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Title:

INNOVATING FIELDWORK WITH WIRELESS WEB GIS AND THIRD-GENERATION MOBILE SERVICES

Abstract:
NTT INFRASTRUCTURE NETWORK CORPORATION, a provider of network management services for telecommunications infrastructure in Japan, has extended Web GIS capabilities by implementing handy mobile terminals such as wireless camera phones compliant to IMT-2000. Facility information is shown visually on mobile terminals, and varieties of hardware, such as a newly developed device to locate underground cables, work together to enhance intelligence of the services. Field crews can report facility status for inspection sites instantly and immediately over the Web GIS platform.

Innovations in Fieldwork with Wireless Web GIS and Third-generation Mobile Services

Introduction

NTT Infrastructure Network Corporation provides one-stop information and communications infrastructure management services, using NTT Corporation's nationwide network of approximately 970,000 km of underground communications lines. NTT InfraNet services cover approximately 70% of Japan's underground facilities, including communication conduits, tunnels, and manholes. NTT InfraNet uses a variety of applications based on Web GIS, information and communications facility management platform developed by NTT InfraNet, to operate and manage the information and communication infrastructure throughout Japan. The information and communication environment in Japan has substantially changed in recent years, the rapid expansion of third-generation cell phone services since their launch in 2002 being a particularly prominent example. The number of cell phone subscribers has exceeded 80 million (end of January 2004), and 18% of them have already shifted to third-generation cell phone services. This paper presents fieldwork innovations using the NTT InfraNet Web GIS platform and third-generation cell phone services.

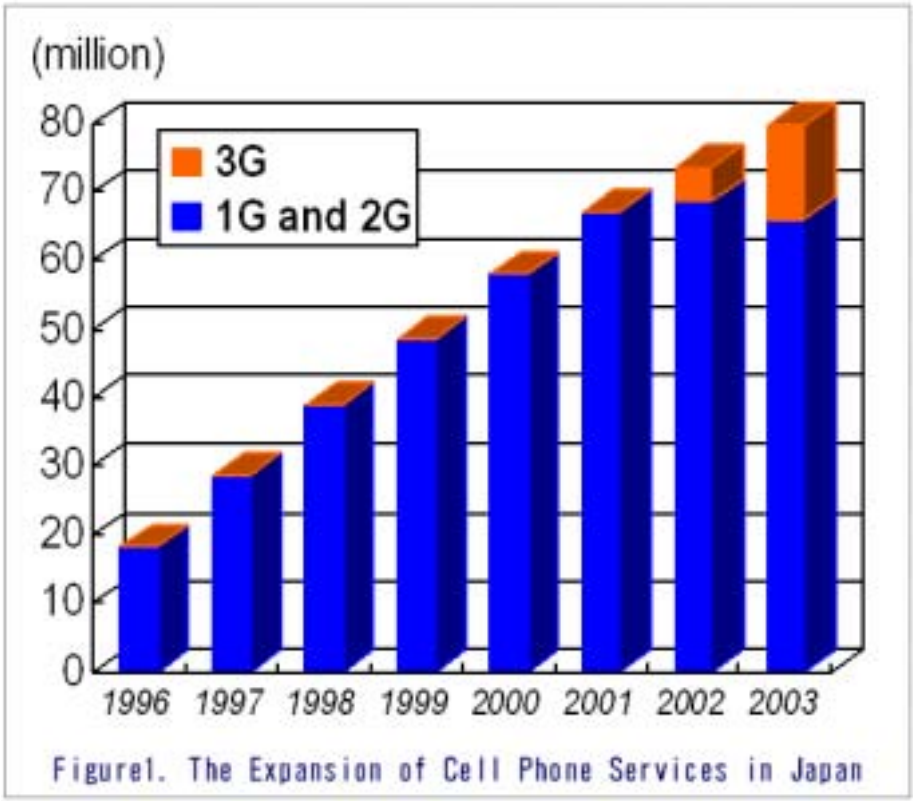

Figure1. The Expansion of Cell Phone Services in Japan

Use of Wireless Services in Fieldwork

NTT InfraNet has 66 bases nationwide with more than 1,700 specialized technicians covering the entire nation. Field technicians print out the maps and diagrams essential for

performing fieldwork ahead of time in their offices and input the data to mobile PCs that they take into the field. Work reports are prepared by the technicians after returning to the office, but system facility information updates are performed by other employees based on these work reports. This work procedure is complex and requires considerable time. When performing emergency work in response to disasters and breakdowns in particular, the exchange of information is repeated numerous times and significantly impairing the quality of the services.

NTT InfraNet uses third-generation cell phone services to link cell phones, PDAs, and laptop computers to a center management system in real-time, creating a structure by which all technicians can share the latest facility information.

Cell phone terminals (FOMA: 3G by NTT DoCoMo) and PDAs are used to display maps of the surrounding area based on current positional information of the field technician received from GPS or a wireless reception area. In addition, information concerning the facilities to be worked on within the display area can be obtained from a center server via a wireless network.

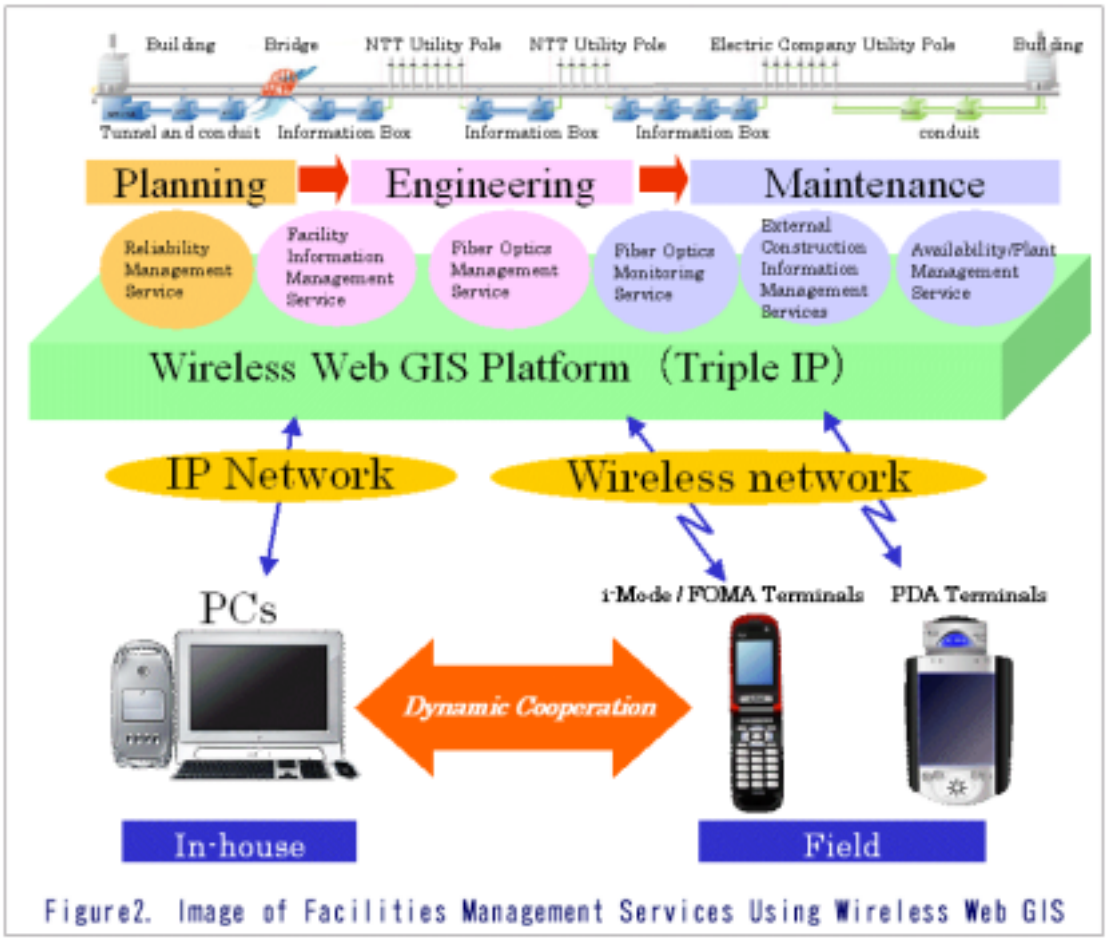

Figure2. Image of Facilities Management Services Using Wireless Web GIS

A prominent feature of this service is the ability to input or update information from a mobile terminal to a center server while in the field. It is also possible to attach to the maps

memos or diagrams with real-time information concerning facilities and transmits this to the center server. Doing this dramatically increases the efficiency of work and ensures that facility information is always up to date. In addition, because the field technicians enter the data directly, the number of data input and output errors have been greatly reduced.

Third-Generation Cell Phone Services and Web GIS Merged in Field Work

The main feature of NTT InfraNet fieldwork using wireless technology is the direct linking and combined operation of fieldwork and Web GIS (databases).

In order to achieve this, it was essential to also develop in conjunction with the services the various hardware technologies that are used for fieldwork. Although this is an example from the past, submarine cable laying operations on ships were dramatically changed when GIS and GPS were linked and used together. Within about 100 years, submarine cables went from management based on nautical charts and the position of lighthouses to management based on GPS information. Since then, all sensors and cable laying equipment has been linked with GIS, and submarine cable laying management has evolved dramatically. The fact that field work requires a level of precision that exceeds that needed for marine operations and the weakness of networks made it difficult to link field work and GIS. Increased precision in GPS position data exemplified by RTKGPS and enhanced networks, as well as the ability of cell phones to function adequately as mobile terminals, however, held the key to unlimited potential for advances in GIS linking with these devices.

Linking Wireless Web GIS and Field Hardware

Third-generation cell phone services differ from earlier wireless networks in that they can transmit high-quality images and transmit and receive large volumes of data in real time. This has greatly changed fieldwork, as earlier mobile devices had only been able to reference supporting information. NTT InfraNet has developed hardware that acts as the “eyes” and “ears” of GIS. By applying this hardware together with mobile devices using third-generation cell phone services, GIS is linked not only to deskwork, but also to field work.

Figure3. Wireless Web GIS Platform Links with Numerous Hardware Technologies Used in Field Work

The Eyes of GIS Centrally Monitor Remote Field Operations

Portable wireless IP cameras (GEOSHOT Live!), which can transmit live images from the field with a single touch, used in conjunction with GIS enable multiple field construction sites to be centrally monitored. Registering the cameras in a construction information database allows image and position information to be managed by using GIS. Remote monitoring from a center makes it possible to issue instructions that ensure the safety of field operations and minimize to risk of accidents, as well as to make rapid and efficient responses in the event of an accident.

A camera that can automatically take images in a 360˚ degree scan (GEOSHOT) is used to give detailed images of manholes and tunnels in the field or of facilities in buildings. These images are stored in a memory card and transmitted wirelessly from the field for recording in the GIS database.

It is also possible to record simple field operations by using a cell phone fitted with an internal high-quality digital camera of at least 1-million-pixel resolution. The images and position information are recorded in the GIS database directly from the cell phone.

Linking the images and their abundant real-time information with a facility database allows the information to be searched while being on site, and for the location and facilities in question to be immediately identified when performing field work, making possible immediate responses to the rapidly changing information and communication

facility environment.

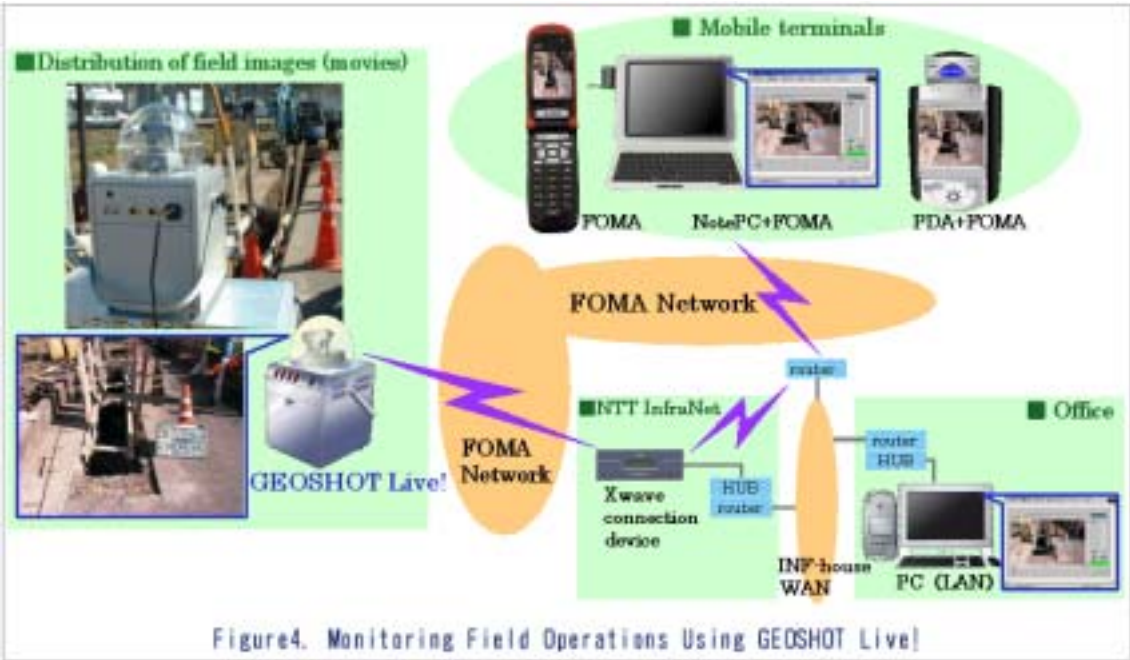

Figure4. Monitoring Field Operations Using GEOSHOT Live!

The Ears of GIS Search for Unseen Facilities

NTT InfraNet has linked technology to search for underground cables from above ground with GIS, making it possible to protect information and communication facilities from disaster and road excavation work and to construct highly reliable networks.

This cable position detection technology uses sensors to detect the unique signals transmitted by cables in buildings and manholes and to locate underground cables from above ground. This technology, which is known as CableExplorer, is linked with high-precision GPS, allowing three-dimensional underground cable position data to be automatically and continuously recorded in a GIS database from above ground. The technology will replace cable management based on drawings and allow all utilities to share data.

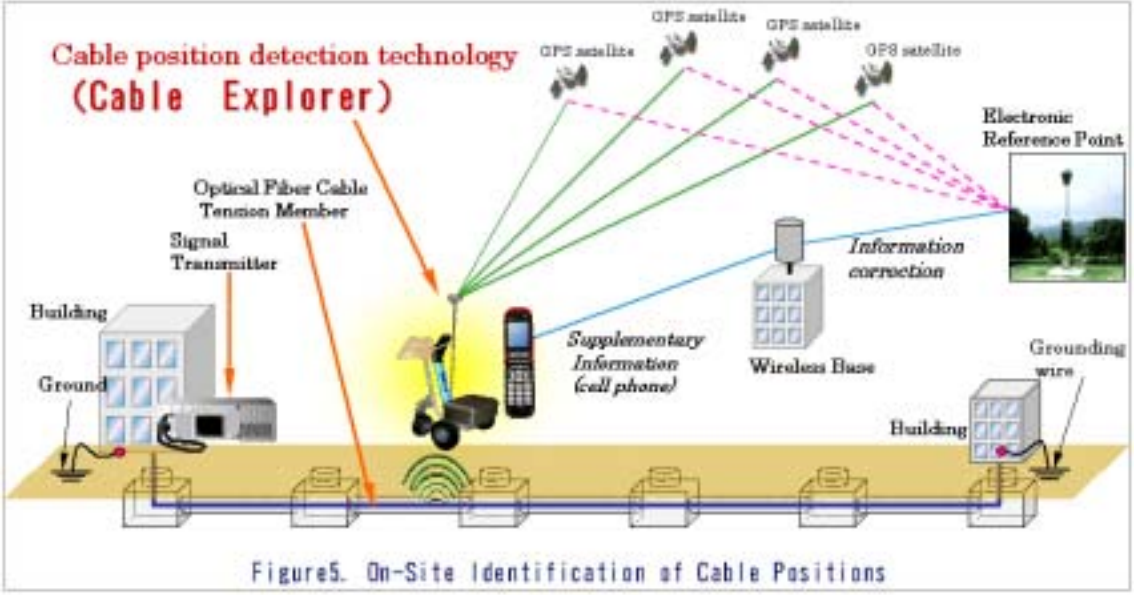

Figure5. On-Site Identification of Cable Positions

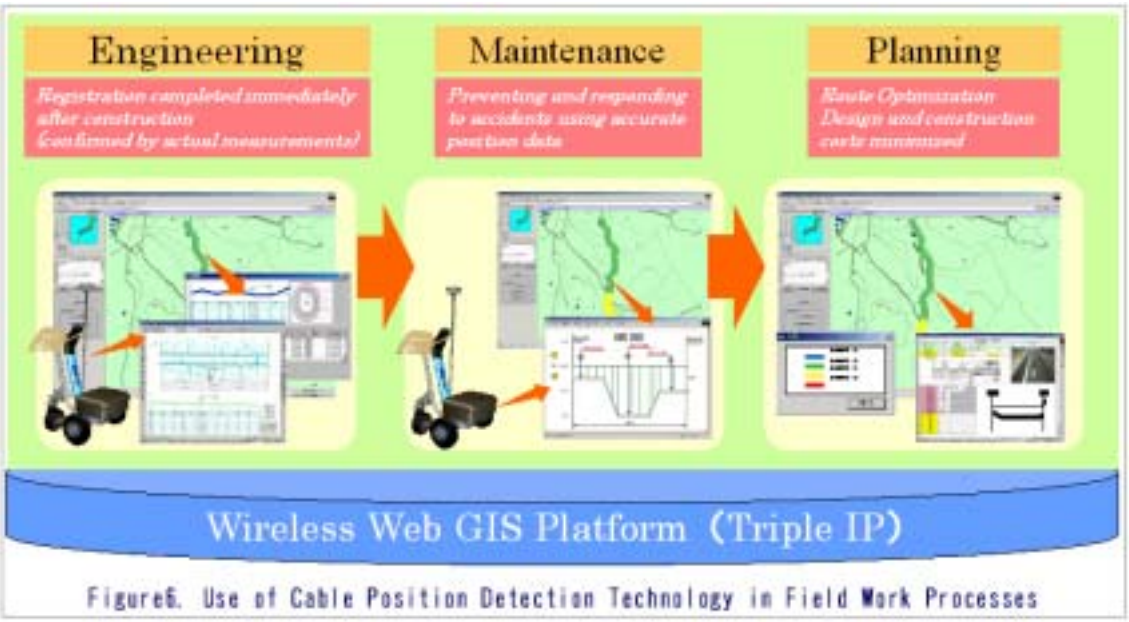

Figure6. Use of Cable Position Detection Technology in Field Work Processes

The Nose of GIS Enables Instant Identification of Facilities

Linking technology that reads encoded data when a sensor approaches (two-dimensional code tags, radio frequency identification (RFID) tags, etc.) with PDA or cell phone GIS enables facilities to be accurately and automatically identified, reducing construction errors and facilitating rapid field operations. In addition, the efficiency of accounting work can be enhanced by linking data on the number of facilities counted by the sensors with a GIS databases and asset management databases.

When connecting or switching optical fiber cores, the relevant cores are identified from the two-dimensional codes assigned to the cores, and information concerning the switched cores is automatically recorded in a database.

Information is automatically and immediately conveyed to all technicians when newly installing or changing optical fiber cores, or when connecting or switching the cores on site.

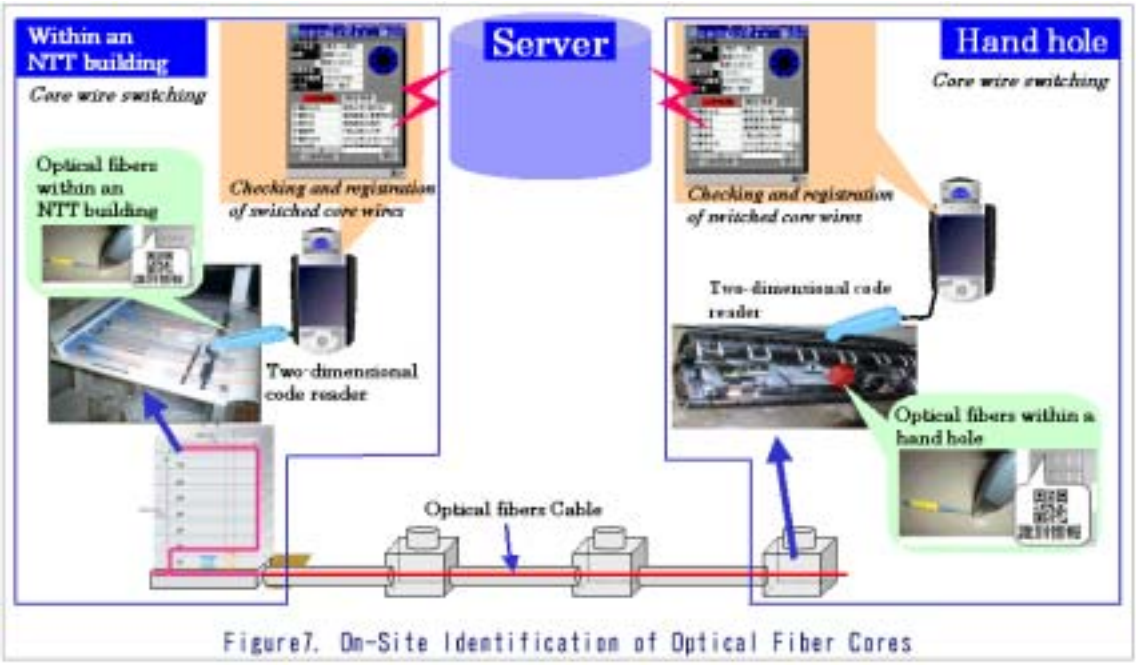

Figure7. On-Site Identification of Optical Fiber Cores

The Mouth of GIS Provides Warning about all Locations

Linking devices that monitor the status of information and communication facilities or that provide alarms in case of a failure with a cell phone or PDA GIS makes it possible to prevent any interruptions to communication services and to restore those services rapidly in the event of an interruption. When an alarm occurs, the latest information concerning the affected facilities is immediately sent to a cell phone or PDA, enabling field technicians to take appropriate measures by working together with the information monitoring center. We are in the process of creating a system by which linking with various devices that monitor communication services makes it possible to transmit optical fiber information directly to the work site.

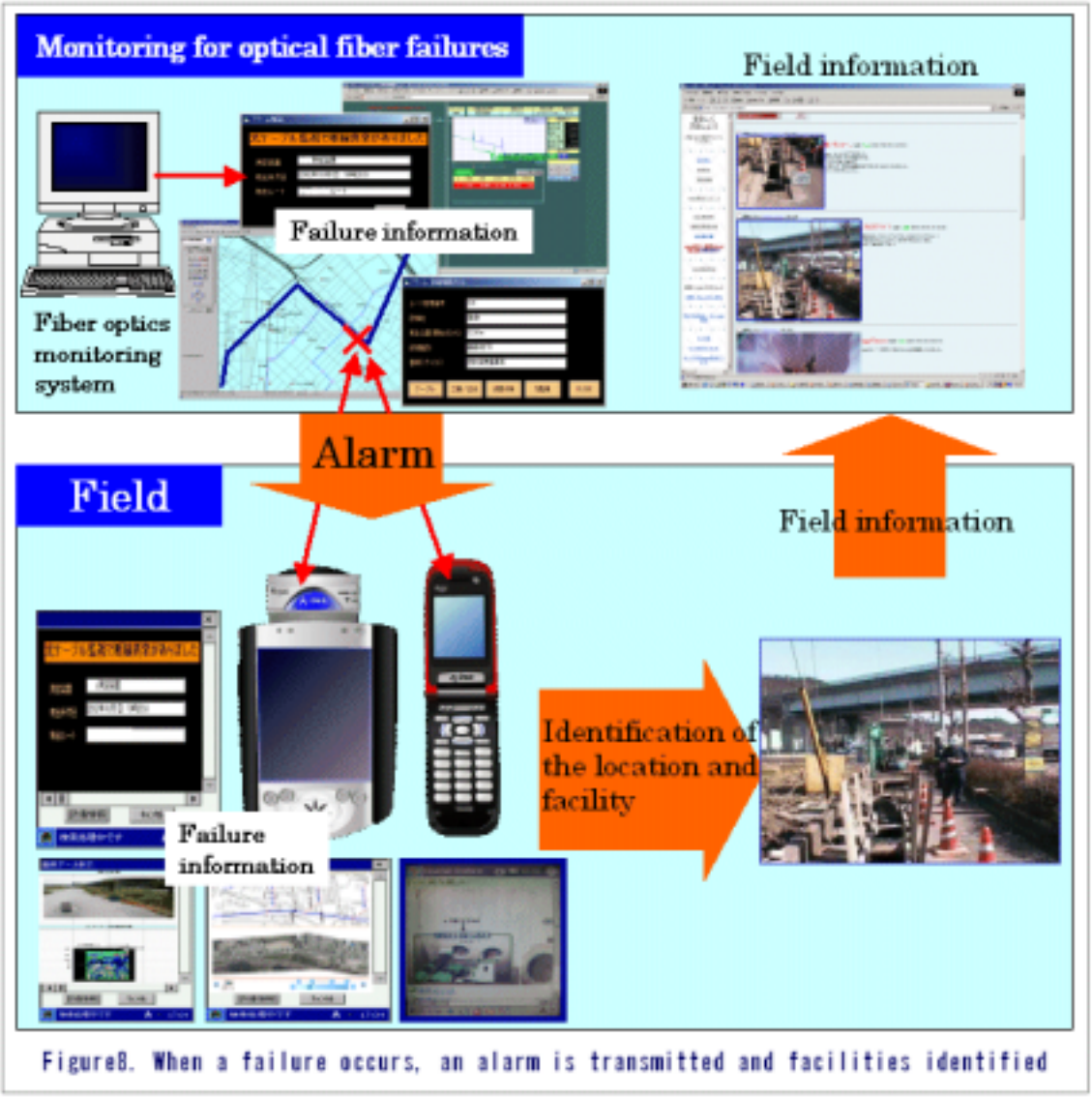

Figure8. When a failure occurs, an alarm is transmitted and facilities identified

Communication Services for Protecting Communication Networks

The spread of third-generation cell phone services will accelerate the linking of wireless Web GIS with field instruments. NTT InfraNet is working to link GIS with the technologies that we have developed in order to optimize fieldwork. Providing workers in the information monitoring center and field technicians with access to field information in real time will enable them to accurately determine what optical fiber routes require now and will require in the future under specific conditions and what is necessary for overall management of external optical fiber routes from planning to maintenance. NTT InfraNet takes full advantage of wireless networks in all aspects of fieldwork to share the latest visual operating information with all technicians in real time, dramatically increasing the efficiency of fieldwork and enhancing the reliability of communication networks.