Latex Research Paper

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Summary

LATEX is a programming-based simple and easy approach for producing a document directly in the dvi or pdf format. LATEX can be used for preparing letters, applications, articles, reports, publications, theses, books, or anything of that kind. One of the major advantages of using LATEX is that manual formatting of a document, as usually required in many word processors, can be automated in LATEX. Therefore, the possibility of committing any mistake in formatting a document can be avoided, such as in numbering and referring items (sections, tables, figures, equations, or references), in choosing size and type of fonts for differentsections and subsections, or in preparing bibliographic list.

Further, LATEX has the provision for automatically generating various lists of contents, index, and glossary. The use of common word processors may be easier in preparing simple and small-size documents. But, the effort and time required in LATEX for preparing complicated and big-size documents are quite less than those required in other word processors. One can become expert in LATEX through a little practice. It can be realized that the preparation of only one academic dissertation would pay off all additional efforts required in learning LATEX.

Keywords—SCADA; SCADA system components; Distributed System; Wireless Communication Systems; IEEE 802.22.

I. 1. Introduction to LATEX

LATEX is a macro-package used as a language-based approach for typesetting documents. Various LATEX instructions are interspersed with the input file of a document, say myfile.tex, for obtaining the output as myfile.dvi or directly as myfile.pdf.

II. 2. How to prepare a LATEX input file?

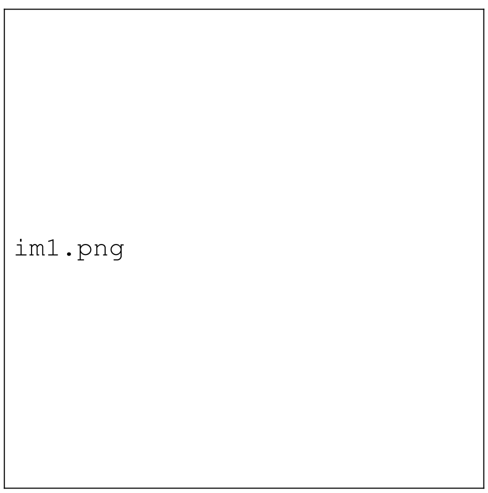
The SCADA system has gone through three generations and these are given below. First Generation: Monolithic: During the first time development of SCADA system, the model of computing is centered on a mainframe system which a single monolithic system is performing all computing functions connected with a given procedure. Networks were generally non existent and each centralized system stood alone. As a result SCADA systems were stand alone systems with virtually no connectivity to other systems. Second Generation: Distributed: The distribution of system functionality across network connected systems served not only to increase processing power but also to improve the redundancy and reliability of the system as a whole. Rather than the simple primary or standby failover scheme that was utilized in many first generation systems, the distributed architecture often kept all stations on the LAN in an online state all the time. For example, if a Human Machine Interface (HMI) station were to fail, another HMI station could be used to operate the system without waiting for failover from the primary system to the secondary.

III. 3. How to compile a LATEX input file?

There are many wired and wireless communication media can be used for communications in SCADA systems such as twisted pair metallic cable, coaxial metallic cable, fiber-optic cable, power line communication, satellite based, modern cellular network based systems etc. We think among them fiber-optic cable system, offers unlimited bandwidth and high channel capacity relatively, for SCADA system is a very technically smart solution. Although fiber-optic cable system is too expensive to use, it offers two benefits largely. Firstly it can carry a vast amount of data easily. Secondly, it can offer fast accurate real time communication. Again, it is serious concerns about economic, reliability as well as flexibility in many cases for using the fiber-optic cable system for SCADA. If the data is being small it is also wasteful. When the fiber-optic cables are cut or broken there high amount of maintenance is required and as the cable is passing through the underground, the repairing and findings consumes a lot of time, in many times it is very difficult to find out if it is situated in dangerous or difficult locations especially for rural remote areas. Therefore, with compared to wireless communication systems to wired fiberoptic cable system, wireless communication offers large benefits likes low installation costs, secured communication, easily maintenance, mobility etc. A comparative analysis is shown in later.

IV. Cognitive Radio Based IEEE 802.22 Standard

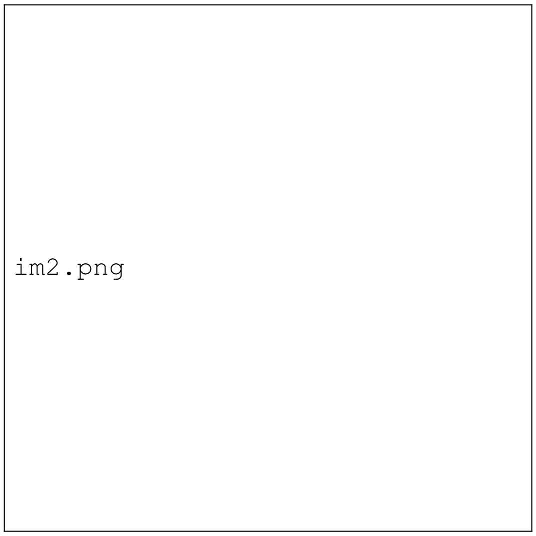
In May 2004, United States Federal Communication Commission (FCC) issued a Notice of Proposed Rulemaking (NPRM) for permitting unlicensed radio transmitter to operate in broadcast Figure 1. IEEE 802.22 System architecture television spectrum at locations where that spectrum is not being used [3]. In response to the NPRM, the IEEE 802.22 working group on Wireless Regional Area Networks was formed in October 2004. Its main objective is to develop a Wireless Regional Area Network system that would deliver broadband connectivity to all particularly to rural areas by sharing the television spectrum. By May 2006 draft v1.1 [4] of the IEEE 802.22 standard was available although much works are still required. Discussions need to be done with broadcasters whose spectrums are being shared as they are fearful of interference and reduced revenues from advertising. According to FCC rules, the cognitive devices have to be operated within the very high frequency (VHF) channels and the ultra high frequency (UHF) channels [5], therefore, the CR based IEEE 802.22 uses 54 to 862 MHz TV band. The standard was expected to complete by the first quarter of 2010 where some of the first networks could then be deployed. Table I summarizes the characteristics of the IEEE 802.22 WRAN standard.

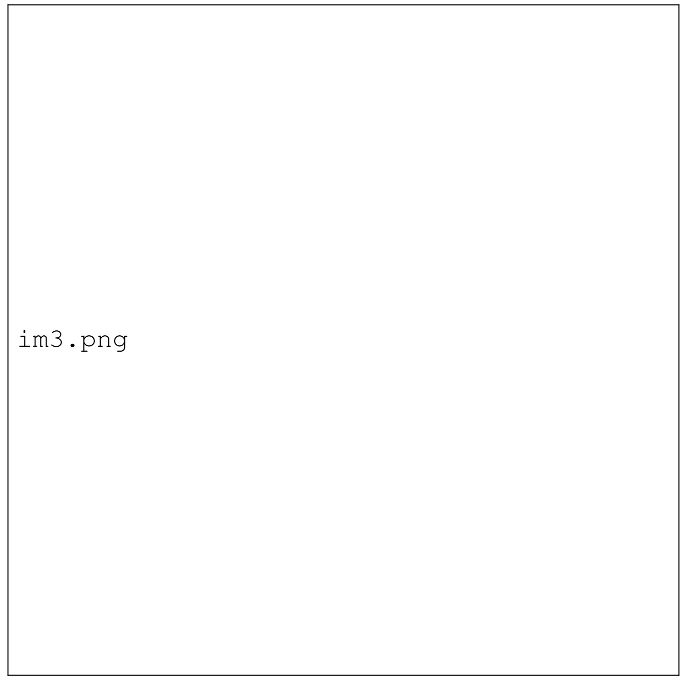


V. Concept Design for IEEE 802.22 Based SCADA System

IEEE 802.22 based system is like to present 3G UMTS and WiMAX technologies as it has a base station and a number of users or customer premises equipments which are located within a cell. A base station is linked to the main network and transmits data on the downlink or downstream to the users or receivers. In IEEE 802.22 based SCADA system the human machine interfaces (HMI), supervisory control rooms, SCADA server rooms, remote terminal units (RTU), master terminal units (MTU), intelligent electronic devices (IED) etc. are situated within one or more cells, depicted in figure 2. The control center houses a control server (MTU) and the communications routers. Other control center components include the HMI, engineering workstations and the data historian which are all connected by a Local Area Network, it may be wired or wireless. The control center collects and logs information gathered by the field sites, displays information to the HMI and may generate actions based upon detected events. The control center is also responsible for centralized alarming, trend analyses and reporting. The field site performs local control of actuators and monitors sensors. Field sites are often equipped with a remote access capability to allow field operators. Standard and proprietary communication protocols running over serial communications are used to transport information between the control center and field sites using IEEE 802.22 standard. Here for data transmitting and receiving all SCADA components are networked through IEEE 802.22 based standard. It is also control the medium access and perform traditional roles as in the conventional systems. Besides that it also manages the cognitive radio aspects of the SCADA system. The base station uses the equipments of SCADA system to perform distributed measurement of the signal levels of other signals on various channels at their current position. These measurements are reported to the base station and decide which frequency, channel or transmission power to be used. It provides the ability to select the best available channel. The basic functions can be summarized as follows, spectrum sensing which Detects vacant spectrum and sharing the spectrum without harmful interference with primary users, spectrum management which captures the best available spectrum to meet user communication requirements, spectrum mobility which maintains seamless communication requirements during the transition to better spectrum and spectrum sharing which provides the reliable spectrum scheduling technique among coexisting users. The coverage area for the IEEE 802.22 is much greater than other IEEE 802 Local Area Network/Metropolitan Area Network standards. IEEE 802.22 standard specified that the range for equipment is 33 km and in some instances base station coverage is extended to 100 km.

As a result, SCADA system is covered about 100 km. For large scale SCADA system it has to set up base stations greater than one. For mini SCADA it is acceptable. Then, to achieve the 33 km distance, the power of the customer premises equipment should be 4 watts effective radiated power relative to an isotropic source. This system has been defined to enable users to achieve performance similar to Digital Subscriber Line (DSL) services. This eventually gives the download speed of about 1.5 Mbps at the cell edge and an uplink speed of 348 kbps.





A. Communications Topologies

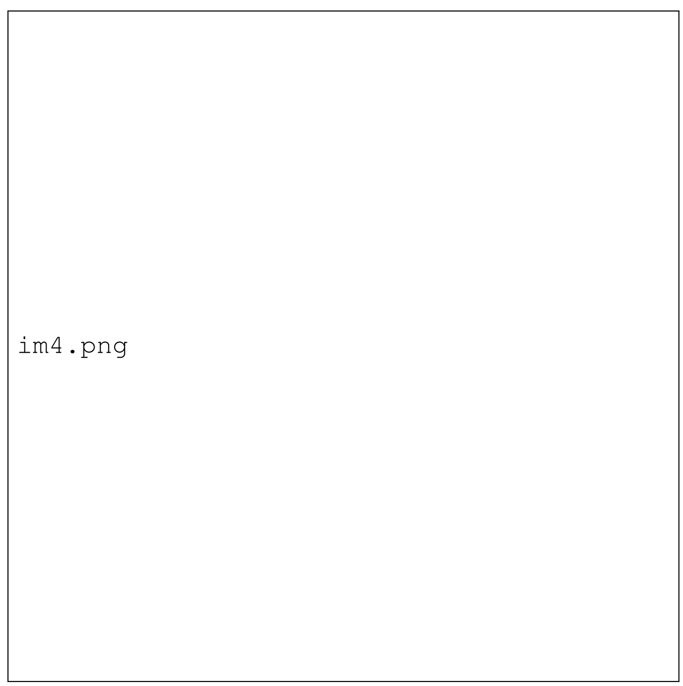
MTU-RTU communication architectures vary among implementations. The various architectures can be used, including point-to-point, series, series-star and multi-drop, are shown in Figure 4. Point-to-point is functionally the simplest type. However, it is expensive because of the individual channels needed for each connection. In a series configuration, the number of channels used is reduced. However, channel sharing has an impact on the efficiency and complexity of SCADA operations. Similarly, the series-star and multi-drop configurations' use of one channel per device results in decreased efficiency and increased system complexity. The four basic architectures shown in Figure 4 can be further augmented using dedicated communication devices to manage communication exchange as well as message switching and buffering. Large SCADA systems, containing hundreds of RTUs, often employ sub-MTUs to alleviate the burden on the primary MTU. This type of topology is shown in Figure 5.

B. Spectrum Sensing

Spectrum sensing, vital part of SCADA communication system using IEEE 802.22, involves observing the radio frequency spectrum and processing the observations to determine if a channel is occupied by a licensed transmission. Spectrum sensing is included as a compulsory feature within IEEE 802.22. In IEEE 802.22 both the base station and equipment sense the spectrum for three different licensed transmissions such as analog television, digital television and licensed low power auxiliary devices.

C. Air Interface

The evident and most critical requirement for the IEEE 802.22 air interface is flexibility and adaptability, since IEEE 802.22 operates in a spectrum where incumbents have to be protected by all means. Also, because the standard operation is unlicensed and a base station serves a large area, coexistence amongst collocated IEEE 802.22 cells is of paramount importance.



D. The Physical and Medium Access Control Layer

The PHY layer maintains a high degree of flexibility for meeting the system requirements [4]. The first characteristic is the modulation type. An OFDM system has been adopted because of the resistance against multi-path propagation and selective fading. Further, the system provides high level of spectrum efficiency and sufficient data throughput. To provide access for multiple users, OFDMA is used for both upstream and downstream data links. IEEE 802.22 allows a variety of modulation schemes to be used within the OFDMA signal such as QPSK, 16-QAM and 64-QAM can all be selected with convolution coding rates of 1/2, 3/4 and 2/3. In order to meet the requirements for the individual users that may be experiencing very different signal conditions, it is necessary to dynamically adapt the modulation, bandwidth and coding on a per SCADA components basis. In order to be able to obtain the required level of performance, it has been necessary to the IEEE 802.22 to adopt a system of what is termed "Channel Bonding". This is a technique where the IEEE 802.22 system is able to utilize more than one channel at a time to provide the required throughput.

E. Duel-Radio for Real-Time Dedicated Communication

Some questions are arrived like possibility of real-time dedicated and secured communication in SCADA's communication system using IEEE 802.22 as SCADA needs dedicated secured communication as well as real time. We can use two different architectures for communication purposes likes' primary radio and secondary radio. The primary radio can provide the wide area coverage due to good propagation of TV bands and in situation where there is more white space available in TV bands and/or the TV user density is small, it can effectively provide broadband access. Again for higher customer density and capacity requirements, availability of unused TV bands is low, can be called secondary radio for transmitting non-critical data, providing as a backup, security purposes or special circumstances. For both primary radio and secondary radio the real-time critical data transmission or emergency data transmission are difficult because of inherent sensing delays and cognitive nature defined IEEE 802.22. Therefore, for solution, we can use duel-radio architecture for secured real-time data transmission in SCADA where one radio chain is dedicated for data transmission and while the other is dedicated for spectrum sensing and here, the sensing radio constantly searches the availability of new channels, as a result, the other radio chain does not need to delay for data communication to search the unused bandwidth. Using this duel-radio architecture can offer high spectrum efficiency and accurate sensing than single radio architecture that need a small amount of time slot for spectrum sensing.

F. Scopes to Enhance the Performance

There are several scopes for enhancing the performance of cognitive radio based IEEE 802.22 standard [6] based SCADA's communication for power system. Here we describe three scopes only. First of all, we know the Base Station's coverage area of IEEE 802.22 standard is larger than other IEEE 802 based standards for example, the range of IEEE 802.16 WiMAX is limited to 5 km. For IEEE 802.22 the Base Station's coverage is 33 km during the power level of the equipments being 4 Watts Effective/Equivalent Isotropic Radiated Power (EIRP). If higher levels of power are allowed, this coverage area can be extended to 100 km, as a result, for wide area coverage the requirements of Base Stations being lesser. Secondly, the Cognitive Radio Systems can be implemented using re-configurable and re-programmable Software Defined Radio (SDR) technology for more flexibility, therefore, modifications through software upgrades are being easy. Thirdly, we think for duel radio communications have a soft limit of capacity because of it's opportunistically and dynamically usage of availability of TV channels for increasing the capacity of the system. To provide SCADA system components with a level of performance related to Digital Subscriber Line (DSL) broadband connections a total data rates of 18 Mbps in a 6 MHz TV channel defined by IEEE 802.22. For increasing the data rates up to 24 Mbps, the IEEE 802.22 physical layer has to utilize channel bonding and use more than one TV channels for transmitting and receiving purposes.

G. Comparative Study

SCADA system's communication can be designed by using modern cellular communication systems like GSM/GPRS [7], CDMA [7-10], 3G UMTS [11], IEEE 802.22 WiMAX [12], satellite based [13] and [14] etc. A comparison of characteristics of wireless technologies for SCADA system is given in table 2. From this study we can say that IEEE 802.22 is suitable for future SCADA system's communication for future distributed system.

H. Issues, Challenges and Future Study

There are a lot of threats [15] of SCADA system using IEEE 802.22 standard likes jamming of the channel used to distribute cognitive messages [16], malicious alteration of cognitive messages [17], masquerading of a primary user [18], malicious alteration of a cognitive radio node [17], internal failure of a cognitive radio node [19], masquerading of a cognitive radio node [17], hidden node problem [18] unauthorized use of spectrum bands for DoS to primary users [16], disruption to the MAC of the cognitive radio network [21], unauthorized use of spectrum bands for DoS to primary users [16], saturation of the cognitive control channel [22] and so on. Although IEEE 802.22 based wireless networks are promising, there are still problems and difficulties in building it such as avoiding interference to primary networks, performing collaborated spectrum sensing among secondary users, establishing links between secondary users, routing among secondary users dynamically, improving the throughput of the entire secondary networks, difficulties on the node implementation include but not limit to system design, synchronization among the whole networks, collaboration and participation among hardware, firmware and software, algorithm optimization, data conversion from floating point to fixed point, firmware or software architecture, code optimization for real-time implementation, system debugging. All of the above questions and issues need to be answered in the future research.

VI. Design for Distribution Monitoring and Control

In this section we show a design for distribution monitoring and control for large scale based on IEEE 8022.22. Figure 6 shows an example of a SCADA system implementation. This particular SCADA system consists of a primary control center and three field sites. A second backup control center provides redundancy in the event of a primary control center malfunction. Point-to-point connections are used for all control centers to field site communications, with two connections using radio telemetry. The third field site is local to the control center and uses the WRAN for communications. A regional control center sits above the primary control center for a higher level of supervisory control. The corporate network has access to all control centers through the WRAN and field sites can be accessed remotely for troubleshooting and maintenance operations. The primary control center polls field devices for data at defined intervals (e.g., 5 seconds, 60 seconds etc.) and can send new set points to a field device as required. In addition to polling and issuing high-level commands, the SCADA server also watches for priority interrupts coming from field site alarm systems.

VII. Design for Railway System Monitoring and Control

In this section we have shown a design for distribution monitoring and control for large scale based on IEEE 802.22. Figure 7 shows an example implementation for rail monitoring and controlling. This example includes a rail control center that houses the SCADA system and three sections of a rail system. The SCADA system polls the rail sections for information such as the status of the trains, signal systems, traction electrification systems and ticket vending machines. This information is also fed to operator consoles within the rail control center. The SCADA system also monitors operator inputs at the rail control center and disperses high level operator commands to the rail section components. In addition, the SCADA system monitors conditions at the individual rail sections and issues commands based on these conditions e.g. shut down a train to prevent it from entering an area that has been determined to be flooded based on condition monitoring.

im5.png

VIII. Conclusion

A SCADA system is a communication and control system widely used for monitoring, operation and maintenance of energy infrastructure grids, industries etc. This SCADA system we can also use in power system using IEEE 802.22 standard [23].

Acknowledgements

Thank You