Wireless network of seismic activity monitoring

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Abstract
Seismic activity is the cause of a lot of natural disasters, such as earthquakes, tsunami etc. That’s why it’s monitoring is extremely important part of providing human and social safety. Using seismic activity monitoring system allows to detect and warn about danger in time and therefore to prevent large number of victims and material losses.

Nowadays wired networks are used for the creation of such systems. This article outlines proposed wireless network of seismic activity monitoring which allows to increase safety and quality as well as simplicity and deployment efficiency.

1. Basics of sensor networks
Wireless sensor networks have significant advantages comparing to wired and can be used in wide range of industrial and civil areas such as industrial monitoring and control, machines and equipment monitoring, environmental monitoring, home automation and motion control, etc.

Wireless sensor network consists of spatially separated node intended for joint controlling of physical or environmental parameters such as temperature, sound, vibration, pressure and pollutants level.

In addition to one or more sensors each node in sensor network as a rule has RF-transmitter or other wireless connecting device, tiny microcontroller and a power source, usually a battery. The size of sensor node can vary from shoes box size to mote size. The price of sensor node also vary, from hundreds dollars to few cents, depending on size of integrated platform and complexity of required nodes. Size and price restrain sensor node through appropriate resource constraints, such as energy consumption, memory, computing power and channel capacity.

In wireless sensor networks two main topologies are used: star and mesh network.

Star is the topology with obviously dedicated center, to which all other nodes are connected. All information exchange goes only through a base station. In this case one cannot compare such different elements as nodes and base stations. Base station is the most powerful, and it is responsible for all functions of exchange management. No conflicts are possible in network with star topology because exchange management is fully centralized.

In mesh network each node can be an independent router without regard to connecting to other network. It allows to provide constant connection and reconfiguration of damaged or blocked ways from node to node for achievement to the destination. One of disadvantages of such network is reduced mobility by restricting of minimal density of network.

Taking into account the above mentioned topologies and required needs which the network has to satisfy, the most suitable for the system architecture is the star topology.

2. How the proposed network works
Monitoring system consists of two main types of working elements: a sensor node (fig. 1) and a base station (fig. 2).

![Fig.1. Sensor node block diagram](image)
Sensor node (fig. 1) consists of sensor S (fig. 3), microcontroller µC, frequency generator FG [1] (fig. 4), modulator M, electronic switch Sw, transmitter Tx, receiver Rx and antenna.

Base station (fig. 2) consists of microcontroller µC, which can be connected to PC using USB interface, frequency generator FG (fig. 5), modulator M, transmitter Tx, receiver Rx and antenna.

The system works as follows.

Base station microcontroller (fig. 2) submits to the frequency generator (fig. 4) controlling voltage which corresponds to one of the sensor nodes. As a result, varicap changes capacity and in accordance the generated frequency is changed. At the modulator M a control signal is submitted. This signal turns on sensor node. After modulation resulting signal goes to transmitter Tx, which transmits signal on sensor node using radio.

Sensor node receiver Rx (fig. 1) has an oscillatory circuit which is set on the appropriate frequency. If the signal, which is transmitted from the base station, corresponds to receiver frequency, modulated signal goes from the receiver to the electronic switch Sw, which turns on output cascade of the transmitter Tx. Sensor S, microcontroller µC, frequency generator FG (fig. 3) and modulator M are working constantly. When output cascade of the transmitter Tx is turned on, sensor node is transmitting signal to the base station.
Base station receives signal from the corresponding sensor node and changes transmitting frequency to check the next node. The cycle continues until all sensor nodes are checked.

Sensor node works using power supply scheme which consists of accumulator battery and solar battery connected in parallel.

In case when the according node does not answer after some time, the base station submits alarm signal to PC which tells about required sensor node replacement. If signal power, which is received from sensor node, is less than minimal, base station submits alarm signal which tells about required sensor node diagnosis.

Sensor node checking is performed after definite time intervals or on demand of user from PC.

Bibliography


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