Monitoring of Environment using Wireless Sensor Networks

[1]Sunil Kumar, [2]Priyanka Bhutani

[1,2]Department of Electronics and Communication, Gurgaon Institute of Technology and Management, IEC College of Engineering and Technology

Email: [1]er.sunil12686@gmail.com, [2]bhutani.priyanka90@gmail.com

Abstract -**Sensor networks play important role for monitoring environment. Different sensor networks are used for monitoring environment continuously so that warning can be sent to the people before the disaster comes. It helps in predicting the upcoming disaster so that people can take early steps to prevent or minimize damage. It also helps in making strategy for disaster relief. If the people and administration know which disaster is coming, they will get sufficient time for taking preventive measures. The warning can be provided by internet, television, community FM and sirens etc.**

Keywords - Sensor network, Disaster Management, Disaster warning system

I. INTRODUCTION

Wireless sensor network has enabled the new communication services. Sensor networks are the most useful way to collect the various parameters and information needed by environments [1]. A sensor network is computing systemscomposed of a large number of sensor nodes that are denselydeployed to measure a specific physical environment factors. Sensor nodes work together to collect information about their surrounding environment, this may include parameters like temperature, pressure and humidity.

Sensor nodes communicate with one another over wireless low-bandwidth links and have limited processing capacity. As sensor networks improve our ability to measure real-time information in an accurate and reliable fashion to collect and analyze various parameters for better prediction of upcoming disaster.

Environmental monitoring is an important pre-requisite for disaster management. For instance, different aspects that can be studied are landscape, flooding alarm, pressure, microclimate and solar radiation mapping, and city meteorology. Environmental Sensor Networks have evolved from automated loggers that record data at specific intervals and require manual downloading by a maintenance team [2,4]. The sensor nodes can store data, make decisions about what data to pass on using base station or wired communication. Fig1 States the block diagram for Sensor network with base station to transmit interested data to sensor data processing center.

Each year, a number of natural disasters strikeacross the globe, killing hundreds and causing billions of rupees in property and infrastructure damage. Disasters cannot be prevented. But through proper warnings and after recovery procedures, the effects can be reduced.

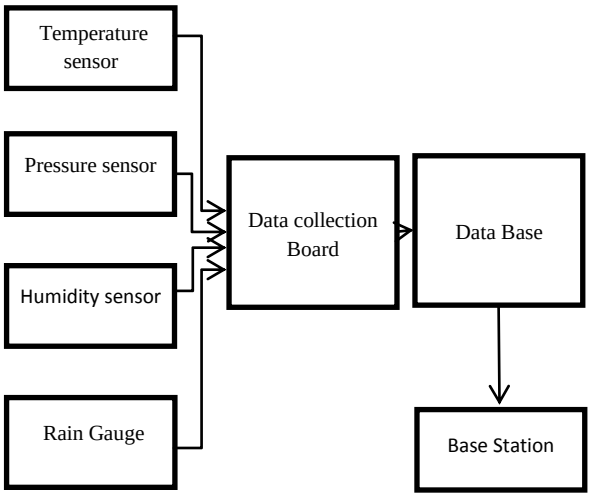

Fig. 1: Sensor Network with base station

The collapse of communications infrastructure is the usual effect of disaster, due to the collapse of antennas, buildings, power etc. But, immediately after the disaster, due to emergency, communications are vital [3]. The remainder of this paper is organized as follows: Architecture of Wireless Sensor Network is described in Section 2. Pre-Disaster Communication is described in Section 3. Section 4 details Post-Disaster Communication. Conclusion is discussed in Section 5.

II. ARCHITECTURE OF WIRELESS SENSOR NETWORK

Wireless Sensor Networks are collections of motes. Motes are the individual computers that work together to form networks. The requirements for motes are extensive. They must be small, energy efficient, multifunctional, and wireless. Collections of motes communicate with each other to reach acommon goal. For example, if the goal is to collect information about the microclimates around all sections ofredwoods in a forest, the motes are placed in the trees to form a network. Once placed, they collect and transmit data to each other, and eventually to a main computer. Due to interference from the surroundings and the mote's maximum broadcast range, not all of the motes placed around trees can communicate will all others. The mote's radios are designed to save as much power as

possible and therefore have a limited broadcast range. This range is approximately 30 meters. If the motes have a short radio broadcast range, and many motes are more than 30 meters off the ground, how can one collect data from the motes farthest away from the computer (or station)? Motes solve this problem by packaging their information and broadcasting it to multiple other motes, which then communicate with others, to find the most rapid or successful route for the information to travel to reach the main computer located elsewhere.

Motes communicate with each other using radio transmitters and receivers. They form networks with other motes that change with the positions of the motes. They create links with each other in different configurations to maximize the performance for each mote. These links all lead to the "parent" mote, which transmits the information from each of the "child" motes to whatever computer device is used to collect and process the data. Figure 2 illustrates one possible path data can travel between the outer motes and those close to the computer/station.

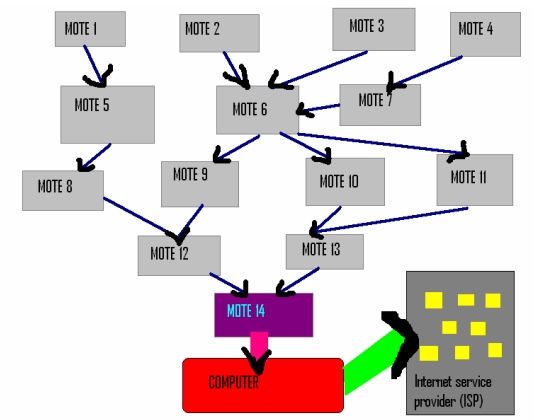

Fig. 2: The Motes 1 through 13 are the children motes (all the ones in light grey), Mote 14 is the parent(in purple). The "Computer" (in red) can be any type of computer such as PDA, laptop, etc. as long as it iscapable of accessing the internet via a specified ISP (the grey building with yellow windows). The arrowsconnecting the motes are not fixed, and to illustrate this, they are purposefully unorganized.

When the motes are linked together, they form parts of a machine with greater computational power than any of the individual parts. These "machines" of motes change with position and with conditions. Sometimes high moisture and other situations can affect broadcast abilities of many motes. Changes inconditions can make some connections stronger than they used to be, and others nearly impossible. The thinking capability within the network allows the pieces to reorganize in such a way that all motes will continue to be functional. When the motes are linked together, they form parts of a machine with greater computational power than any of the individual parts. These "machines" of motes change with position and with conditions. Sometimes high moisture and other situations can affect broadcast abilities of many motes. Changes in conditions can make some connections stronger than they used to be, and others nearly impossible. The thinking capability within the network allows the pieces to reorganize in such a way that all motes will continue to be functional.

III. PRE-DISASTER COMMUNICATION

Before the disaster, the main aim is creating a timely and accurate disaster warning. Sensors networks are employed in the areas that can be liable to a disaster and these sensors send information at regular intervals to the data processing center. For example, seismic sensors are used forearthquake related information. The information is sent by communication mediums such as wired, wireless or satellite transmission as shown in Figure 3.

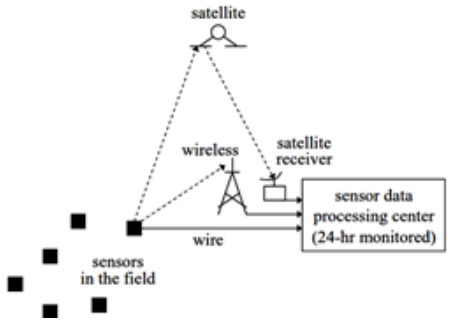

Fig. 3: Data transmission from sensors to the processing center

The sensor data processing center, which is being monitored by humans or computers continuously, analyzes the sensor data and makes a decision whether the signals are showing any pattern for any disaster. Then a warning can be issued if required. This decision is mainly done by humans and notautomated. If the decision of issuing warning has been taken, then the warning information will be distributed by the data processing center with no human involvement. The warnings can be sent to the individuals in the disaster area via television or by the use of alarms as shown in Figure 4.

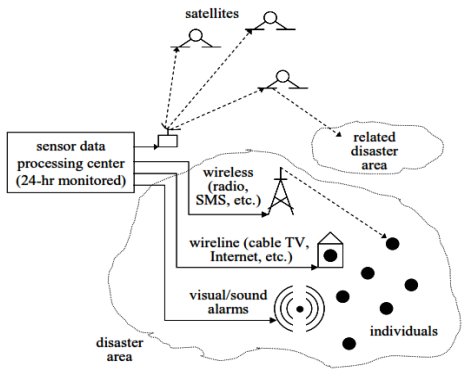

Fig. 4: Transmission of disaster warnings by different mediums

Some important problems just after disaster arenetwork congestion and Damage to telecommunications infrastructure which is to be handled with care so that relief can be sent as soon as possible.

IV. POST-DISASTER COMMUNICATION

It is done in two parts i.e. Improving congestion in emergency situation and Minimizing disturbance in communications due to damage of base stations [5].

Voice calls over the telephone network enable real-time communication being an important mean of other person's safety during disasters. However this creates congestion due to an enormous surge in voice call traffic. In this regard, some mobile phone carriers are taking steps to configure multiple switching equipment units which can support voice call reduced sound quality because due to this more users can use the system at such times. Designing robust networks to cope with congestion can be other solution.

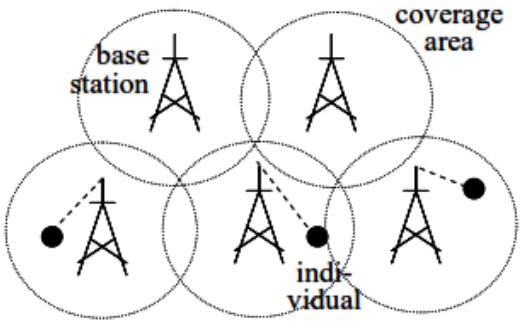

Fig. 5: Before the disaster (Small cells)

For minimization of the disturbance in communication that has been created due to damage of base stations, some solutions may be suggested as: Emergency repairs to damaged telecommunications infrastructure, Network sharing and collaboration between carriers, providing emergency information on special link.

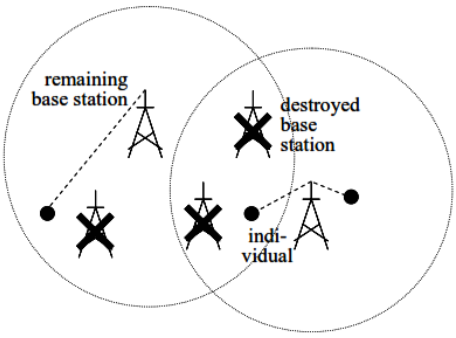

Fig. 6: After the disaster (Increase Cell size)

After disaster some of the base stations of cellular networks get affected, In that case we can utilize the remaining base stations by changing the transmission scheme for example different frequency band, higher power, etc. for larger coverage areas as shown in Figure 5.

If none of the base stations is in working condition then one possibility is to use satellite communication for each mobile by connecting each mobile with satellite directly as shown in Figure 7.

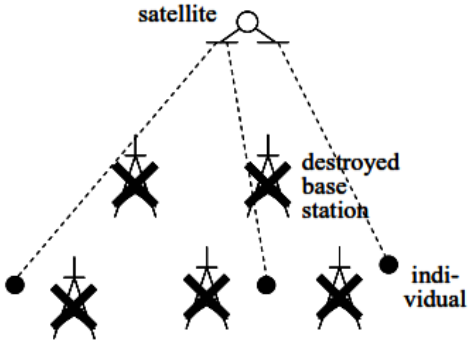

Fig. 7: Phone connected with satellite directly

V. CONCLUSION

Environmental Sensor Networks represent a new way to sense and understand the environment, which have a huge potential in many areas of the environmental sciences. Earth system and environmental scientists are playing a vital role to predict the upcoming disaster. Telecommunication researchers need to search for the alternate methods of communication after disaster.

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