

## FEASIBILITY STUDY ON APPLICATION OF WIMAX TECHNOLOGY TO UNDERGROUND CABLES DATA ACQUISITION



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### ABSTRACT

*This paper presents a feasibility study on WIMAX technology application to underground cables data acquisition. This feasibility study is based on a field data collection prototype system that is composed of field monitoring and host control platforms. The data transmission, communication, and control of these two platforms are accomplished using WIMAX technology. Based on the transmission characteristics of WIMAX, this paper proposes a WIMAX based communication architecture and then develops a specific data format that is suitable for monitoring the underground area and collecting cables data, such as temperature, humidity, partial discharge, leakage current. After establishing the prototype system, the authentication and performance tests were conducted. The authentication test shows that the underground cables data were transmitted correctly.*

### KEYWORDS

Underground cables, Wireless sensor networks, WIMAX

### INTRODUCTION

Combined with sensor technology, electronics technology, computer technology, and communication technology, the on line insulation monitoring system can fulfil the on line monitoring and diagnosing of the electrical equipments by signal acquisition, data processing, logical decision and data transmission. So in recent years, high voltage engineering researchers have paid more and more attention to the technology. But the current insulation on line monitoring system is found to have many disadvantages in practical usage, such as complexity in wire connection, difficulty in device installation, and liability to be interfered by other electrical equipment. In order to solve the problem, we introduce a new insulation monitoring system based on WIMAX technology and IEEE1451.2 standard.

### WIMAX

WIMAX is defined as World Interoperability for Micro Access by the WIMAX Forum, formed in June 2001 to promote conformance and interoperability of IEEE 802.16 standard, officially known as WirelessMAN. WIMAX aims to provide wireless data over long distances, in a variety of different ways, from point to point links to full mobile cellular type access.

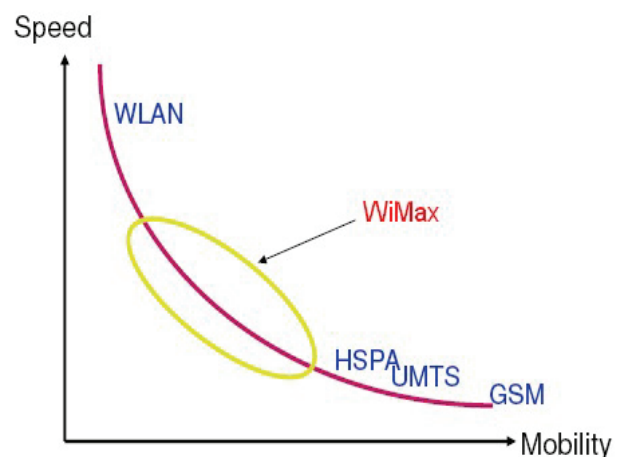
### WIMAX uses

The bandwidth and reach of WIMAX make it suitable for the following potential applications:

- Connecting WiFi hotspots with each other and to other parts of the Internet.
- Providing a wireless alternative to cable and DSL for last mile (last km) broadband access.
- Providing high speed data and telecommunications services.
- Providing a diverse source of Internet connectivity as part of a business continuity plan. That is, if a business has a fixed and a wireless internet connection, especially from unrelated providers, they are unlikely to be affected by the same service outage.
- Providing nomadic connectivity

### Competing technologies

Within the marketplace, WIMAX's main competition comes from widely deployed wireless systems with overlapping functionality such as UMTS and CDMA2000, as well as a number of Internet oriented systems such as HIPETMAN and WiBro. Fig. 2 shows the WIMAX's speed over the mobility.



### WIMAX APPLICATIONS

Fig. 2 shows an example of the cables and their surroundings in a 154 kV underground installation at S district, Seoul, Korea.

## Return to Session



Figure 2: A typical installation of the underground 154 kV power cables at S district, Seoul, Korea

### WIRELESS ON LINE INSULATION MONITORING SYSTEM BASED ON WIMAX TECHNOLOGY

The scheme of the on line insulation monitoring system based on WIMAX technology and IEEE1451.2 standard is shown in Figure 3.

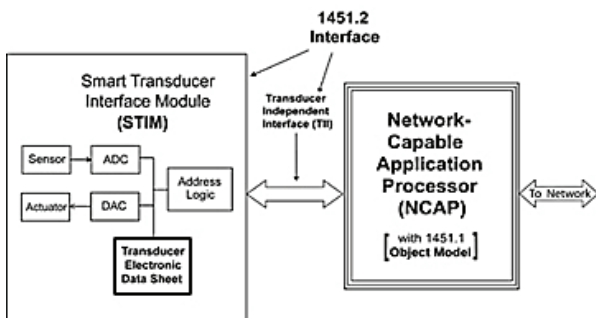


Figure 3: The scheme of smart sensor

In every data acquisition node, a wireless STIM module is installed. The installation of the wireless STIM module is quite simple, so it can approach the node as near as possible to eliminate interference. The data collected by STIM module are sent to the appointed NCAP by a wireless way, and then transmitted to the master computer by NCAP via CAN bus. In the master computer, the data are calculated and analyzed, after that a diagnosis can be made according to the calculated results. The result will be shown not only on the master computer, but also on the corresponded STIM module. If the result surpasses the set warning magnitude, a sound light warning signal will be sent by the executor of STIM module, it tells the operator to master the working condition of the devices in time. The paralysis of any single NCAP module will cause the interruption of data transmission, so in this design, each STIM sends sampling data to two NCAP at the same time. When master computer monitors a failure of one NCAP, it sends an alarm signal, and notifies the operator to replace the

paralyzed NCAP, meanwhile the other NCAP can carry the mission of data transmission. As a result, the stability of the whole system is raised.

### CONCLUSIONS

This paper introduces the WIMAX technology and the IEEE1451.2 standard in detail, completes the design of hardware part and software part of smart sensor, and proposes the total design concept of an on line insulation monitoring system based on WIMAX technology. The WIMAX devices have advantages such as low power, small volume, low cost, so when it is applied in the insulation on line monitoring system, it gives a great convenience to the installation and maintenance of the on line monitoring devices, and also fulfills the plug&play function on the smart sensor.

### FUTURE WORK

The next immediate step of this research project is to test performance of the sensors and the platform itself in a wide variety of field conditions. Ultimately, the WSN will have to work in many different environments with many different cable configurations. Therefore, the miniaturization and the improvement of electro-mechanical performance of WSN are important areas of further research. The use of energy scavenger, in the framework of WSN, is also an important direction of future work.

### Acknowledgements

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### GLOSSARY

WSN: **W**ireless **S**ensor **N**etworks

WIMAX: **W**orldwide **I**nteroperability for **M**icrowave **A**ccess