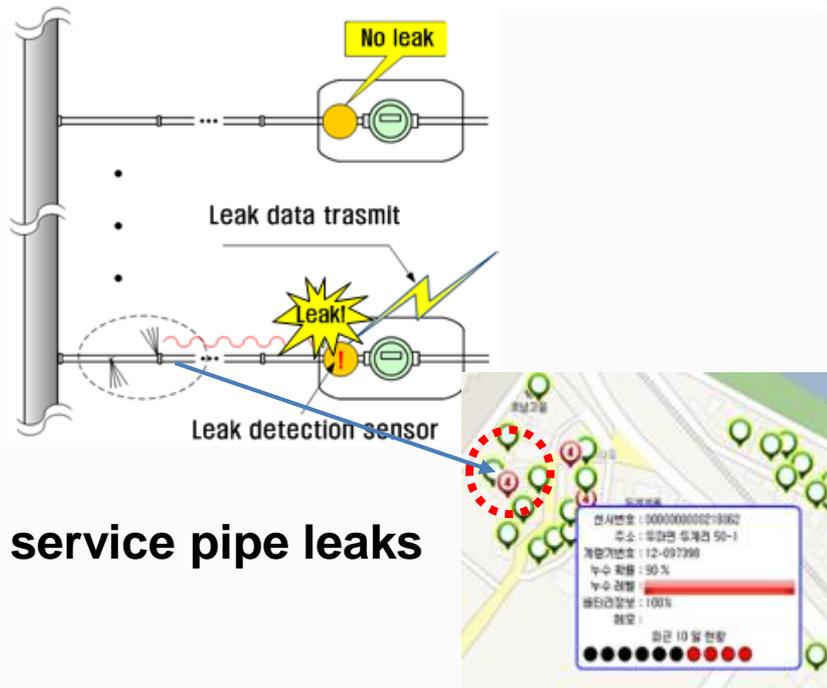
main pipe leaks

▶ **If there is a leak on a service pipe or inside of house, the sensor will detect the leaking sound.**
   → We will see a red dot on the screen.

▶ **If there is a leak on a main pipe, the leaking sound spread to near service pipes.**
   → We will see a group of red dots on the screen.

→ In our office, we know leaking position and whether it is big or small.

Why we need daily monitoring?

The change of the minimum water flow level of the site

88.0 ㎥/hr
64.0 ㎥/hr
52.2 ㎥/hr
19.5 ㎥/hr

2014.1.17

New leak found!
(The reason why we need daily monitoring)

Two months later

2013.11.1 — **Start!**

2013.11.7

2013.11.19

2013.11.21 — **Done!**
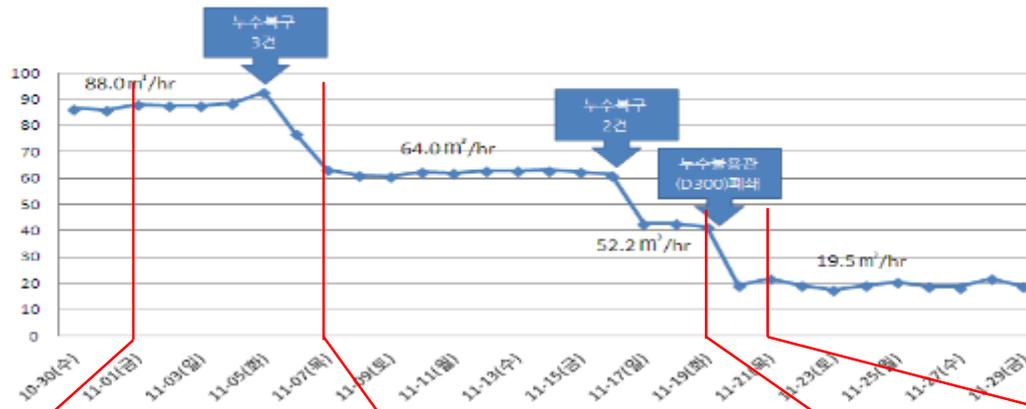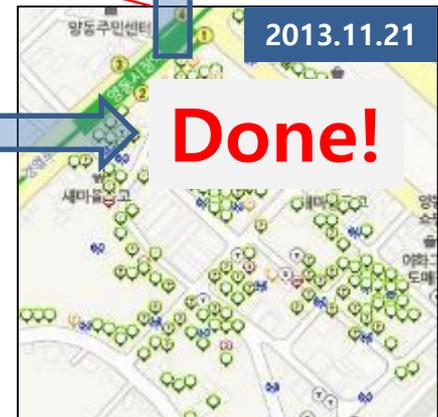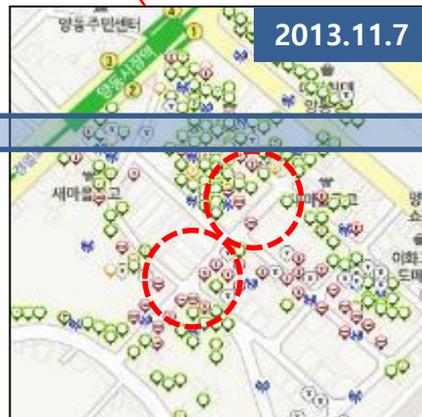
* We can reduce leaking water in very short time and keep it low with monitoring.

the case without exact information

- **number of water meters**
  - **1,621 (2016.2)**

- **pipe length**
  - **unknown**

- **kinds of pipes**
  - **CIP, HI-3, STS, PVC (not exact)**

- **revenue water ratio**
  - **50~60% (estimated)**

- **features**
  - **old town, tourist attraction.**
  - **no exact information about water pipes**
  - *** common case of cities have heavy leakage problem.**
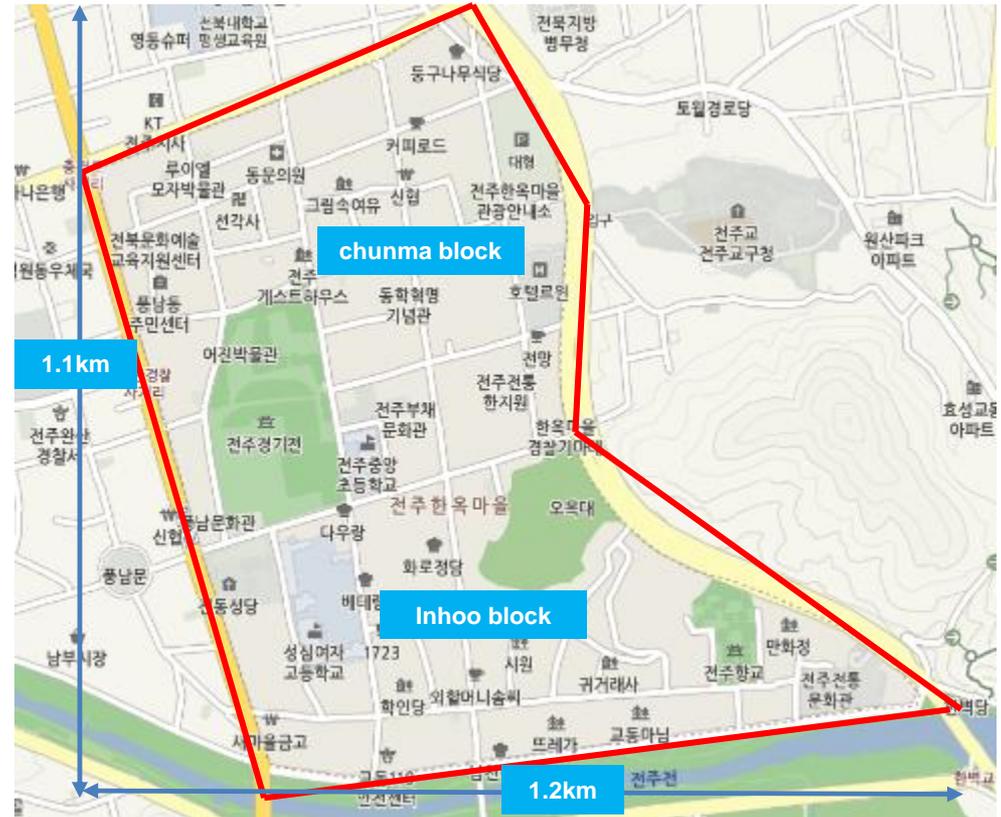
the case without exact information

🔴 **2016.3 - found 18 leaking points, and fixed. 8 more leaking points should be fixed.**
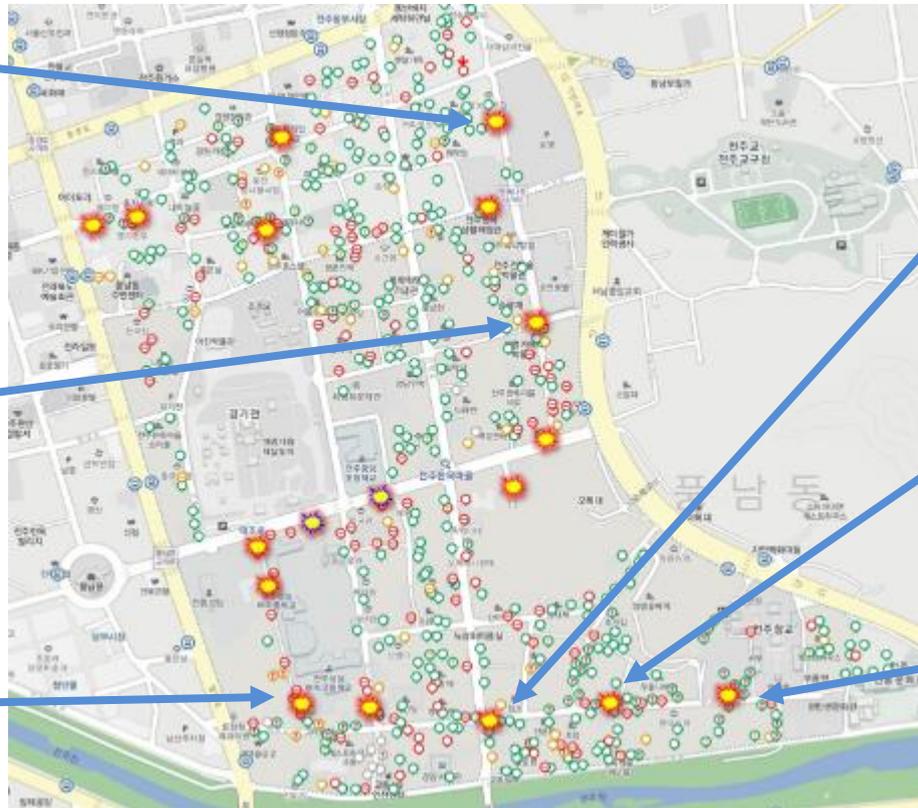
the case without exact information

① **We expected a leak should be here with the distribution of red dots.**

② **Actual big leak was here.**

③ **Then why these 2 points turned to green? → pipe map is not correct.**

④ **And there should be another leak around here.**

< Before fixing leaking pipe >

< After fixing leaking pipe >

the case without exact information

① **We expected a big leak here with the distribution of many red dots.**

② **But the leak was too small. Why?**

③ **Why these 2 points turned to green?**
→ pipe map is not correct. There should be another main pipe.
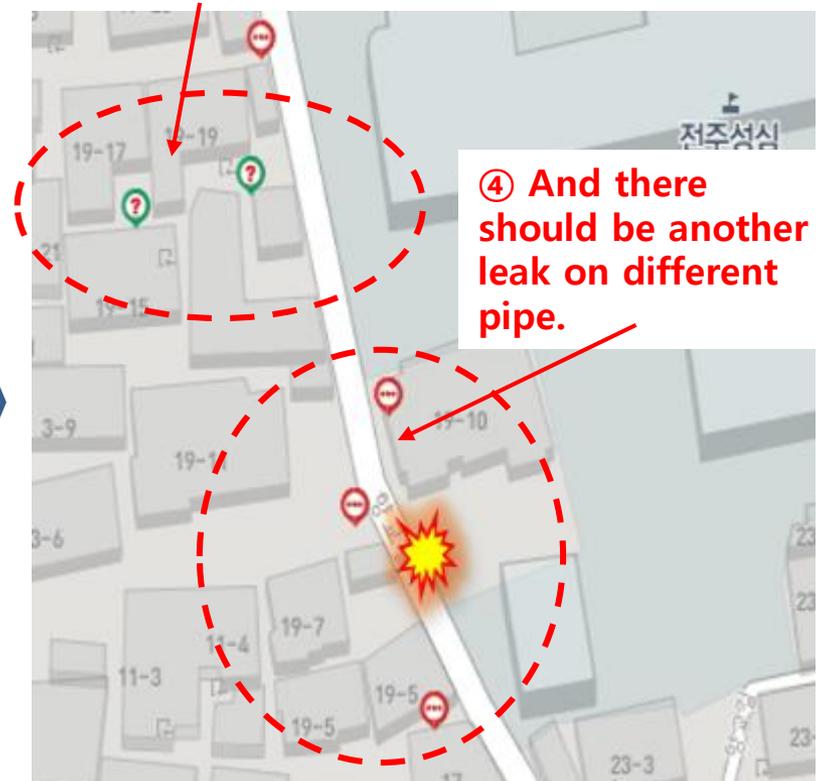
④ **And there should be another leak on different pipe.**

< **Before fixing leaking pipe** >

< **After fixing leaking pipe** >

the case without exact information

① **We expected a big leak here with the distribution of many red dots.**
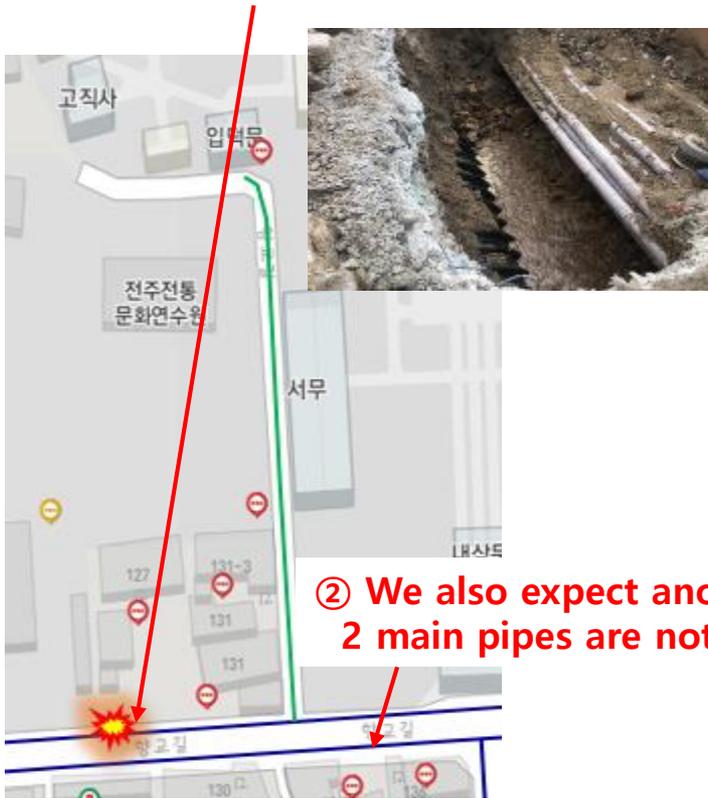
② **We also expect another leak here, 2 main pipes are not connected.**

③ **This is reasonable. After leak fixed, red dots turned to green.**
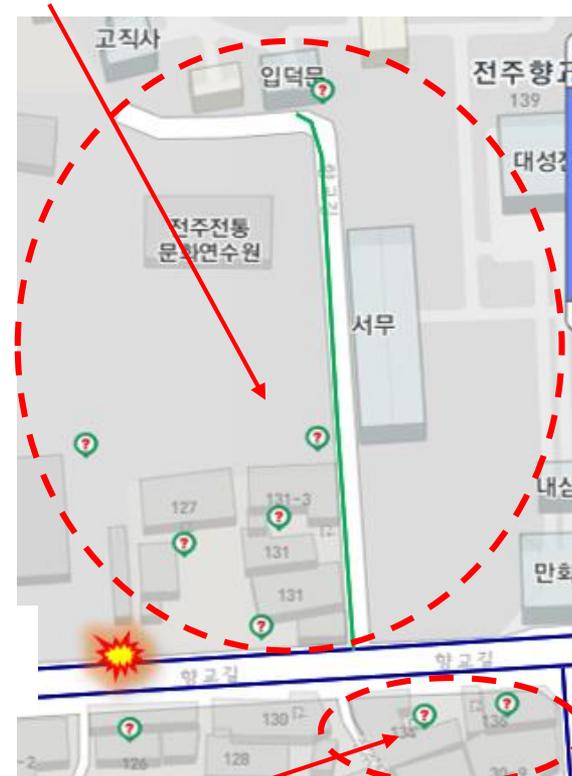
④ **Why these points turned to green?**
→ **pipe map is not correct. 2 pipes are connected!!**

< Before fixing leaking pipe >

< After fixing leaking pipe >

Gongju city – NRW decrease before block isolation

● **Gongju city situation (2013)**

▶ **The number of water meters : 12,850**

▶ **revenue water ratio : 63.9% (2013)**

▶ **They deployed 6,945 leak sensors from Nov. 2014 to May. 2017.**

▶ **They invest 2 million USD, and saved 3 million USD only in 2 years. (The sensors will work more than 10 years.)**
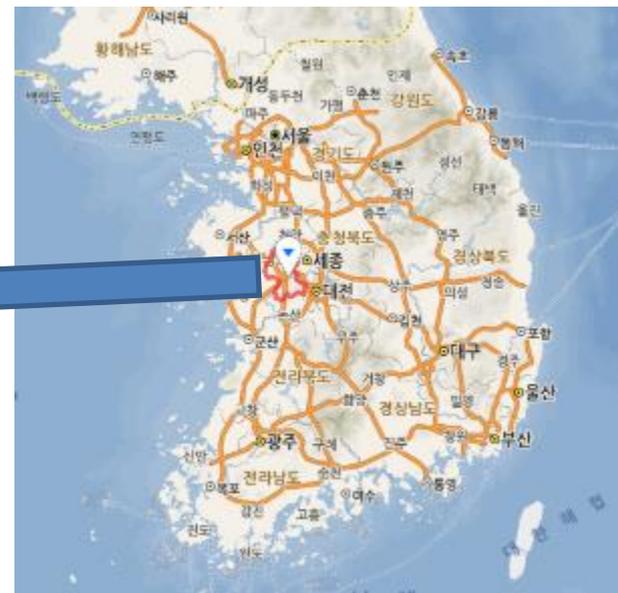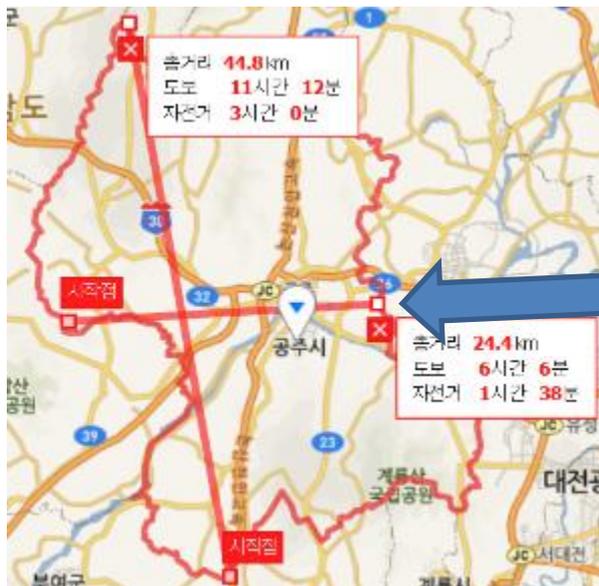
Gongju city – NRW decrease before block isolation

● **Change of the leak situation**

< 15 Aug 2015 >
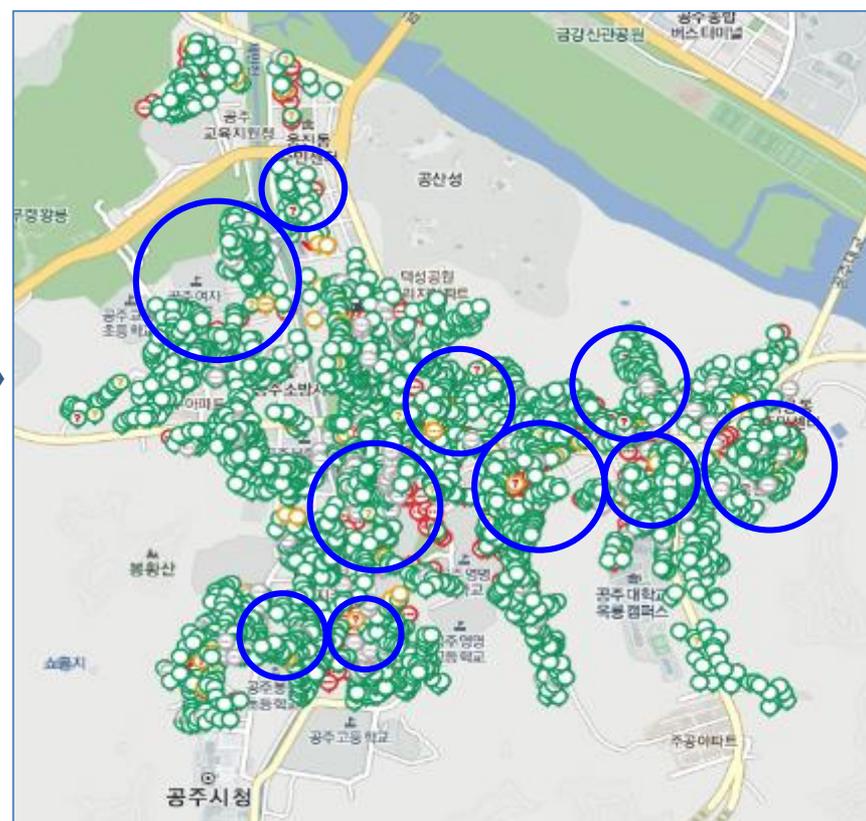
< 8 May 2016 >

Gongju city – NRW decrease before block isolation

● Revenue water ratio change

Revenue water ratio has been going high!!

① **Nov.2014**
  - **Started to deploy sensors**

② **May.2015**
  - **Started to fix leaking pipes**

③ **Oct. 2015**
  - **Got the first result!**
  - **Monthly revenue water ratio : More than 80%**

④ **Feb. 2016**
  - **Deploy more sensors on rural are of the city, fix, & replace pipes.**

⑤ **Nov. 2016**
  - **Got the second result**
  - **The 2nd half of 2016 revenue water ratio : 81%**

⑥ **Feb. 2017**
  - **Deploy more sensors, fix, & replace pipes.**
  - **They covered whole city with 6,945 sensors**
  - **We expect the revenue water ratio of 2017 will be about 85%.**
  - **Now they started to block isolation.**

The benefits

- **Minimize the water loss with immediate leak detection.**

  * If a leak occurred yester day, we know it this morning and will fix it this afternoon!

- **Use the budget for replacing old pipes exactly.**

  * This system produce nice big data that determines real status of pipes.
  * We can judge which pipes should be replaced not in the order of burial.

- **Free AMI network (You only need digital water meters)**

  * We already have communication network. Only we need digital water meters to have AMI.

- **Easy block isolation**

  * Easy to find unknown pipes. Only with following red dots, hidden pipes will be found.

- **This is problem resolving & maintenance system**

  * It works from the beginning to the end of the leak reduction project.

Leak position, AMI, water flow, water pressure

| See Leak | See Flow | See Pressure |

< leak monitoring (+ AMI) > < water flow monitoring >< water pressure monitoring >


LTE, RF, Internet

See ALL
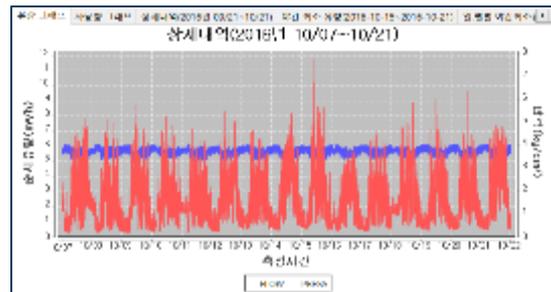
See ALL – Simple, but powerful system

🔴 **You can see all of this on your laptop or smart phone.**
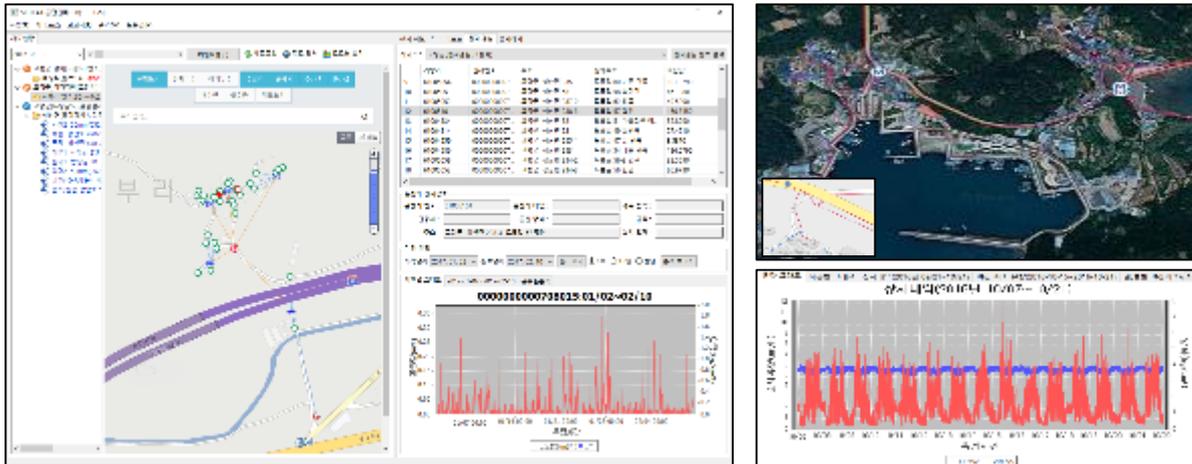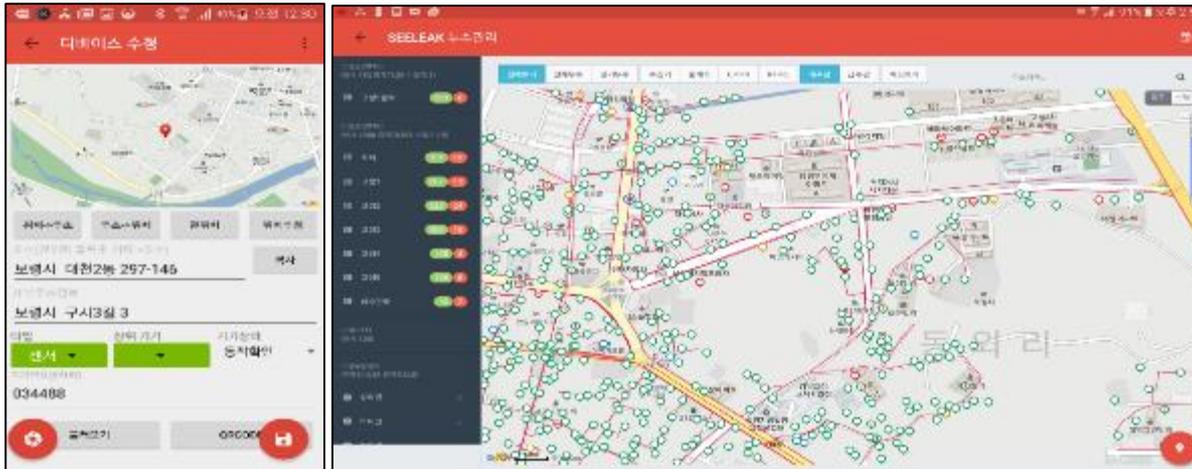
▶ **Device registration**
▶ **Pipe map on internet map**
▶ **Leak monitoring result**
▶ **Leak position**
▶ **Leaking pipe repair result**
▶ **Water flow pattern**
▶ **Water flow quantity**
▶ **Customer water use quantity**
▶ **Customer water use pattern**
▶ **Block water supply quantity**
▶ **Non-Revenue water quantity**
▶ **Daily revenue water ratio**
▶ **And so on.**

6. The purpose of this system

Why we made this system?

▶ No Assumption or Estimation : We want real data

- You have 3 essential real data (Leak position, water flow, water pressure).
- Real data can lead us exact decision.

▶ We can get data at any time and everywhere.

- You know leaking points of your country even if you are in Korea.
- Engineers in the field and office see same thing together at the same time.

▶ We want to make jobs easy.

- Minimize the jobs that need many people, equipment, and civil complain.
(Minimize closing water supply, night step test, and so on.)

Reduce NRW in very short time, and keep it low with small money and people