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# A FIELD WLAN FOR AGRO-METEOROLOGICAL DATA COLLECTION

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***Abstract*** *- Planning remote sensing experiments involves acquisition of airborne and in-situ data of the studied objects. The in-situ gathered data provides additional information that is helpful in establishing ground control points by GPS, measure the meteorological conditions, moisture. The last two parameters are of vast significance when monitoring vegetation cover and soil conditions. The proposed telemetric system consists of distributed network stand-alone field measuring devices. The main components are the autonomous, battery-powered microcontroller operated devices. The network has flexible structure that can be changed easily in order to meet the requirements of different type applications such as commands and data exchange between field-based devices.*

## *Introduction*

Sensor networks are an exciting class of computing systems that combine distributed sensing, computation and wireless communication. This technology is touted as being as disruptive and enabling as the Internet, with broad applications such as monitoring public exposure to contaminants, managing land use and supporting safer structures.

Since the Internet transformed the way in which individuals and organizations interact with each other and the virtual world the embedded systems also followed that model. Sensor networks combine the wireless technologies that have revolutionized communications with sensor technologies that have revolutionized industrial technology. Micro sensors, on-board processing and wireless interfaces can now be integrated at a very small scale, and at relatively low power, to enable up-close monitoring of a wide range of physical phenomena, thereby enabling spatially and temporally dense environmental monitoring.

Across this wide range of applications, sensor networks promise to reveal previously unobservable phenomena and might eventually help us understand and manage an increasingly interconnected and fragile physical world.

This technology presents many challenges and has captured the attention and imagination of researchers around the world. Sensor network systems now comprise many distributed elements, often deployed in physically difficult environments. Consequently they will need to be adaptive and self-configuring in order to operate autonomously for long periods of time in dynamic, heterogeneous environments. Perhaps the greatest challenge is that deployed systems will need to exploit increasing amounts of intelligence inside the network in order to scale up. In particular, as the number of sensing points increases it will be infeasible to run these systems by bringing back every sensory input to a centralized location for human inspection or computer processing. Instead, deployed systems will need to process the sensor data close to where the data are observed, and thereby filter out the interesting events from the uninteresting ones.

Embedded sensor networks will increasingly exploit motion in addition to sensing. By introducing even small amounts of mobility into these observing systems, their coverage and effectiveness can increase tremendously. This holds true for both imagers and communication antennae (consider how your field of view is increased with small movements of your eyes or neck, or how your cell phone reception is improved with very small movements of orientation or position). We have several projects under way that exploit robotic technology to support high-density sensing and sampling in both air and water. For example, to determine the preconditions for the development of harmful algae blooms in our marine biology application, robotic nodes move around on the water surface and autonomously collect samples of microorganisms at both the water surface and below which can then be correlated with sensed environmental micro conditions.

As these dense monitoring systems are deployed they will present tremendous opportunities for integration with remote sensing capabilities. Establishing “ground truth” for interpretation of remote sensing images is an obvious application. However, the possibilities also include real-time adjustment of in situ assets, position, focus, attention and so on, in response to more global phenomena observed via remote sensing.

Although significant information technology research and development is needed to realize the potential of this technology (in particular in areas such as robustness, scaling, data integrity, data fusion, as well as additional sensor development), we are now at the point where we can begin applying early versions of these dense sensing and mobile technologies to engineering and commercial applications. The technology developed to characterize contaminant transport in soils and microorganisms in aquatic environments has direct applicability to precision agriculture and water quality monitoring worldwide. In addition, the structural and seismic monitoring technologies, now being used to model structural response, will be applicable to monitoring structural safety.

It is easy to see that the integration of geospatial information and mobile Internet is inevitable, which is simultaneity driven by market demands and technologies. The developed system is considered as first step in implementation of mobile GIS on test sites. At this stage the network will complement the existing GIS database with field data (e.g. temperature, moisture, GPS data, etc.), but in the near future it could serve as communication backbone in future requests to thematic layers in the GIS.

## *IMPLEMENTATION*

The field network system comprises of two communication media units:

- first of them is RF transceiver working on one of two fixed frequencies 433.9 MHz or 418 MHz (ISM in Europe and England) with power output 10 mW, which covers up to 300 m open ground area.
- the second one is powerful RF transceiver, which is working on free programmable frequency between 150 MHz and 180 MHz with power output up to 30W. Both of the units support different type of serial wire connections like RS232 and RS485, etc. in order to be connected to single device or in a network.

The first unit performs the data collection from all micro sensors in its range, thus forming single node of the network, and the next unit is servicing the all nodes of the network acting as long term storage and central communication device. Requests for data retrieval are made from the GIS station to it.

Data rates and structure:

The “in-house” developed data exchange protocol complies with the 7-layer OSI model. The commands and data are transferred between the units in the network on

packages, which contain up to 208 Bytes information. The data rates are as follows: up to 115,2 kbouds at wire communication, up to 50 kbouds at short range wireless communication and up to 4 kbouds at long range communication. Central computer running real-time operating system Windows CE is taking care for data archiving from the experiment and the control of the network. Requests to it could provide end user with information from any node of the network.

The approach adopted during the design phase of the system presents one serious advantage – this system is completely autonomous and relies only on its own resources. Similar data transmission networks usually rely on the existing GSM cells (Wang, 2004) and are not reliable as the proposed one. Moreover the used directional antenna between the points communicating in 150MHz range provides additional independence and security.

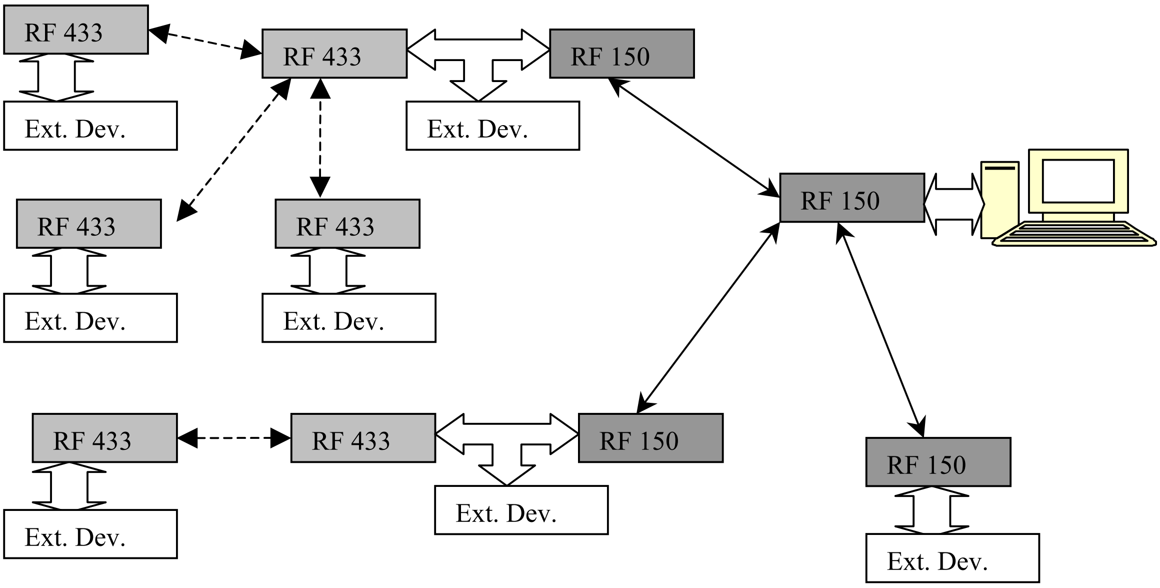
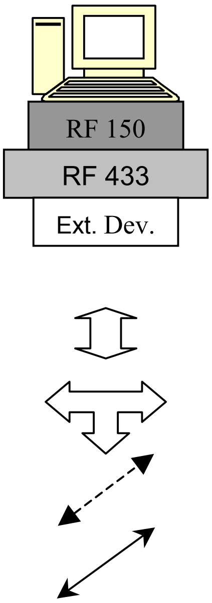


Fig. 1. A sample schematic of wireless network



Main computer – control and GIS

Transceiver 150-180 MHz, 5-30 W power output

Transceiver 418 or 433 MHz, 10 mW power output

External devices /end points of the network/, which receive commands and exchange data trough the network, sensor control

Interfaces between external devices and transceivers such as RS485 network, RS232 etc.

RS485 network

Short range bidirectional wireless connection on 418 or 433 MHz

Bidirectional wireless connection on frequencies from 150 to 180 MHz

## FUTURE RESEARCH

Our future research is focused on increase the speed in the short and long range radio. Other important trend is to prolong the life and data consistency of the autonomous devices. Thus the data from local measurements could create long time series which is related with the multitemporality of remote sensing experiments.

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