

# Coverage Area Expansion of WiFiRe & Wireless Sensor Networks using co-ordination free Repeater Groups for Agriculture

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**Abstract**—WiFiRe stands for Wi-Fi- Rural extension [1]. This license free wireless technology is very useful to provide broadband to rural household. It is equally useful for agriculture. Wireless sensor networks [WSN] is the promising technology for instrumentation and control. The sink in WSN is the major node and can be implemented in smart phone [2]. But to increase the coverage area and to reduce the complexity in operation, repeater nodes are useful [3]. Here we have suggested the model in which the mobile phone based sink controls the sensor actuator network and broadband provided by WiFiRe helps in context aware water irrigation.

**Keywords**—Repeater group, wireless sensor network.

## I. INTRODUCTION

Agriculture may be defined as an integrated system of technique control the growth and harvesting of crops. How to improve the productivity and irrigation area in the available water is a good tread off.

The smart decision in irrigation depends upon the ambient temperature, soil temperature, water holding capacity of the soil, humidity etc. Types of crops, growth and productive status of that crop also are the deciding factors in irrigation.

Context aware computing means sensing the context and other input channels, taking smart decision and feedback tracking from the context. Agriculture is a very rich context aware domain. Context aware solution in agriculture is the next step of the precision agriculture.

The smart phone based mobile sink is possible for WSN [2] and use of this sink in the context aware model for irrigation control has been explain in [4].

Wi-FiRe is the combination of Wi-Fi (IEEE 802.11b)and WiMAX (IEEE 802.16), and is very useful and viable in rural area [1]. Wireless extension of WiFiRe in the agriculture field is possible using co-ordination free repeater groups [3]and radicallynew architecture [5]. It is also possible to increase the range and reduce the complexity of wireless sensor network which is useful in agriculture.

A repeater group is a coordinated group of sensor nodes placed close to the destination node [3]. The group is responsible for receiving in coming packets & members jointly ensure that this packet is received by a destination node with high probability. The repeater group concept can be regarded as a practical co-operative diversity scheme [23],[24] with additional consideration of node sleeping cycles and transmit/receive operation carried out by the same group of nodes.

A new breed of low-latency, high-bandwidth application such as web based application and video

conferencing is also possible in a rural area. But to maintain the cost, license free technology such as WiFiRe is useful to provide such kind of application in agriculture. The license free nature of the WiFiRe spectrum (IEEE 802.11b, 2.4GHz Band) and the easy availability of Wi-Fi RF chipset are two major reasons behind the selection of this technology for rural and agriculture purpose. This paper proposes a system for automation of agriculture methods by integrating mobile phone and wireless sensor-actuator network. Along with the coverage area expansion in the large agriculture field has been suggested using coordination free repeater groups.

This paper also used the WiFiRe architecture and suggests the suitability of radically new architecture [5] for the extension of range of WiFiRe. The rest of the paper is organized as follows. In section II extended WiFiRe architecture for agriculture has been explained. In section III features of WiFiRe which are useful in agriculture & comparative analysis have been explained. The paper has been concluded in section IV.

## II. EXTENDEDWIFIRE ARCHITECTURE FOR AGRICULTURE.

Figure1 shows the wireless sensor repeater – mobile phone based MANET using WiFiRe.This model is excellent to control the agricultural parameters specially where water availability is very less. In the Indian agriculture, use of computers and grid computing are costly techniques instead of computers, the smart mobile phone is easy to use and installation of such model is cheap because of falling mobile prices. Also because of repeater group, network complexity getreduced and coverage area gets increased which are two important system design criteria.

### A WiFiRe System architecture

Wi-FiRe is an open standard defined by CEWiT [1]. Its main design goal is to enable the development of low cost hardware and network operations for outdoor communications in a rural scenario. It has 40 m tower at the base station (BS) near the fiber PoP(Point-Of presence) and 10-12 m poles at subscriber terminals (ST), in order to maintain the desired system gain of about 150 dB. The network configuration is a star topology as shown in figure 2[1].

There will be one fixed subscriber terminal (ST) in each village, which could be connected to voice and data



Currently there is a strong trend towards creation of heterogeneous systems, where users can use a variety of connectivity technologies. The emerging IEEE 802.21 [9] standard is devoted to a seamless handover between networks of the same or different types.

A new generation of MANETs with a radically new architecture has been proposed in [5]. Also using such type of architecture, high speed MANET is possible. Here we are suggesting the different license free band other than 2.4GHz to avoid the interference between WiFiReand MANET. Also the Two-way DF relaying scheme is an interesting approach for high speed WLANs to increase the coverage of a basic service set and to improve the spectral efficiency if there is often symmetric traffic [11].

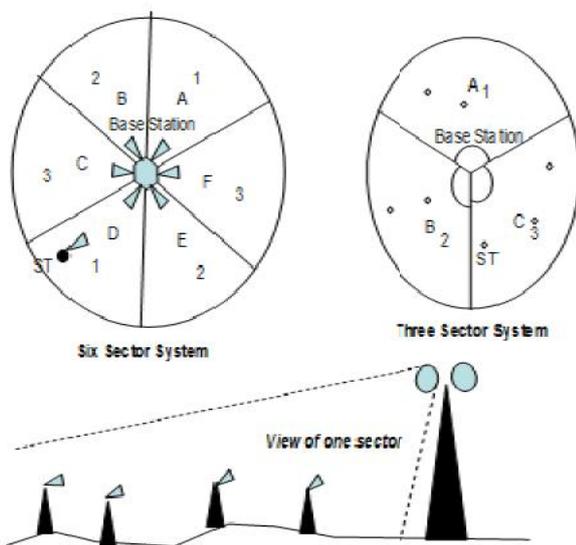


Figure 2: Network Configuration

Context aware computing required the ability of network to detect and offer response to environmental variation. It can be achieved by analyzing the user request and based upon that the data from the distributed data bases stored in the servers can queried. The relevant information can be retrieved and delivered to the users. Context awareness appears to be a fruitful idea for increasing the usability of web based services with mobile routers so that the client can access dynamic data as per requirement routed through the interface designed for users. For example Agricultural Universities as a service provider could be connected to the network, serving needs of the client with variety of information from various sources. This is a client sever base service where the client places the requested and the distributed data- base present in the server responds to the client's request to provide services that are appropriate to the specific people, place, time and event. Context awareness helps to get and utilize information about the physical situation in which user and their wireless

network is embedded in order to provide improvised services that are suitable to the specific users in the given interaction platform. Hence the information retrieved from the distributed database has to be achieved with minimum interactions. So the context-awareness facilities using WiFiRe is a very fruitful idea.

### III. FEATURES OF WIFIRE USEFUL IN AGRICULTURE AND COMPARATIVE ANALYSIS.

In future mobile cellular technologies may meet the technical specification but operate in the licensed bands which lead to increased cost while agriculture in developing countries needs low cost technology.

Proprietary broadband technologies typically have low volumes and high costs. While WiMAX (IEEE 802.16) still has low volumes and high costs at present. Wi-Fi (IEEE 802.11b) is an inexpensive local area broadband technology. It can provide 256 Kbps or more to tens of subscribers simultaneously but can normally do so only short distances (less than 50m indoors).

There are also commercial products which support long-distance WiFi links. While the protocols used by such products are proprietary.

While WiFiRe is an open standard and designed for higher spectral reuse through multiple carefully planned sectors of operation. Such reuse is estimated to achieve 3-4 times higher throughput performance with WiFiRe, it is estimated that one can support about 25 Mbps (uplink + downlink) per cell using a single Wi-Fi carrier at 11Mbps service. This would be sufficient for about 100 villages in a 15km radius. In a 15km radius some subscriber terminals (ST) can be given directly to the agriculture.

Some researcher have suggested that water conservation efforts should be primarily directed at farmers, in light of the fact that crop irrigation accounts for 70% of the world's fresh water use [26]. We can treat this irrigation control as a green technology because it also conserved the electricity required for water upliftment and distribution.

Some agricultural areas can afford the technology. Co-operative groups in agriculture can setup their own wireless network. Also diverted agricultural subsidy in technology can meet the viability gap.

### IV. CONCLUSION:

By extending the WiFiRe using high speed relay we can implement this license free technology in the agriculture field. It can help in water irrigation where wireless sensor network using mobile phone will control the water irrigation and poly house parameters using context aware model. The direct broadband in the agriculture field of remote areas will open the new market and reduce the "digital divide". It will help to change the socio-economical structure of developing country like India.

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