Network Solution with the IPGW as the Core Component

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Independent information and communication systems, owned by road and river administrators, have undergone unique development as individual dedicated systems. Due to the social conditions of the day, however, there has been pressure to reduce the costs by downsizing.

A network solution intended to resolve this issue with the IPGW as the core*1) is presented in this paper.

Present Status of the Independent Information and Communication Systems of Road and River Administrators

Road administrators have built independent information and communication systems that make it possible to maintain a smooth flow of traffic during normal times while being prepared to provide accurate and rapid responses when a disaster occurs. This is done by collecting, managing and providing users with meteorological, terrestrial, accident, disaster, environmental, traffic and other information related to the roads subject to management.

The river administrators, on the other hand, have built independent information and communication systems that make it possible to maintain stable flow rates and water levels of rivers during normal times. They are also prepared to provide rapid and accurate responses when a disaster is anticipated or in order to prevent damage resulting from flood or other causes. This is done by collecting, managing and providing local governments with meteorological, flow rates, water levels, water quality and other information related to the rivers subject to their management.

Furthermore, road and river administrators also collect management information regarding roads and rivers, as well as incidental facilities.

Independent information and communication systems, established to collect, manage and provide such information, have been developed over many years and have evolved into solid and robust dedicated systems for supervising and controlling, with the primary emphasis on accuracy and reliability (Figure 1).

The demand for improving the efficiency of public utilities and the policy of privatizing special public corporations, all require vast cost reductions of road and river administration entities. Such recent social situations have prompted the downsizing of facilities. These have been realized with such means as the use of general purpose products and technologies. General purpose hardware, operating systems and middleware are now used instead of central computers, while package software is used instead of dedicated application software. Furthermore, LAN switches and IP routers are being implemented for communication networks while personal computers are being implemented extensively, to replace terminals.

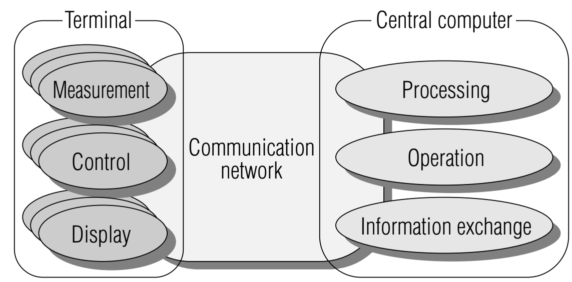


Fig. 1 Existing independent information and communication system of the road and river administrators

Summary of the IPGW

The IPGW equipment, created in response to needs for transforming independent information and communication systems of road and river administrators into general purpose systems to reduce costs, has been available from Oki Electric since 2001.

However, even if independent information and communication systems were downsized using an IP(general purpose technology), it would be quite difficult to convert all the central computers, communication networks and terminals to IP networks in one sweep, as the costs involved in such an implementation would be enormous.

The IPGW, therefore, is communication equipment with a function that converts existing measurements, controls and display information (hereinafter referred to as "legacy information") to IP data so that progressive conversions of existing central computers and terminals to equipment compatible with IP technology can take place.

The IPGW is composed of the following three elements (Figure 2).

• Appliance blade server

This is an appliance server that converts legacy information into IP data. Numerous types are available, with selection depending on the type of interface required for responding to the needs of various legacy information.

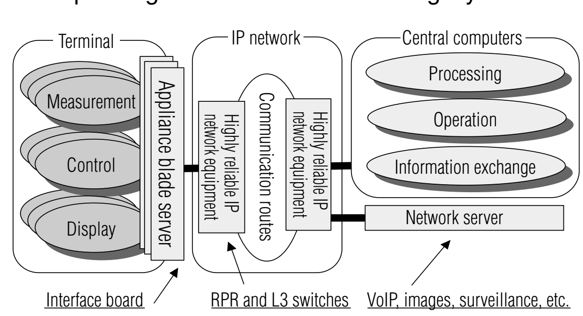
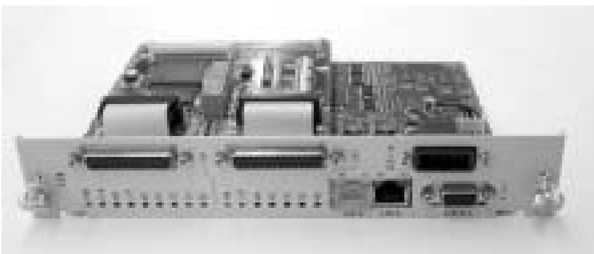


Fig. 2 Components that configure the IPGW

*1) IPGW is a registered trademark of Oki Electric Industry Co., Ltd.

Further, application software that runs on general purpose operating systems and responds to the processing of individual legacy information types, can be installed in the equipment, providing not only simple protocol conversions, but also high level processing capabilities.

Further, the IPGW is configured with a blade structure, in which a single board basically contains two legacy inputs.



Phot. 1 Example of an appliance blade server (V.24IF)

• Highly reliable IP network equipment

In order to realize an extremely high level of reliability, to equal or supercede that of existing communication networks, equipment is used, such as the Resilient Packet Ring (RPR, the latest communication technology for urban ring networks with abundant failure resistant characteristics) (Photo 2).

Phot. 2 An example of highly reliable IP network equipment (RPR)

• Network servers

General purpose servers are installed at arbitrary locations and loaded with software. They are then connected to highly reliable IP network equipment, to respond to applications that require high speed processing and a large hard disk capacity for the call control of Voice over IP (VoIP), the storage of images and overall surveillance of the IP network, etc.

Phot. 3 Example of a network server (image management server)

Features of the IPGW

The IPGW has many features that are not available with traditional IP communications equipment, as it was developed specifically for the independent information and communication systems of road and river administrators.

• Environment resistance characteristics

The management facilities of road and river administrators are naturally established outdoors. The IPGW therefore, needs to conform to environments throughout Japan, from Hokkaido to Okinawa. The blade server and highly reliable IP network equipment have, therefore, been designed to operate within a temperature range of -10 to +70 degrees Celsius through efforts to devise better environmental resistance by using heat shields and heaters for the housing of the equipment.

• Network synchronization

The current communication networks of road and river administrators are synchronized networks. In order to make it possible to implement progressive conversions, the IPGW also needs to be able to operate while synchronized to these networks. For this reason, network synchronization was realized through the installation of common components at arbitrary locations, which receive synchronous signals from existing communication networks and converts them into synchronous packets before sending them to the appliance blade servers as IP multicast data. The synchronization accuracy is rated at 2ppm and lower, which is adequate for the purpose.

• Low fluctuation rates

In general, the arrival intervals of packets of IP networks may vary, depending on the load conditions of the communication routes and communication equipment. These variances in the arrival intervals are called fluctuations. If legacy information is set in an environment with fluctuations, interruptions to audio and images will result. In order to overcome this problem a buffer memory was added to absorb the effects of a certain number of fluctuations. Attempts to absorb larger fluctuations will inevitably result in larger delays, as a deeper buffer will be required.

Fluctuations with the IPGW are limited to an extremely low level, through the rigorous application of the Class of Service (CoS) with highly reliable IP network equipment.

Actual measurements of the fluctuations, with the IPGW, have been taken and found to be 2ms or less, even under high load conditions.

• Low delay rates

There may be times when a delay becomes a problem as the legacy information assumes that existing communications have low delay rates. In order to satisfy the low delay rate condition of some of the legacy information, the appliance blade server makes it possible to set the time for IP packet conversions, which is the controlling element of delays, starting from 10ms. Further, since network synchronization is possible and, as fluctuation rates are low, the buffer memory size is extremely small, making it possible for the IPGW to bring control of the overall delays to 50ms or less.

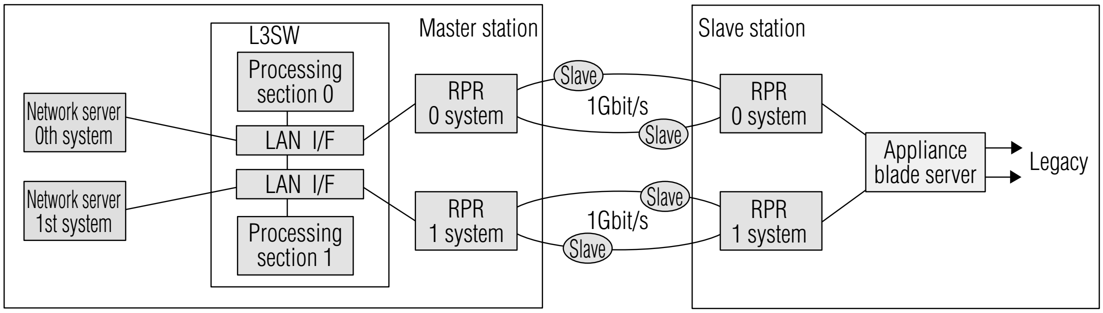


Fig. 3 Example of an IPGW redundant configuration

• Redundant configuration

Information that are critical for the purpose of disaster prevention, are included in legacy information. No part of the information, therefore, may be absent. Measures have been taken with the IPGW for this reason, to improve the quality of communications and to maintain an extremely high level of reliability of the respective components.

One such measure is the completely redundant configuration of communication routes. In general, a redundant configuration involves a redundancy in the configuration of equipment or in the configuration of communication routes. A high degree of reliability is attained with the IPGW, through the configuration of the communication routes themselves in a redundant ring configuration (Figure 3).

Another measure taken is the shortening of the circuit routing time using the RPR to 50ms or less. The RPR, which makes high speed routing possible, was developed because some legacy information does not allow long circuit routing times.

• Low cost

Simplifying the configuration of the networks, made possible through the use of general purpose technologies, realized a reduction in costs, when compared with existing communication networks.

• Stable supply

The upgrading intervals of the facilities for road and river administrators are longer than for the private sector. When general purpose equipment are implemented, there may be problems with the guarantee for expanding or repairing equipment, which may not last until the system has been upgraded.

The IPGW has been designed with the assumption of long term use. A supply organization has also been established to deal with this condition, which makes it possible to secure stable supplies of the necessary components and parts.

Network Solutions using the IPGW

Two examples of the solutions made possible with the IPGW, for the problems of road and river administrators relating to the conversion of independent information and communication systems to general purpose systems, will be shown herein.

• Integration of the network and central computer

The first example shows a conversion of the road administrators' central information display board system.

The central information display system is an independent information communication system used by road administrators. Information is edited and then displayed on variable information display boards, installed on the roadside for the purpose of providing road information.

A minicomputer for control and a dedicated control device were installed in the past as hardware, while large scale and exclusive development was necessary for each piece of software. Further, existing communication networks that link up information display boards with the central information display system, are conventional, dedicated communication equipment, linking dedicated control devices of information display boards with the dedicated control devices of central information display system in units of groups (Figure 4).

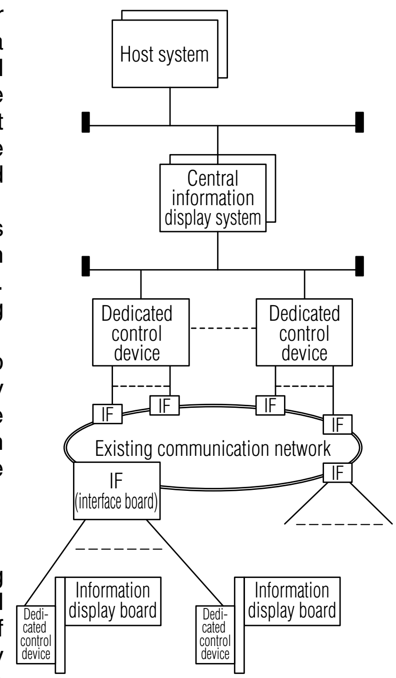


Fig. 4 Figure 4: Conventional central information display system

As for the hardware, it is possible to downsize the system by replacing the minicomputer for control and the dedicated control device, with the appliance blade server, by converting the central information display system to the IPGW. Further, with regard to software, a massive cost reduction can be realized, mainly by porting the existing applications into general purpose operating systems. Furthermore, by replacing the existing communication network with IP networks, through the implementation of highly reliable IP network equipment, integration of the communication network with the central computer becomes possible, thereby limiting the scale of investment to a fraction of what it used to be (Figure 5).

• Integration with telephone exchange equipment

The second example is the integration of the system with telephone exchange equipment.

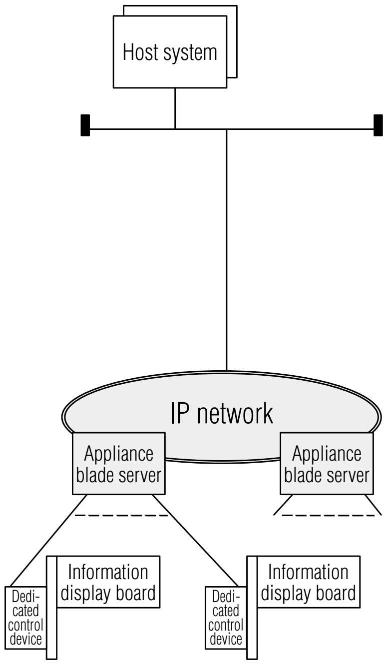


Fig. 5 Solution for converting a central information display system

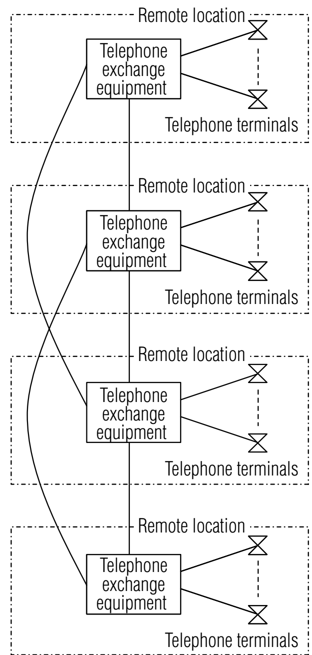


Fig. 6 Conventional telephone exchange equipment

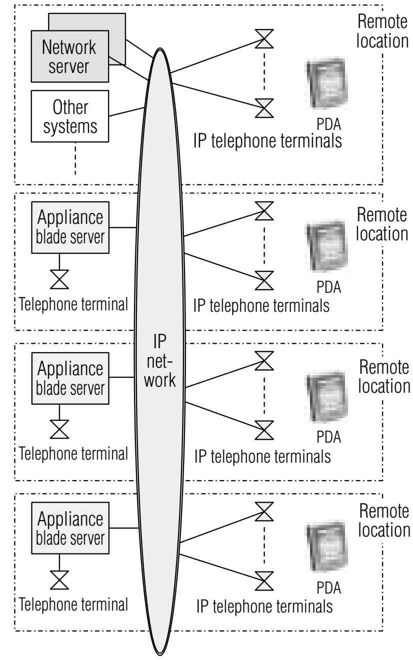


Fig. 7 Solution for converting telephone exchange equipment

Telephone exchange equipment have been providing voice communications that are extremely critical for routine work as well as the disaster prevention work of road and river administrators. The cost of the exchange equipment, however, has been high, due to measures implemented for the improvement of hardware reliability and dedicated software created for and installed in particular equipment.

When converting telephone exchange equipment, it is possible to limit the scale of investment to a fraction of what it used to cost by integrating telephone exchange service functions into the network server of an IPGW. In the past, a telephone exchange equipment had to be installed at each remote location and these locations were linked with trunk lines. Each telephone exchange equipment had redundant hardware and inter-exchange channels had several routings to ensure that detours were viable. Further, large-scale dedicated software, tailor made to suit the purposes of road and river administrators, have been created and installed (Figure 6).

When upgrading the telephone exchange equipment, it is possible to integrate several telephone exchange equipment by replacing the hardware with an appliance blade server and network server of the IPGW and by loading VoIP call control software.

Further, since information exchange with existing independent information and communication systems for road and river management, is viable through the IP network, the integration of information with voice as the core element also becomes possible (Figure 7). Mobile work becomes viable as well, through the realization of a voice portal system with which various information can be extracted in a unified manner and information can be displayed on PDAs along with voice.

Conclusion

Descriptions of the IPGW and examples of network solutions, with the IPGW as the core component, were introduced in this paper.

We are certain that the IPGW will become the solution for the problems facing road and river administrators. We shall strive for the establishment of even better independent information and communication systems, by reflecting the needs of users during the proposal stages of projects in the future.

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