

SURVEY ON APPLICATION OF INFORMATION TECHNOLOGY (IT) TO DISTRIBUTION SYSTEM

Isao IYODA *; Kresimir BAKIC †; Giuseppe MAURI †
 * TMT&D-Japan; †ELES-Slovenia; † CESI- Italy
 * isao.iyoda@tmt-d.co.jp; † kresimir.bakic@eles.si; † giuseppe.mauri@cesi.it

INTRODUCTION

Application of Information Technology (IT) to distribution systems is an important factor for making the business effective and profitable. Similarly to other fields of the electrical sector, IT is rapidly increasing in the distribution system. A survey on the current status has been carried out (from December 2002 to May 2003) as an activity of the CIGRE Working Group WG 37.35 "Information technology development and its effect on the economy, security and market operation of power systems". The results of a survey on the current status of the Information Technology application to distribution systems is described in this paper. A questionnaire has been sent to many organizations all over the world. Six topics were surveyed: Intranet/Internet, Communication Media, GPS, Remote monitoring, Automatic metering, and Trading.

1. PROFILE OF RESPONDANTS

Figure 1 shows location of respondents, and System Maximum Power Demand of Respondents. Half of respondents have the maximum demand less than 2GW. It is because half of respondents are distribution company that supplies for customers in a limited area. The remains are vertically integrated utilities that have large customers.

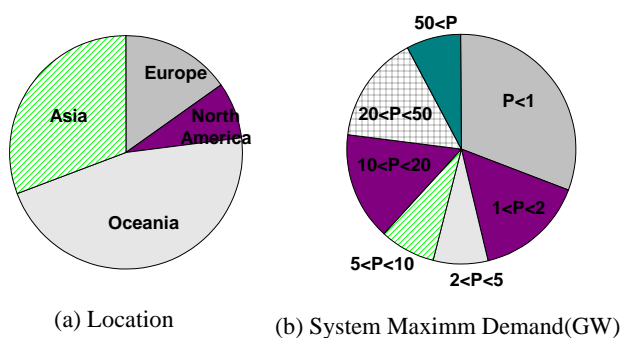


Figure 1 Location and System Maximum Demand of Respondents

As for sideline businesses, the percentage of the respondents who operate gas business is more than 70%, and each percentage of telephone business, Internet business, and media providing business for CATV (mainly optical fibre) is 30%. On the contrary, the percentage of financial service business is very low. Besides these businesses, Japanese company operates recycle businesses to solve environment problem.

2. INTRANET/INTERNET

2.1 Intranet

As shown in Figure 2, all respondents use intranet. Its purpose is mainly for in-house communication, automatic metering and remote monitoring of facilities. Problems that should be solved for further penetration are security and the initial and operation costs. As shown in Figure 3, intranet will prevail in future; however, many utilities answered that for Monitoring/Control/Protection/Operation they may use dedicated communication channels too.

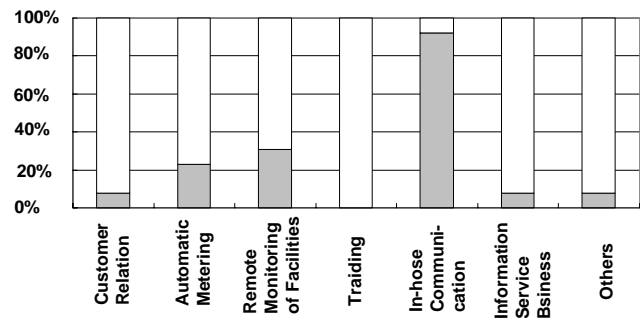


Figure 2 Purpose of Intranet

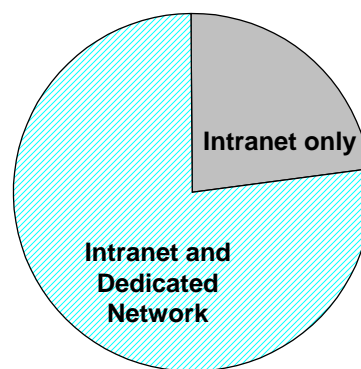


Figure 3 Information Network in Future

The intranet has been installed mainly from 1996 to 2000. It has only several years' experience, and new and epoch-making application of the intranet will be appeared in the near future.

2.2 Internet

As shown in Figure 4, Internet is mainly used for customer relation. Really few companies use it for remote metering, remote monitoring, and trading. Communication network in distribution systems is designed

to be applicable to Internet as well as the Distribution Automation System (DAS). And returns from Internet business and other commercial business are larger than that from the DAS.

In addition, Internet Protocol (IP) telephone is promising application for future. Distribution system will provide information as well as electricity in future. If the communication networks of the DAS are used as internet media or other commercial business such as Cable Television Service (CATV), the redemption of the investment to network could be achieved in a short time.

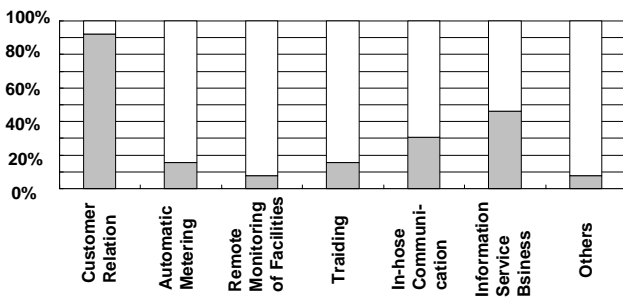


Figure 4 Usage of internet

As shown in Figure 5, problems that should be solved for further prevalence are response time, security and the initial and operation costs.

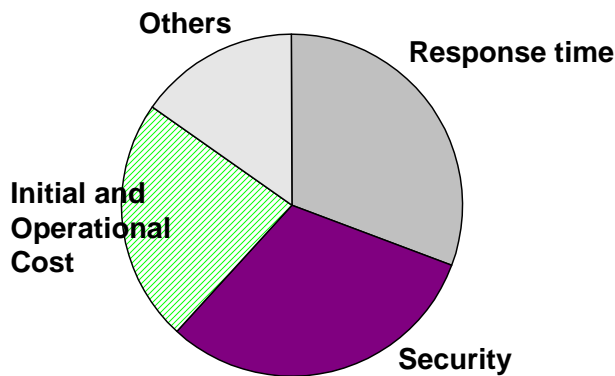


Figure 5 Problems in Prevailing internet

3. COMMUNICATION MEDIA

There are various communication media available for distribution systems, i.e. Optical Fibber (OF), Power Line Communication (PLC) and Radio Communication (RC) (that include Cellular telephony), etc. The type of communication media for distribution system is different depending on the speed needed for applications and customers' density.

Advantage of the optical fibre is due to its high-speed communication, and its disadvantage is the cost for its installation works. Installation of lines is one of expensive works, and optical fibre installation is especially expensive. Advantage of PLC is its low cost for installation works. Since there is no necessity to install lines, installation cost is very low. Recently high performance PLC system is available by changing its carrier frequency. However, frequency is one of public asset and change of regulation is necessary in Europe and Japan. Disadvantage of PLC is the security of information and noise interference to neighbor equipment.

Advantage of Radio is also the low cost for the installation. And its disadvantage is noise interference and security. Utilities in Japan already have infrastructure for Personal Hand-phone System (PHS), one kind of cellular phone. The additional cost for radio system is very small.

As shown in Figure 6, optical fibre and radio are used for facility monitoring.

As shown in Figure 7, optical fibre and radio are used for protection.

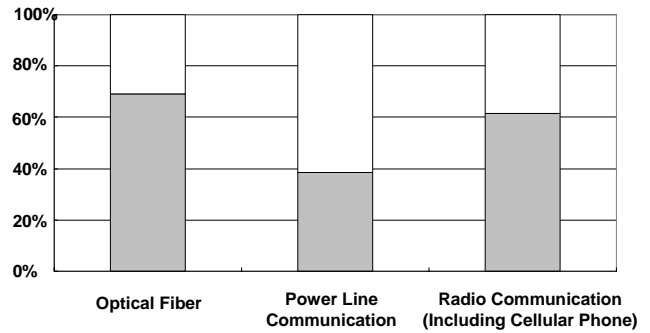


Figure 6 Media for Monitoring

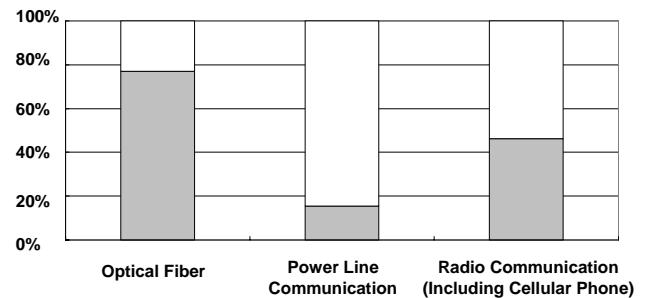


Figure 7 Media for Protection

Generally speaking, optical fibers are used in high-density area, coaxial cables are used in medium density area, and twist pair lines are used in low-density area. The communication media between distribution substation and electric pole are metallic wire or telephone in the urban area, PLC or OF for rural area. If the communication media reaches to poles of distribution system, the internet could be completed by installing additional communication media between the pole and customers.

As shown in Figure 8, half of respondents consider the dedicated line as the countermeasure for security, rather than Cryptogram.

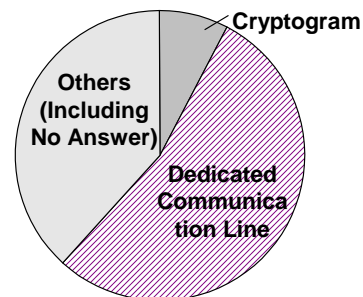


Figure 8 Security Countermeasures

As shown in Figure 9, most respondents predict that optical fibre becomes the dominant media of distribution system in

future.

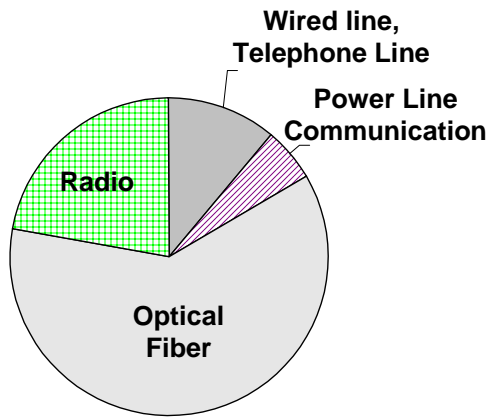


Figure 9 Dominant Media in Future

4. GPS

As shown in Figure 10, 40% of respondents have already applied GPS, and 15% is studying on GPS applications for their distribution systems.

One of applications is the positioning of maintenance crews. By using the location data of the maintenance personnel, the most appropriate personnel could be assigned to the trouble location. Existing PHS system is also used as a positioning system in a Japanese utility, even though it has a rough positioning function rather than GPS.

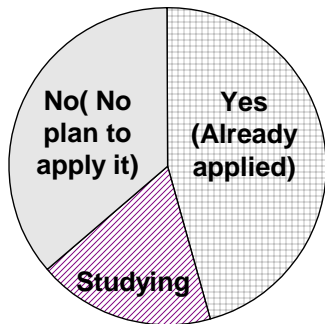


Figure 10 Status of GPS Application

As shown in Figure 11, 40% of respondents use GPS for positioning, and 30% uses it for time stamping of acquired data. In addition, two company uses it for synchronization of ripple control plants, and one company is used it for positioning of facilities.

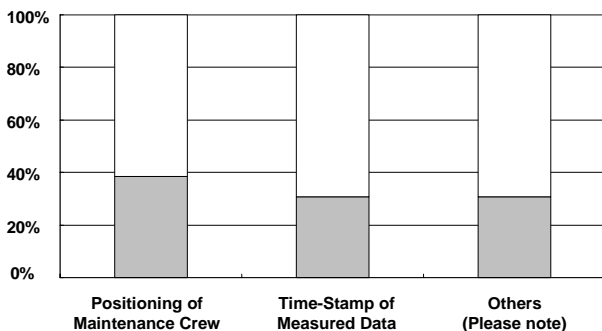


Figure 11 Usages of GPS

5. REMOTE MONITORING

As shown in Figure 12, the purpose of remote monitoring is monitoring of facility or monitoring for energy solution service.

Various monitoring businesses are reported to become commercial by the progress of the internet. One is the Home Security Service that many sensors in a home sense the condition such as the invasion, health condition of elder person living alone, operation condition of domestic apparatus, fire, etc, and those information is sent to the service center through the internet based on the communication media that the utility owns. However, as shown in Figure 12, this survey says such business does not start in distribution systems at this moment.

40% of respondents use it for the Energy Solution Service that surveys the customer's load through the internet, and provides customers with energy saving consultation, solution to save CO₂, etc. In addition, advanced Demand Side Management (DSM) that control the customer's apparatus through internet considering to minimize the impact of DSM control to the customers is also considered.

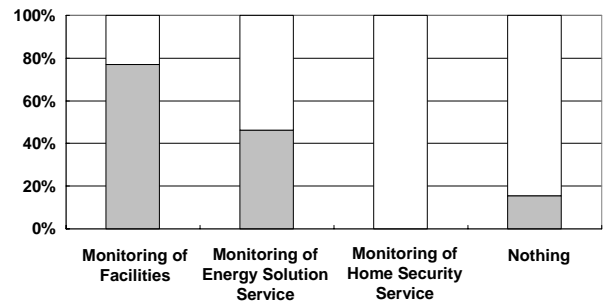


Figure 12 Purpose of Remote Monitoring

6. AUTOMATIC METERING

There is one scenario for future metering. Since the electricity rate schedule will be complex and will be updated frequently in the future market-based power industry, conventional metering equipment would not be applicable in the near future. However, it is not economical to install intelligence in each meter. Digital power meters with communication functions will be major in the near future. The metered demand data is sent to the computer center and the charge is calculated based on the latest rate schedule.

However, as shown in Figure 13, this survey says the prevalence of automatic metering is very small.

No utility foresees the prevalence of remote metering. They think they can manage the complex rate schedule by the improvement of individual metering device at customer. However, they are studying in parallel on the collaborative metering business with other company, such as a gas company or a water company that need metering works. And most company foresees automatic metering will not be popular before 2011.

As shown in Figure 14, 8% has collaborated with other company on metering business, and 23% is studying. However, a majority of the respondents have no plan for

collaboration.

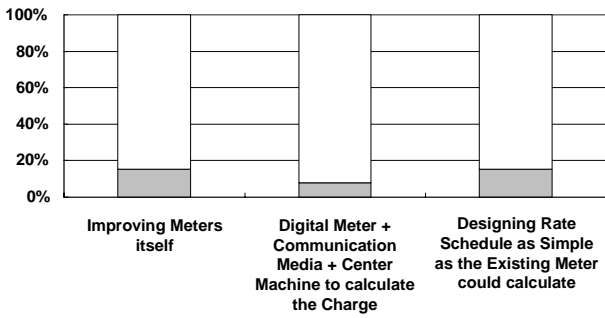


Figure 13 Countermeasures for Complex and Frequency Changing Rate Schedule

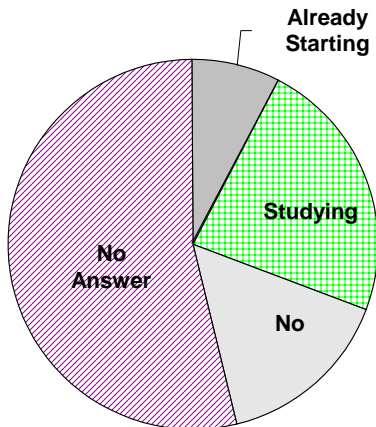


Figure 14 Metering Collaboration

7. TRADING

Only 40% of respondents has customer who procures electricity by trading. Independent Power Producer (IPP) is requested to keep the balance of generation and demand every curtain period to avoid the disturbance for the power-load balancing control of existing power system. The balancing is mandated to IPPs by regulation in many countries. The cost to monitor the customer’s demand decreases by internet system,

As shown in Figure 15, among the respondents who has customer that procure electricity through the trading market, 80% provides the participants of the trading with real-time information of trading market.

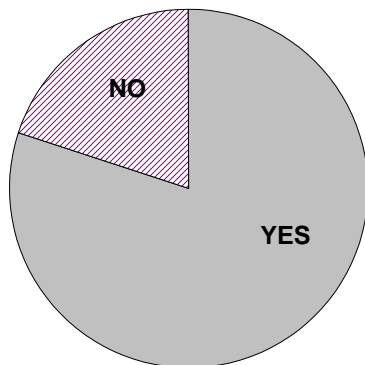


Figure 15 Provision of Real Time Information

8. CONCLUSIONS

[Intranet/Internet] All respondents use Intranet, mainly for in-house communication. Problems that should be solved for further penetration are security and the initial and operation costs. Intranet will prevail in future, however, many utilities answered that for Monitoring/Control/Protection/Operation they may use dedicated communication channels too. Internet is mainly used for customer relation.

[Communication Media] There are various communication media available for distribution systems, i.e. Optical Fibber, Power Line Communication and Radio Communication, etc. The type of communication media for distribution system is different depending on the speed needed by applications and customers’ density. Communication media reaches secondary substations. Most respondents predict that optical fibre will become the dominant communication media in distribution systems.

[GPS] Respondents use GPS for positioning, for time stamping of acquired data, and for synchronization of ripple control systems.

[Remote monitoring] Purpose of remote monitoring is mainly for monitoring own facilities or monitoring energy solution services.

[Automatic metering] This survey pointed out that automatic metering is not very diffused. It is not foreseen becoming popular before 2011. However, they are studying in parallel on the collaborative metering business with other company, such as a gas company or a water company that need metering works.

[Trading] 40% of respondents have customer who acquire electricity on the market. They provide participants with all the real-time information needed for the market, for this service IT has an important role.