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ENHANCEMENT IN WHEEL IMPACT LOAD DETECTOR SYSTEM USING WIRELESS SCADA

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ABSTRACT

Wheel Impact Load Detector (WILD) is a technique used for measuring impact load of technique. Based on the modern requirements of the WILD system the Wireless SCADA system may has a great role in measuring and transmitting the information related to impact load. SCADA (Supervisory Control and Data Acquisition System) is a particular protocol in which the data is acquired as well the data can be controlled using the GUI designed on PC. A SCADA system involves the integrated technologies of computer, communication, electric devices etc. By using IEEE802.22 SCADA system real time signal is obtained. Wireless SCADA deals with the creation of an inexpensive, yet adaptable and easy to use SCADA device and infrastructure using the mobile telephone network, in particular, the General Packet Radio Service (GPRS).. From the wireless SCADA system which is proposed in setup the real time signal of impact load can be measured. If any abnormal signal is found then the SCADA system will send a message through GPRS on mobile number.

Keywords: *SCADA, WILD, PLC, Automation, Sensors, Impact load.*

I. INTRODUCTION

WILD is an unmanned intelligent trackside data acquisition system that measures the dynamic impact load of wheels on the rail. WILD is a Wayside system with reliable 24x7operation without Manual intervention. It Provide Automatic Identification of Train and Automatic Measurements. Impact load measurement & impact load factor (ILF) measurement of all wheels. It has automatic transfer of report & analysis to Railway Control Office/Train Examining Station through GPRS. By using IEEE 802.22 SCADA system a real time signal of impact load can be obtained and its transmission is also done by this. It offers extensive coverage area of 33–100 km due to the good propagation characteristics of TV bands. WILD system transfer data through OFC links which is expensive by using SCADA system and its wireless communication has large benefits likes; low installation costs, secured communication, easily maintenance, mobility etc can be done.

II. WILD SYSTEM COMPONENTS

Components used in WILD system before its enhancement:-

- Instrumented Rails
- Train Trigger Sensor
- Instrumentation Panel
- Signal conditioning unit/module
- Impact Load Analyser Software
- Wireless data transfer Modem
- Power Unit
- Calibration Setup

Components used in WILD system after its enhancement:-

- Instrumented Rails
- Train Trigger Sensor

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- Instrumentation Pane
- Impact Load Analyser Software
- IEEE 802.22 SCADA system
- Power Unit
- Calibration Setup

III. ARCHITECTURE OF WILD SYSTEM AFTER ENHANCEMENT

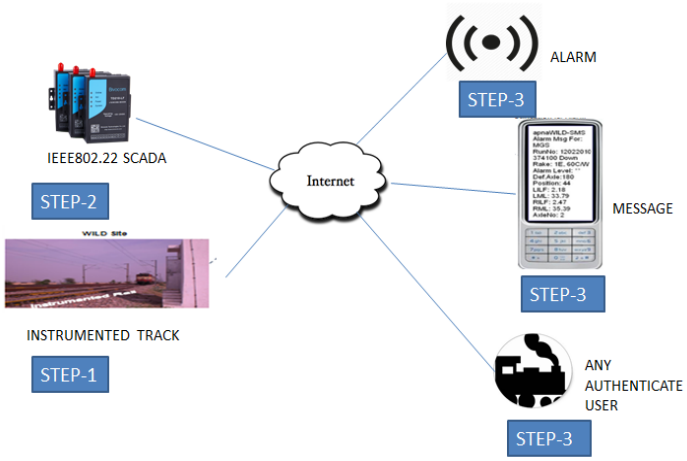

Figure 1: Architecture of WILD System

Tracks are instrumented with strain gauges to measure the load pattern of the wheel on the rail. The track consists of 18 Strain gauge measuring channels. Each channel has a full bridge consisting of 4 Rosette type strain gauges.Signals from strain gauges are connected to signal conditioning unit. There is aInbuilt surge protection to meet harsh field conditions.Real time embedded controller analyses the conditioned signal and prepares the summary report for publishing in the website.Each channel produces a portion of load profile for all the wheels**.** Accumulating all the data, a complete load profile of the wheel is obtained**.** Any abnormality in the load profile is analysed to detect the flat wheel and overloaded wagon.Each channel produces a portion of load profile for all the wheels**.** Accumulating all the data, a complete load profile of the wheel is obtained**.** Any abnormality in the load profile is analysed to detect the flat wheel and overloaded wagon.

Working of wild system

Each channel produces a portion of load profile for all the wheels.

Accumulating all the data, a complete load profile of the wheel is obtained. The maximum load detected by the channels is primarily used to flag the defective axle/wheel. As the Train passes over the instrumented rail, the data is collected and analyzed through IEEE802.22 SCADA system.The data collected is tested, all extraneous noise removed and the pure raw data analysed.Analysed data is converted to a report form and sent through GPRS network to central Server. A PC in Control room (or anywhere as desired) continuously scans for report every 5 minutes/lesser and displays the newest report as and when released by the system. If defective axles found, an audio visual alarm is activated through GPRS on mobile phone and on system of authentic user. All reports can be viewed and consolidated period wise in the dedicated website.

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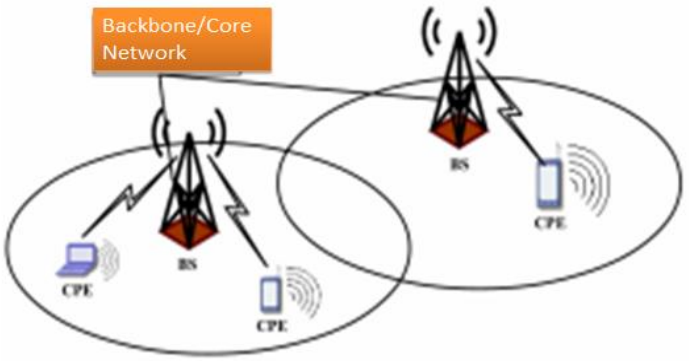
IV. ARCHITECTURE OF IEEE802.22 SCADA SYSTEM



The SCADA system consists of several equipments such as Intelligent Electronic Devices (IED) Human-Machine Interface (HMI), Remote Terminal Units (RTU), Programmable Logic Controllers (PLC), Data Historians, Input/Output Servers, SCADA Server or Master terminal Units (MTU), Control Server, power equipments, substation controllers etc.IEEE 802.22 is based on orthogonal frequency-division multiple access (OFDMA). It gives variety of advanced communications technique. It allows a variety of modulation schemes to be used within the OFDMA signal such as QPSK, 16-QAM and 64-QAM and it all be selected with convolution coding rates of 1/2, 3/4 and 2/3.

IEEE 802.22 system is able to utilize more than one channel at a time means it is able to do multi-functioning. It has daul-radio architecture for secured real-time data transmission in SCADA one radio chain is dedicated for data transmission while the other is dedicated for spectrum sensing. For IEEE 802.22 the Base Station's handling area is 33 km during the power near of the equipments being 4 Watts Effective/Equivalent Isotropic Radiated Power (EIRP). If higher levels of power are acceptable, this coverage area would be extended to 100 km, as a result, for broad area coverage the necessities of Base Stations being less. The Cognitive Radio Systems can be fulfilled using re-configurable and re-programmable Software Defined Radio (SDR) technology for more elasticity. It is having a channel bandwidth of frequency 6 to 8MHz.

It has a Channel capacity of 18Mbps with user capacity of Downlink: 1.5 Mbps and Uplink: 384 kbps. In IEEE 802.22 there are three different types of licensed transmissions such as analog television, digital television and licensed low power auxiliary devices. It is based on real time dedicated and secured data. This system can do multiple functions of indian railways including WILD for example status of the trains, signal and systems, traction electrification systems and ticket vending machines.

Working of IEEE802.22 SCADA system
IEEE802.22 SCADA systems base station having 30 UTMS and WiMAX technologies, this technology is used to provide ease to customers/users. All these base stations are linked with main station and provide communication to transmitter and receiver. These main stations logs all information collected by base station from field sites, it sends all data to HMI for further action based on detected system.

The another function of control center is to provide centralized alarming, trend analyses and reporting of all information, in addition with this it also having a remote access capability of field sites. It system provide selection of cognitive radio aspects so that the system can perform distributed measurement of signal levels of recorded signal and decide which frequency channel or transmission is to be used it provide ability to select best channel.

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V. SOME BASIC FEATURES OF IEEE802.22

- Communications Topologies: The structure of MTU/RTU can used different architectures. Point to point and series to series architecture can be used here. The point to point architecture is used for simplest type but in this individual channels are required and in series to series type architecture the number of channels are reduced.
- Spectrum Sensing: Spectrum sensing is one of the important part of SCADA communication. In IEEE802.22 spectrum sensing of both base station and equipment sense the spectrum of three types that are analog television, digital television and licensed low power auxiliary devices.
- Air Interface: The most critical requirements of IEEE802.22 is flexibility and adaptability because the standard operation is unlicensed and a base station serves a large area, coexistence amongst collocated IEEE 802.22 cells.
- The Physical and Medium Access Control Layer: The PHY layer maintains a high degree of flexibility for meeting the system requirements . 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.
- Duel-Radio for Real-Time Dedicated Communication: SCADA IEEE802.22 requires a secured communication as well as real time. Here we can use two different types of communication i.e primary radio and secondary radio. The primary radio provide this system a wide area coverage, but for large number of users requirements and availability of unused TV bands is low for fulfilling this we require secondry radio for 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 of IEEE 802.22.
- Scopes to Enhance the Performance: It enhance the performance of system by providing it a re-configurable and re-programmable Software Defined Radio (SDR) technology for more flexibility. Using dual radio communication helps system to have a soft limit of capacity due to dynamically availability capacity of system.
- Comparative Study: SCADA system's communication can be designed by using modern cellular communication systems like OSM/OPRS [7], CDMA [7][8][9][10], 30 UMTS [11], IEEE 802.22 WiMAX [12], satellite based [13] and [14] etc.

Advantages of using IEEE802.22 in wild system

i. It provide fast communication to WILD system.
ii. Other works of railway like status of train, track electrification and ticket vending can be done through this.
iii. This system is more flexible than previous one.
iv. It will give alarms when found some fault.
v. This system is more realible than previous one.

Disadvantages of using IEEE802.22 in wild system

The disadvantages of using IEEE802.22 in Wheel Impact Load Detector system are:

i. It has a limited range of 33Kms to 100Kms.
ii. It's installation process is time taking.

VI. CONCLUSION

SCADA communication system based on IEEE 802.22 standard has been designed and also shown its feasibility, benefits, issues etc. There are some benefits of using this system such as cost effectiveness, overcome the present limitations, efficient usage of new technology, controlling and real-time monitoring any large or medium scale system which is situated also in the rural or remote areas, highly reliability, flexibility etc.

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REFERENCES

1. wireless systems, IEEE 802.22, SCADA system, distributed system, supervisory control and data acquisition, contemporary power systems, integrated technologies
2. IEEE 802.22, SCADA, SCADA system components, Distributed System, Wireless Communication Systems
3. http://www.apnatech.com/railways/wheel-impact-load-detector