GIS Initiatives to Address the Diversification and Advancement of Digital Data

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Abstract

To address issues relating to social infrastructure such as deteriorating equipment, intensification of natural disasters, and increasing grid complexity, there is a need to comprehensively analyze and visualize location information and spatial information (information related to temporal changes in location information) on digital maps, and to efficiently raise the level of equipment maintenance, resilience response, power system design, and so forth. In addition to the above items, Mitsubishi Electric provides a Geographic Information System (GIS) that supports new data types such as 3D and point cloud data.

1. Introduction

Transmission and distribution operations of power companies are facing a changing environment in light of carbon neutrality, and there is a need to deploy services to diverse players through dissemination of renewable energy and utilization of power data. The issues faced include proliferation and increasing sophistication of contracts and resource management accompanying the spread of renewable energy, rapid response during disasters, and decreasing numbers of field technicians.

To address these issues, Mitsubishi Electric is developing solutions for solving social issues, such as the utilization of Internet of Things (IoT) technology and smart devices, adoption of initial response support systems employing satellite images and drones to support rapid response during disasters, and the development of systems to visualize and manage such information.

The role of GIS is becoming increasingly important for effectively supporting these solutions. GIS enables various types of data processing and management, map creation, and analysis, and by overlaying and visualizing these data, it realizes efficiency improvement in field operations and acceleration of disaster response (Fig. 1). Moreover, linkage with IoT technology and smart devices will enable real-time data sharing and visualization, and this is expected to greatly contribute to higher work efficiency.

In promoting these initiatives, there will be an even greater need going forward for diverse digital data and ease of linkage with other systems. This paper describes the technical issues and solution methods, as well as future prospects, for the GIS that needs to be expanded toward next-generation systems.

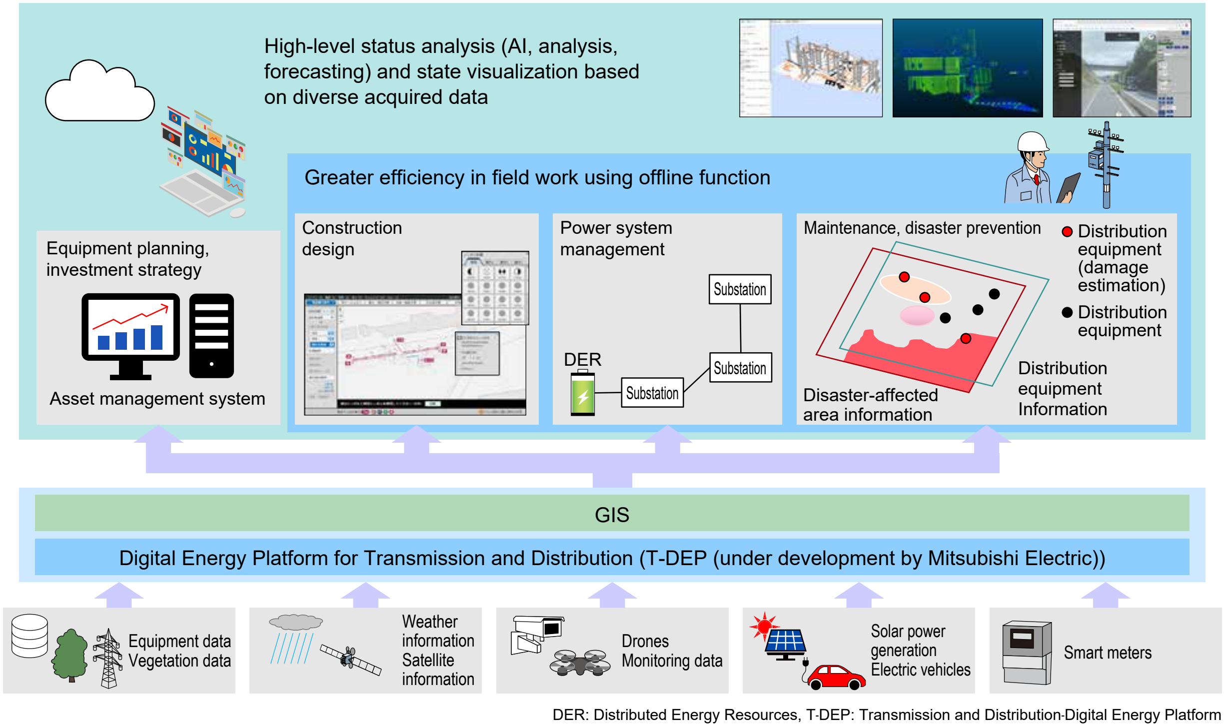


Fig. 1 Sectors using GIS

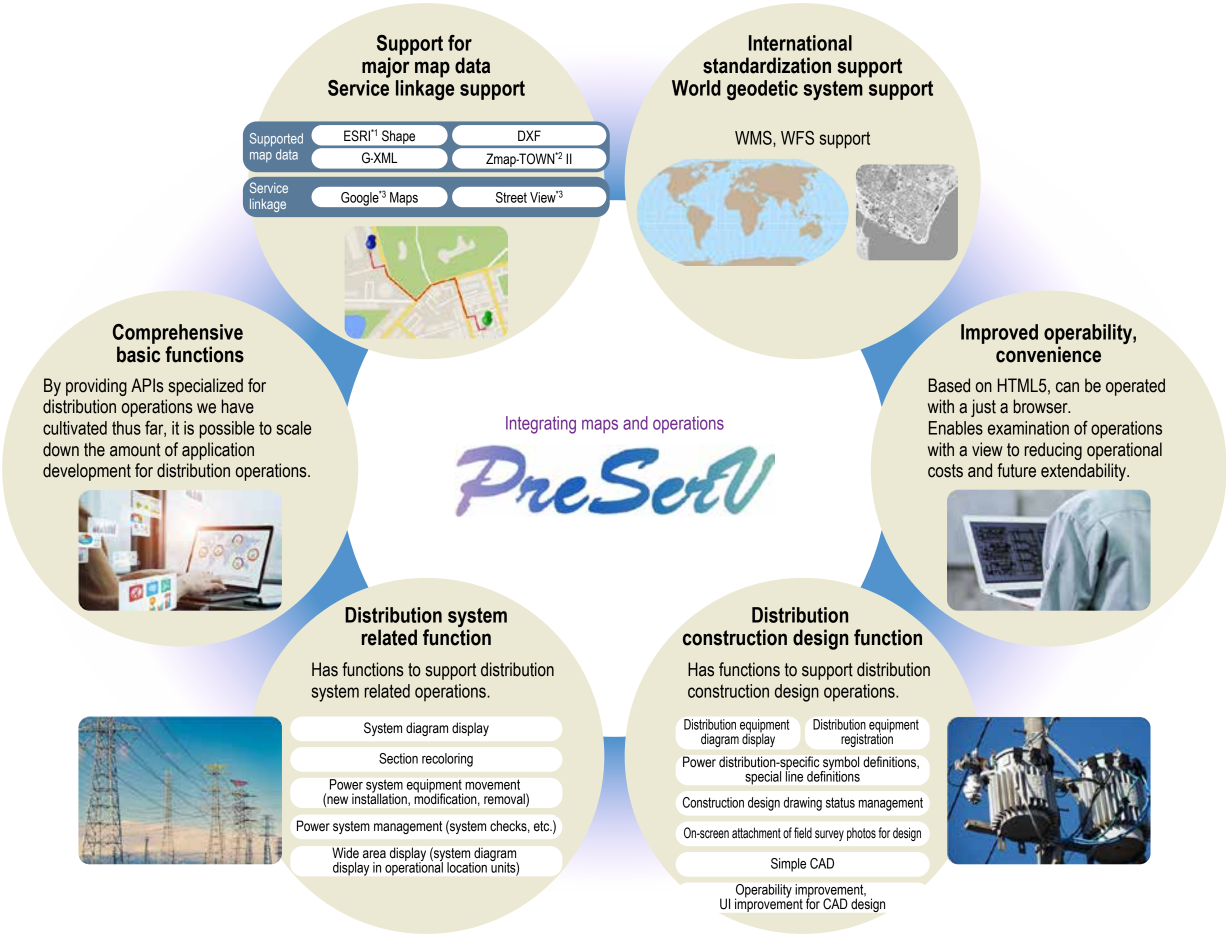
2. GIS

GIS is an information system technology that handles data with various types of information on locations, on electronic maps. In this field in recent years, there has been a need to respond to diversification and increasing sophistication of data types. Within that trend, utilization of 3D data and point cloud data is attracting particular attention, and they are expected to contribute to efficiency improvements in equipment maintenance, disaster response, and power system management.

This chapter describes the development situation to date and future initiatives for PreSerV-X, a GIS that we are developing for the purpose of improving the efficiency of operations utilizing maps at power companies.

2.1 Overview of PreSerV-X

PreSerV[1] is a GIS product developed by Mitsubishi Electric. It has been adopted at social infrastructure-related companies—mainly power companies and government agencies—and local governments. This product has a 30-year history since its initial release and has evolved while responding to various technologies and standardization. In the current latest model PreSerV-X, functions specialized for the distribution field are provided, by leveraging past development achievements, to improve productivity in field operations and efficiency of system development (Fig. 2).



WMS: Web Map Service, WFS: Web Feature Service, API: Application Programming Interface, UI: User Interface
*1 ESRI is a registered trademark of Environmental Systems Research Institute, Inc.
*2 Zmap-TOWN is a registered trademark of ZENRIN CO., LTD.
*3 Google and Street View are registered trademarks of Google LLC.

Fig. 2 Product concept of PreSerV-X

We have been working on adding new functions of PreSerV-X as a state-of-the-art GIS, to differentiate it from other companies' products. One function developed in recent years is the offline function. "Offline function" refers to achieving functionality equivalent to that in an online environment without using communications.

In power transmission and distribution operations, work is often performed in mountainous areas where communication is difficult, so a function that does not require communication is vital. The offline functionality developed by Mitsubishi Electric utilizes technology compliant with HyperText Markup Language (HTML) Living Standard, an HTML specification established by an organization called Web Hypertext Application Technology Working Group (WHATWG). This enables realization of functions and performance assurance on a par with online operation using only a web browser. This function is expected to further improve the efficiency of field operations. The system configuration is shown in Fig. 3.

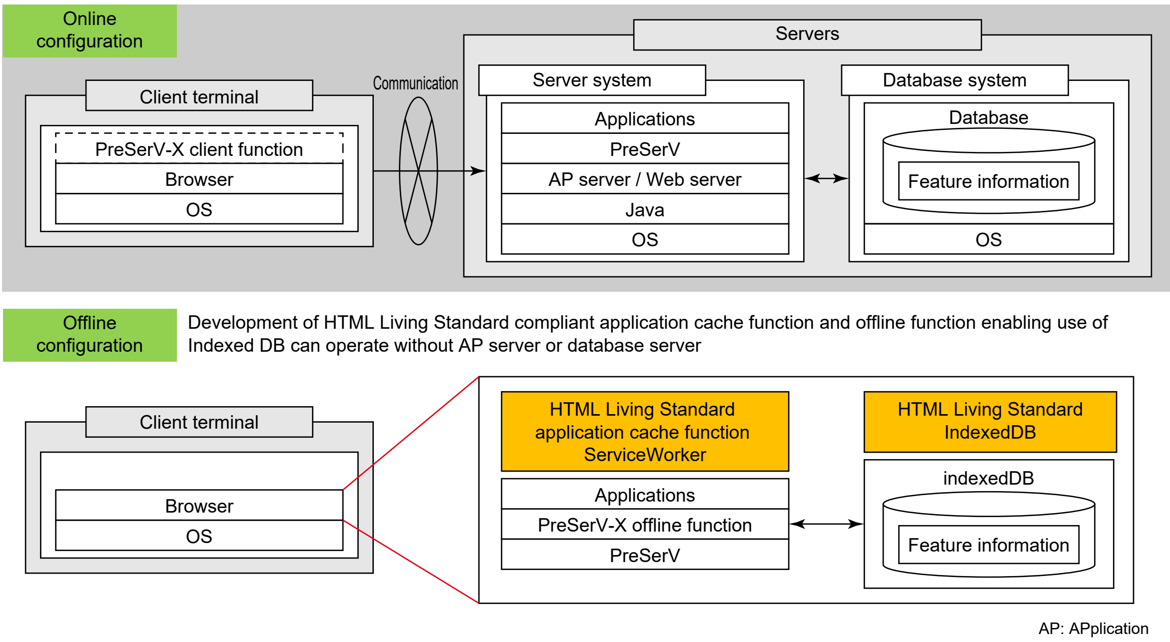


Fig. 3 System configuration of offline function

2.2 PreServ-X expansion areas

The current PreSerV-X supports 2D equipment data, vector data (a data format that represents map information through combination of points, lines, and surfaces), and raster data (a map data format with information in pixel units). There is a need for expansion of compatible data types, and in PreSerV-X development, we are developing international standard interface support and linkage with GIS made by other companies. Developing these functions will enable API enhancement for open data and real-time data acquisition, 3D and point cloud display, and more. We also achieve greater development efficiency by maintaining the APIs specialized for power distribution operations while supplementing deficient areas through linkage with GIS made by other companies. Furthermore, we are also looking to link with other packages made by our company such as BLEnDer and INFOPRISM by supporting data diversification and API enhancement. BLEnDer refers to Mitsubishi Electric's power Information and Communication Technology (ICT) solution package, the BLEnDer series, and INFOPRISM refers to our IoT platform for power and social infrastructure, which consists of hardware for easily and quickly constructing solutions utilizing IoT, and a software suite including analysis functions.

2.2.1 International standard interface support

In this development, we have implemented WFS/WMS support for international standard interface compatibility. WFS is an international standard defined by the Open Geospatial Consortium (OGC) for providing geographic feature data (physical objects, such as railways, roads, and street trees, as well as non-physical objects like boundary lines, place names, and bus routes, that appear on maps) via the web. We developed functionality to receive feature data from sources such as GIS made by other companies and manage it together with PreSerV-X managed feature data, and this made it possible to overlay feature data managed by GIS made by other companies, and display it on maps.

WMS is an international standard defined by OGC for providing map images via the web. Through linkage with Google Maps, we are developing a function that accesses Google servers via WMS and displays maps composed of acquired raster data, providing support for road maps and satellite imagery. Google Maps API enables the acquisition of map data in various formats. We examined a Google Maps API and ensured integration feasibility by leveraging our development track record from the previous years to support maps of the Geospatial Information Authority of Japan.

By supporting these international standards, we expanded the methods for acquiring map data and feature data of diverse data types.

2.2.2 Examination of linkage with GIS made by other companies

To respond to the recent growing need for sophisticated displays such as 3D and point clouds, as well as for analysis utilizing such data, we must compensate in deficient areas with GIS made by other companies that have advanced display and data analysis functions. Therefore, PreSerV-X aims to provide new value through a combination of existing functions with functions from products of other companies. This will be done by managing diverse data and strengthening linkage with GIS made by other companies.

Data integration becomes a crucial point when considering linkage with GIS made by other companies. Realization of data linkage enables data sharing, integration, and utilization, and promises enhancement of data information content, improved ease of data management, and API linkage.

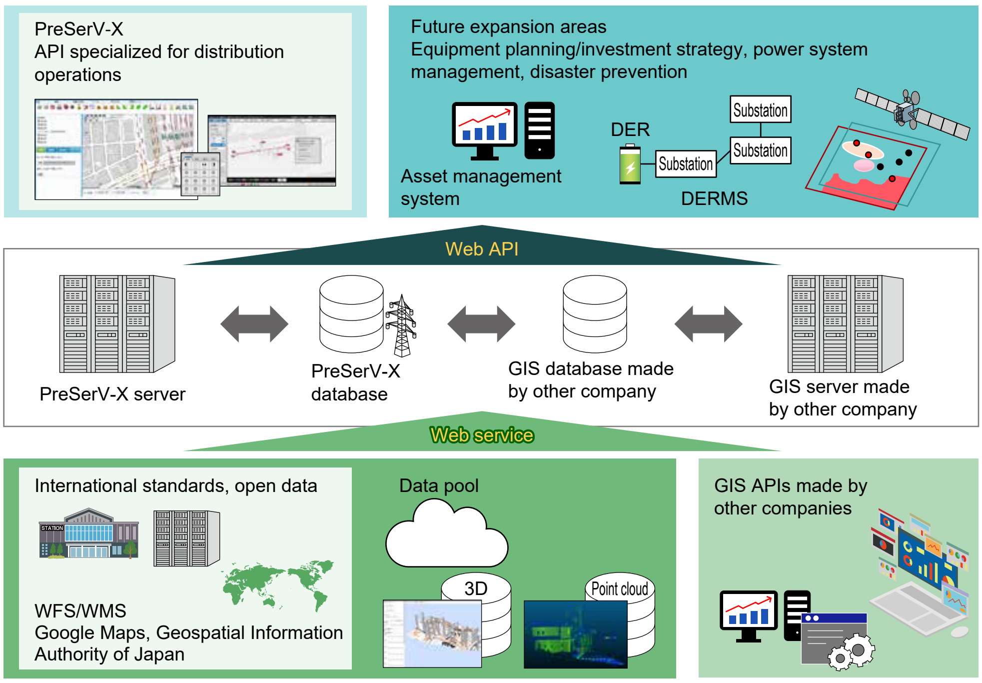
However, data linkage involves technical challenges. Since database management configurations and security measures differ between systems, it is necessary to study data management key linkage methods and data exchange methods. Non-functional issues also become apparent when handling large volumes of data. Furthermore, increased security risks are also a concern.

To address these issues, PreSerV-X is working on ensuring feasibility through support for major middleware and utilization of web services. Going forward, we will realize linkage by deepening our examination of countermeasures not only for functional issues but also for non-functional issues related to quality and performance.

3. Future Prospects

As transmission and distribution operations become more sophisticated, demand for GIS utilization is expected to increase for analysis functions used in equipment planning and for disaster response. Therefore, for PreSerV-X we are examining the coexistence of distribution operation-specific APIs and efficient data management mechanisms to serve as differentiators from other companies—approaches developed in our past development—with the sophisticated display and analysis APIs of GIS made by other companies. To realize these goals, it is necessary to consider database linkage, development of interfaces enabling direct data reference, and API linkage methods.

We are also continuing development of interfaces that can support international standards and major services in order to provide compatibility with diverse data types. In recent years, public institutions, research institutions such as universities, private companies, and others have started actively utilizing and providing open data. We will strive for the enhancement of PreSerV-X as a highly versatile GIS platform that can seamlessly incorporate these resources (Fig. 4).



DERMS: Distributed Energy Resource Management Systems

Fig. 4 Future prospects

4. Conclusion

This paper has described the overall picture and future prospects of PreSerV-X, the GIS offered by Mitsubishi Electric. By developing interfaces that support international standards and are linked with GIS made by other companies, we will enhance the ease of linkage with other systems, expand functionality to enable handling of diverse digital data, and look toward global expansion and development into solution businesses.

Also, this initiative aligns with the transformation toward circular digital engineering that our corporate group is promoting. With a view to linkage with "Serendie," our company's digital platform, we will enhance the versatility of PreSerV-X as a component of circular digital engineering so it can be adapted to data aggregation and utilization.

Reference

(1) Nakamura, N. et al.: Geographic Information System Software "PreSerV" with Reinforced Functions for Large-scale Facilities, Mitsubishi Denki giho, 85, No.10, 564–568 (2011)