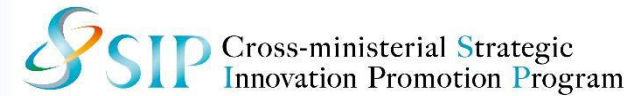


- R&D Topics : Inspection, Monitoring, and Diagnostics Technologies
- R&D Theme : Field Validation of the Continuous Remote Monitoring System with Power saving Wireless Sensor
- Principal Investigator : Hideshi Nishida (Omron Social Solutions Co., Ltd.)
- Collaborative Research Groups : Tokyo Institute of Technology



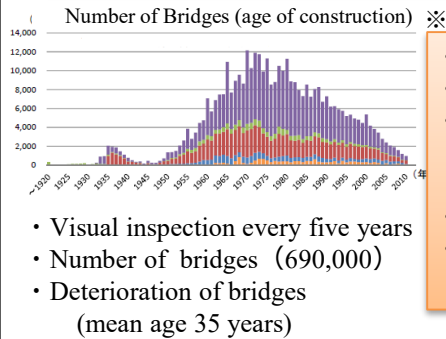
R&D Objectives and Subjects



Objectives

To realize an advanced maintenance and management system with easy installation and acquisition of objective information.

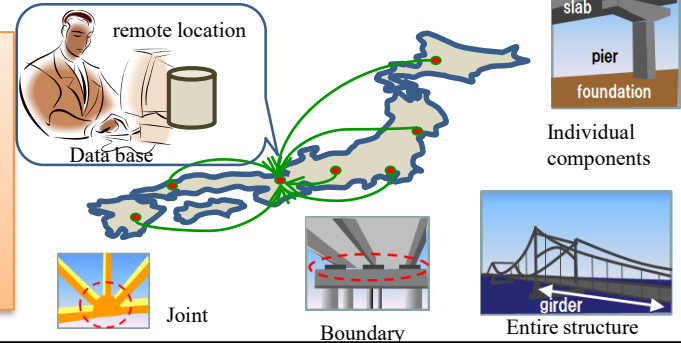
Problem-solving in inspection



- Engineer shortage
- Difficulty with access
- Prioritization at disaster
- Omissions
- Drop of the maintenance level

Remote Monitoring System

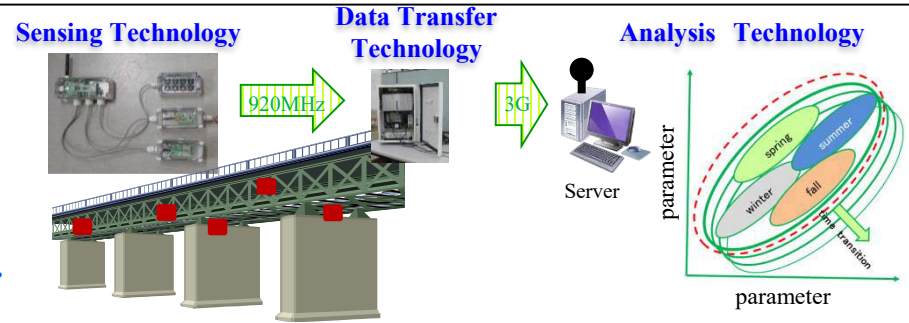
- Easy installation
- Remote monitoring
- Capture of slight change
- Offer simple information



※Source: Home page of “Ministry of Land, Infrastructure, Transport and Tourism, Kinki Regional Development Bureau”

Subjects (2014-2018)

- Sensing technology for outdoor installation with low power
→ **Long-term reliability. (Battery life over 5 years)**
- Data transfer technology (Wireless)
→ **Easy installation and efficient remote monitoring.**
- Data analysis technology
→ **Indexing of the various types of deterioration damage. (Creation of Characteristic Chart for target bridge)**



1. Built a Monitoring System on Real Site

Sensing Technology

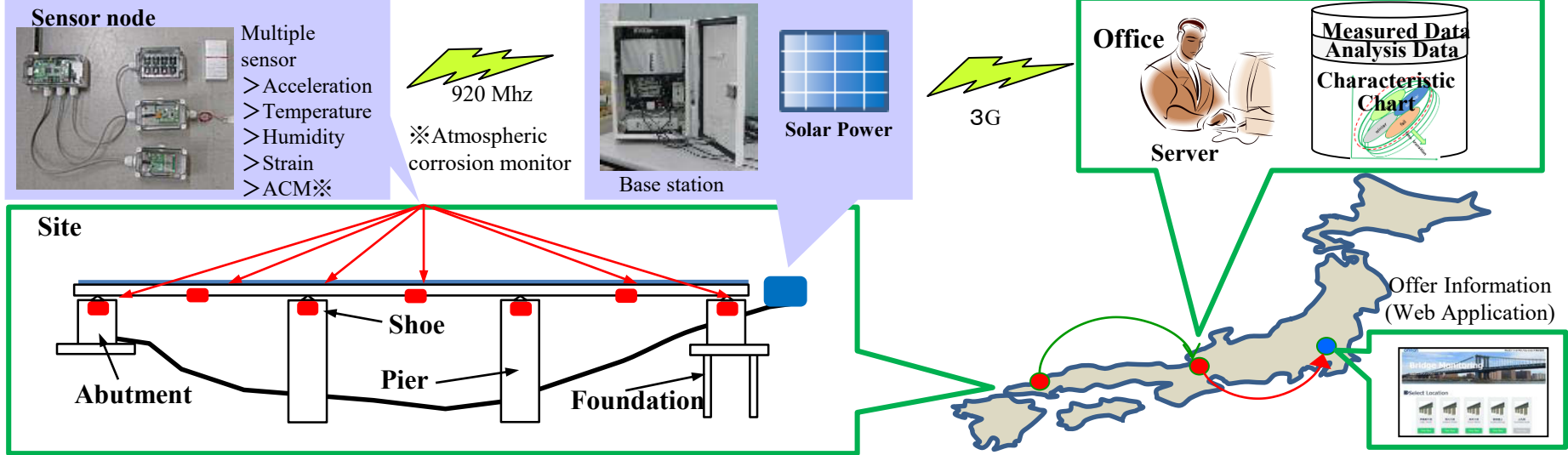
- Implement 31 sensor nodes on real site. (Power-saving wireless)
- Good prospect for long operation over 5 years with Li battery. (5 minutes x 3 times / day)

Data Transfer Technology

- Implement a Base Station on real site.
- Operational experience with only solar power. (continuous working result : over 1 year)
- Good quality of 920 MHz Wireless (230m length)
- Time synchronization under 1 msec (GPS)

Analysis Technology

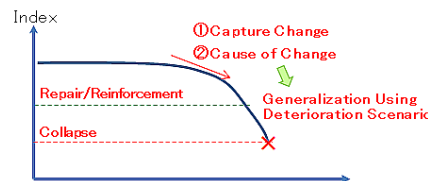
- Implement a Server at remote location.
- Data storage over 1 year
- Start offering Characteristic Chart



- Realize a remote monitoring system with Easy installation and Long-term usage without power distribution work.
- Realize sensor data indexing enabling understanding of the state of the bridge without professional knowledge.

Utilization example

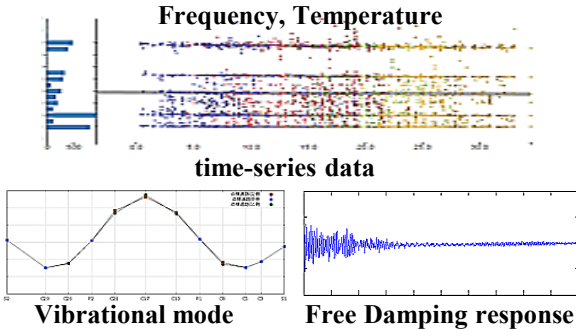
Remote monitoring of damage and deterioration of the bridge



Enable proactive maintenance of the bridge by monitoring slight changes in evaluation indexes.

2. Acceleration Data

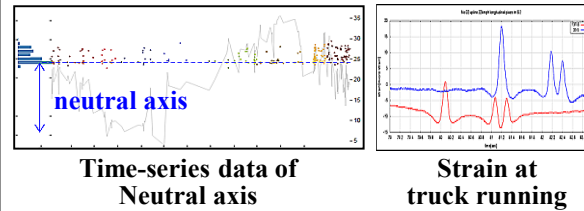
Practical use of Frequency, Damping Ratio, Shape of vibrational mode as health index.



Capture the behavior of entire structure or individual components quantitatively.

3. Strain Data

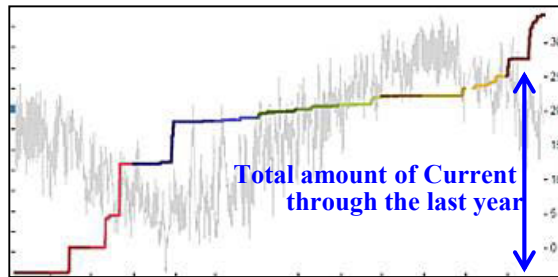
- Practical use of self-power generation piezoelectric strain sensor.
- The validity evaluation of index:
 - Calculation of neutral axis
 - Calculation of live load (input for the bridge)



Capture the deterioration related to crack or stiffness reduction quantitatively.

4. Corrosion Data

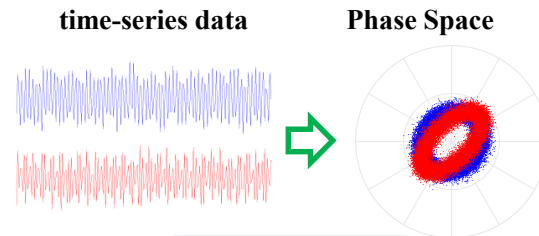
Trend of corrosive environment index
= Investigation result of real site
(Board Thickness Decrement)



Presume the position and the time of corrosion degradation quantitatively.

5. Analysis Technology

Time-series data are analyzed to evaluate structural characteristics and condition changes in target bridge. One of the applied damage evaluation methods is phase space topology. Time-series data are converted to phase space and changes in phase space are monitored.



Detect the time, position, and level of the damage when it happens.

Flow of utilization

Presume the deterioration scenario of the target bridge, by site investigation and structure analysis.

Determination of needed sensors and indexes

2. Acceleration Data

3. Strain Data

4. Corrosion Data

5. Analysis Technology

1. Built a Monitoring System on Real Site

Realize optimum monitoring system for the target bridge

Numerical targets

To implement sensor system that can be operated over 5 years with battery.
To implement Monitoring menu that is easy to understand and use.

users

Road Companies (Highway, MLIT*, Municipality) etc

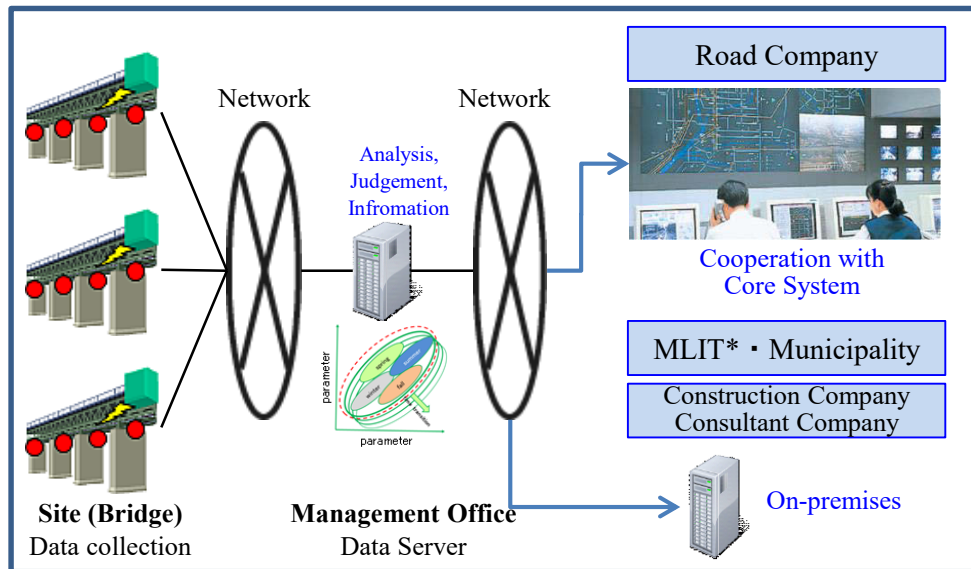
how to use/Places of use

- Install sensors in the local bridge needs monitoring.
- Store the sensor data at management office.
- Monitor the analysis information at maintenance office.

Sales method

Omron Social Solutions Co., Ltd.
Monitoring Proposal, System Offering

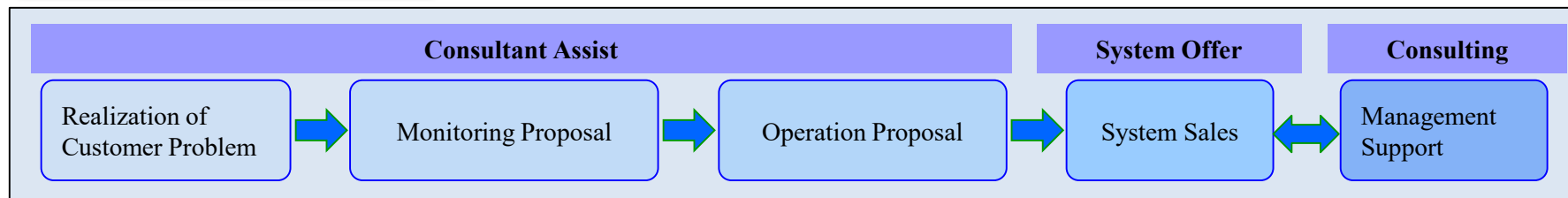
Services to Offer



Construction Company:
Monitoring before and after construction.
Consultant Company:
Assistance of operation and maintenance

Road Manager
(Road Company / MLIT, Municipality)

* Ministry of Land, Infrastructure and Transport



Value provided → Enable to

- Optimize LCC.
- Speedup recovery operation at the time of disaster.
- Judge repair method Quantitatively by visual control.
- Monitoring between inspection cycles.

Realize

- Reduction of economic losses.
- Proactive safety plan.
- Gain in social confidence.

Infrastructure Maintenance, Renovation, and Management