OPERATION INFORMATION MANAGEMENT USING MOBILE NETWORK

Luciano B. ROCHA
GSEE-PUCRS - Brazil
lubero@gmail.com

Flávio A. B. LEMOS
GSEE-PUCRS - Brazil
lemos@ee.pucrs.br

Daniel P. CORREA
GSEE-PUCRS - Brazil
daniel.correa@pucrs.br

Jaime JEFFMAN FILHO
GSEE-PUCRS - Brazil
jjeffman@ee.pucrs.br

ABSTRACT

This paper presents a proposal of a mobile network to manage and access information related with operation of electrical networks. To support different models and types of PDA (Personal Digital Assistants) and mobile phones, the application is being developing using Java Technology. This option was made due to different types, models and operational systems available for mobile equipment, since Java is multiplatform software. To illustrate the paper are presented examples of access and consult of historical and equipments database using PDA.

INTRODUCTION

Electrical utilities are in the forefront of change in operation practices and how they operate their business. Nowadays, a common matter in electrical utilities is the containment or reduction of the cost base whilst maintaining and in many cases improving business efficiency and performance. New challenges in working practices is forcing electrical utilities re-evaluate the communication networks and services that support theirs business. In this way, the use of mobile technologies is a natural choice.

There are many industries and services areas that use mobile technology to enhance process and service quality. The emergence of mobile computing is creating a wide range of application, fast becoming indispensable in our modern society. Several benefits can be derived from the implementation of effective mobile data solutions, since mobile technologies are maturing in terms of availability, functionality and costs [1] [2].

The authors have been working with mobiles technologies in power system area. References [3] [4] [5] present some examples of utilization of PDA and smartphones for inspection routines, operation and maintenance planning and outage cause identification, respectively.

The availability of electric system information for power system operation is fundamental for a safe and economic operation. The correct decision and the agility to do it is the difference between the best and the worst result obtained in operation area. The information access of historical database, equipment database and database of events and outages must be ease to manipulate, since it is necessary several consults to consolidate and display customized information. Primarily, this set of information is used for engineers and dispatchers of the operational centre and maintenance teams. However, others sectors such as planning, commercial and executives need to make use of this information for strategic decisions and to support technical and economics analysis. Sometimes, it is need to have the information for on-line access using programmed queries or in an interactive form, in order to allow mobile devices to make customized remote consults from different databases. An example of this functionality is a remote access of current or historical demand, demand forecasting or outage information using PDA or mobile phone by directors or technical staff outside the utilities.

MOBILE TECHNOLOGY

Mobile technology is fast become indispensable in our modern society, mobile phones and PDA (Personal Digital Assistants) will probably merge in single equipment. The wireless capability of these new mobile devices provides a new way to deal with information and opens wide new possibilities for this technology. The recent proliferation of cheap, small and increasingly powerful mobile computers provide the application of these equipment in areas that would be impossible years ago, mainly areas that needs graphical capabilities, wireless communication and memory storage. There are several fields that mobile technology could be applied inside a power system utility. Each process that collect or need remote information can be enhancing using mobile technology. In this paper were used two mobile devices, the Personal Digital Assistant – PDA and smartphone.

PDA (Personal Digital Assistant)

PDA are portable devices with graphical representation display and touch screen for data enter. Application interface allows easy and cost efficient design of mobile data applications. The physical interface is provided by USB communication, bluetooth®, infrared or wireless LAN network (IEEE 802.11b). Figure 1 presents two types of commercial PDA [1].

Figure 1 – Personal Digital Assistant - PDA

Smartphones

Smartphones are mobile phones with PDA functionality. The major disadvantage at present, very small display size, may be overcome in the near future. Smartphones with the same display size as the available on PDA are called WDA (wireless digital assistant)[1]. Figure 2 presents two types of smartphones.

Figure 2 - Smartphone

The second is a PDA with characteristics of mobile phone, called WDA.

PROPOSAL SYSTEM

Dispatch and Control Centres need to manage a lot of information, which are stored in historical database in order to provide information for operation and planning processes. There are many data application that could deliver benefits to the energy business using mobile devices and computing. The utilization of mobile devices can bring resources and services closer to the managers, dispatchers and engineers, enabling quicker response times, better services, and more efficient resource management. Additionally, field crew can access to real time data and operation information using mobile devices such as PDA and smartphone. Figure 3 shows an example of mobile network.
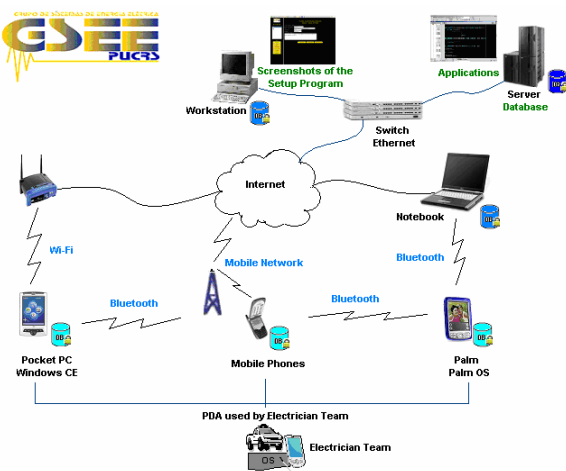

Figure 3 – Example of a mobile network

Next sections present some characteristics of the developed system.

Communication Aspects

Mobile devices use different communication technologies, like Wi-Fi, Bluetooth, Infra-Red, etc [6]. In order to assure the connectivity between the mobiles devices and computers, it is used HTTP protocol and TCP/IP, as shown in Figure 4.
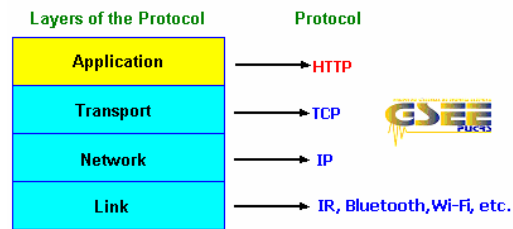

Figure 4 – Protocol Layers

This feature allows mobile devices interaction with servers independently of physical infrastructure.

Programming Languages

To support different models and types of PDA (Personal Digital Assistants) and mobile phones, the application is was developed in Java Technology, since Java is multiplatform programming language that permit to create applications to desktops, servers and mobile equipments (figure 5). This option was made due to different types, models and operational systems available for mobile equipments [7].

Figure 5 – Java Platform

The Java technology used in this application is J2ME (Java Micro Edition)[8], which was developed by Sun Microsystem for mobile devices. This permit that application can be executed in any mobile equipment (PDA, Smart Phone, Table PC, Mobile Phone) with a virtual machine installed.

Databases and Information Exchange

The data manipulation is essencial in a network of mobile devices. Figure 6 depicts the databases used in diferrent sub-systems that are part of mobile network.

Figure 6 – System databases

The common information is stored in the PostgreSQL 8.0 master database [9]. The database choice was due to characteristics of robustness, freeware and options for Windows and Linux operation systems. This database can be used as auxiliary database when the mobiles devices can not access the main database. The information is stored in mobile devices using RMS (Record Management System) [10], which is a native characteristic of Java Language. The structure of system information is stored and exchanged using XML (Extensible Markup Language) [11].

The mobile system device integrates J2ME[8] and PHP [12] to access the server database. Firstly, the mobile application, written in J2ME, creates a HTTP request, adding the parameters which will be send to the PHP application by the POST method. After, a HTTP connection is opened between the Web server and the mobile device through a TCP/IP network, like the Internet for instance. At the Web server side, the PHP application receives from the client the necessary parameters to establish a connection with the HOL database, where the query is done according to the values received from the PDA. After the database query, the PHP application returns the values to the mobile device. The mobile device receives the values sent by the PHP application and then processes it according its application.

One of this method advantages is the complexity reduction of the implementation in the server side, because the many simultaneous connections done by several mobile device are responsibility from the webserver application, leaving to the programmer only the complexity of the database requests.

The mobiles devices were testing considering performance of data exchange, as showed by Table I.

Table I – Test of access time of mobile devices

Communication	Mobile Device	Data Size	First Access	Other Access
Bluetooth	PALM Zire 72	256 bytes	2710ms	690ms
Bluetooth	PALM Zire 72	512 bytes	3250ms	900ms
Bluetooth	PALM Zire 72	1024 bytes	3870ms	1720ms
Cable USB	iPAQ HP h5500	256 bytes	582ms	650ms
Cable USB	iPAQ HP h5500	512 bytes	1161ms	1006ms
Cable USB	iPAQ HP h5500	1024 bytes	1477ms	1410ms
Wi-Fi	iPAQ HP h5500	256 bytes	309ms	240ms
Wi-Fi	iPAQ HP h5500	512 bytes	380ms	370ms
Wi-Fi	iPAQ HP h5500	1024 bytes	620ms	580ms

Mobile Devices Used

Table II shows the devices used for testing of the proposal system. The purpose was to assess the performance of different types of mobile devices considering characteristics of operational system, memory and processor.

Table II – Mobile devices used

Device	Communication	Operational System	Processor / Memory
PDA PALM ZIRE 72	Bluetooth Infrared USB	Palm OS 3.5	ARM INTEL 312MHZ / 32 MB RAM
PDA PALM ZIRE 72 Silver	Bluetooth Infrared USB	Palm OS 5.2.8	ARM INTEL 312MHZ / 32 MB RAM
SmartPhone Samsung SPH-I330	AMPS800/CDMA 8000 USB Infrared	Palm OS 3.5	Phone: 32 Mb + SRAM 8 Mb PDA: 4 MB + DRAM 16 MB
HP iPAQ Pocket PC h5500	wireless 802.11b Bluetooth Infrared USB	Windows CE 4.2	400 MHz Intel XScale/ 48 MB ROM/ 128 MB RAM

EXAMPLES OF SYSTEM UTILIZATION

In this sections are presented some examples of operation data information and equipment information, which are provided by system developed.

Operation Data Information

This feature allows the user to access demand information. There are four consult options: Demand (Max, date hour, min, date, hour), Power demand forecast (next day, real and forecast for a period), Load curve (tabular and graphics) and Outage information (equipment, cause, hour and date).

Figure 7 shows the main menu of operation data information and figures 8 and 9 show the results of demand and power demand forecast database queries, respectively.

Figure 7 – Main menu of operation data information

Figure 8 - Results of demand database query.

Figure 9 – Results of power demand forecast database query.

Equipment Information

This characteristic allows the user to access equipment information from master database and can be customised by user. Figure 10 shows a screen with main menu of operation data information.

Figure 10 - Main menu of operation data information

After the choice of equipment consult, PDA shows the equipment description. Figure 10 shows a screen with seven equipment consult options: transformer, transmission line, breaker, switch, relay, generator and customer. Figure 11 shows the results of transformer database query.

Figure 11 - Results of transformer database query.

CONCLUSION

The mobile computing technology improves efficiency and accuracy of several processes in a power utility. The mobile technology opens a wide range of new possibilities to enhance the utility internal process, making the information flow easy and reliable. In this paper was presented a computational system based on mobile computing network for information management of operation of distribution system. Some aspects involved mobile computing such as technologies, programming languages, database, performance and functionality had been presented and commented. The results obtained allow identifying the potentialities of the use of mobile computing in power system operation routines. Information access and insertion in operation database had presented excellent results in relation the performance and functionality. The security was kept through the use of safe protocols that use encrypted information.

REFERENCES

[1] CIGRE Task Force 35.07, 2002. "The Benefits of Mobile Data. How Can They be Realised?" *Report of CIGRE* Task Force 35.07.

[2] Bruegge, B. Bennington, "Applications of wireless research to real industrial problems. Applications of mobile computing and communication**"** *Personal Communications, IEEE*, Volume: 3 , Issue: 1 , Feb. 1996, Pages:64 - 71.

[3] C.O.Pretto, F.A.Lemos, M.A.Rosa "Computational System For Outage Causes Identification And Analysis For Assessment Of Distribution Systems Reliability Index" *CIRED*, Barcelona, May 2003 [on CD].

[4] C.O.Pretto, M.A.Rosa, F.A.Lemos "Data Acquisition using Mobile Computing Technology to Enhance Operation and Maintenance Planning ". 18th *CIRED*, Turin, June 2005 [on CD].

[5] C.O.Pretto, M.A.Rosa, F.A.Lemos, R. Faller "New Approach of Electrical Distribution Inspections Routines using Mobile Technology". 18th *CIRED*, Turin, June 2005 [on CD].

[6] J. LaRocca, 2002, 802.11 DEMYSTIFIED. McGraw-Hill , New York, NY-USA.

[7] JAVA Official – http://java.sun.com

[8] J. Keogh, 2003, J2ME : the complete reference. McGraw-Hill, New York – NY-SUA

[9] The PostgreSQL Global Development Group, PostgreSQL 8.0.10 Documentation, 1996-2005 on line http://www.postgresql.org/docs/8.0/interactive/index.html

[10] Sun Microsystems Inc., Eric Giguere, Databases and MIDP, Understanding the Record Management System, February 2004, on line http://developers.sun.com/techtopics/mobility/midp/articles/databaserms/

[11] W3C, Extensible Markup Language (XML), 2006/09/11 on line http://www.w3.org/XML/

[12] J. Castagnetto, S. Schumann, H. Rawat, C. Scollo, D. T. Veliath, 1999, Professional PHP programming. Vrox Press Birmingham , UK.