



# WIRELESS SYSTEM OF COMMUNICATIONS APPLIED TO TRANSPORTING OF CRITICAL PATIENTS

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## Introduction

The Modern Technologies of wireless communication offer great chances with reference to critical medicine (urgencies and emergencies) which have not been used so far. The established protocol of transporting critical patients by ambulance, is done without any communication of the monitoring life-support system to or from the hospital of reference. By reason of a research project of Science and Technology TIC 2003-07953-CO2-02, a group made up of investigators from both the University of Almería and Torrecárdenas Hospital, have developed a system of wireless communication for standard medical monitors. Up to now, there is no record of the developing of specific systems for a long-distance wireless monitoring in ambulances, through systems that can create a standard.

## Objectives

1. Developing and assessment of a wireless system of telecommunications which integrates different technologies (special sensors, bi-directional communications by radio, getting and treating data in real time, etc.) installed in an ambulance for the transmission of biomedical signs of a critical patient, and the reception of it in a hospital.
2. To assure a better attention and care during the transporting, as the staff in the ambulance receive in real time, direct instructions from the people in charge of the ICU (Intensive Care Unit), according to the information received in the hospital.
3. To fit the diagnostic and therapeutical resources to the characteristics of the patient when it arrives to the hospital, because there is already all the information transmitted during the transporting.
4. By these means, ailments could be treated immediately and so, we could attend earlier and faster the initial and acute complications that may arise which can risk the patient's life or cause its final clinical evolution, thus improving its quality of life.

## Results

Up to now, a trial system of communications is functioning. It is situated in a moving vehicle equipped with the complete system of communication together with a patient simulator and a medical monitor, which sends out wireless signs to the Repeat Units.

At the present time, tests in a hybrid way with Repeat Units which are not situated strategically are being carried out, and it is expected soon the placement of Repeat Units and the developing of trials in the GPRS way.

In the preliminary tests in direct method between Almería University and Torrecárdenas Hospital (8 Km of urban route), the average quality was 45% (in the 45% of cases direct communication has been achieved). In cases of tests with local Repeat Units placed inside Almería University, the average quality has been 85% within a distance of 4 Km round the University.

## Conclusions

1. Long-distance telemetry systems of wireless medical monitors are of great interest for its application in transporting critical patients by ambulance. They cause the improvement of the attendance quality and the management of the process. This improvement is related both with the patient and with the staff, as there is a greater implication of more than one professional and specialist if necessary. Thus the clinical practice improves because there is a constant contact between the ambulance and the hospital.
2. There is also a marked improvement regarding the following quality markers: time of reaction, evaluation, attendance, treatment of the Emergency Equipment and derivation to an upper level (more qualified professionals).
3. These means of communication improve the adaptation of the diagnostic and therapeutical resources to the characteristics of the patient when it arrives to the hospital, and the Urgency Staff -ICU (Intensive Care Unit), Radiology, Surgical- and all the necessary means for a fast and better treatment and care are already prepared and on alert.
4. At the same time, this communication system has an influence on the quality of life of the patient -if it does not die-, because the most efficient therapeutical resources are immediately applied and agreed, thus obtaining the best response and the least sequels.
5. They also involve an economic benefit because an only doctor is the responsible in the hospital of reference and he or she supervises different cases simultaneously. Besides, the doctor in the ambulance can be substituted by some staff with the appropriate training and formation, depending of the cases.
6. From the results obtained we can deduce that the system of monitoring and long-distance transmission telemetry is suitable for this aim and it is also viable; with few economic resources we could install a highly efficient basic net of communication Units with intraurban and interurban range.

Now we are working out and designing the improvement of the quality of the signals by increasing the number of Repeat Units, so as to get the best values in order to be able to cope with all the possible roads within a radius of 50 Km from the hospital of reference -which is Torrecárdenas Hospital-. A second phase will include patients.

## References

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## Acknowledgements

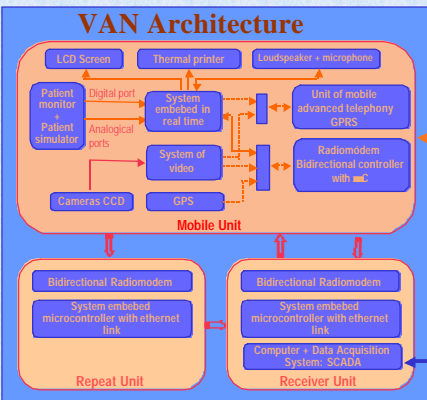
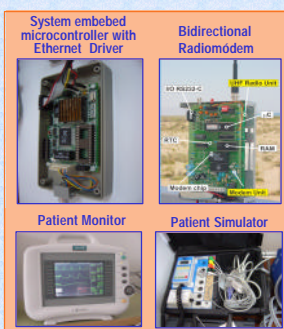
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## Design

The system can be divided into the following stages:

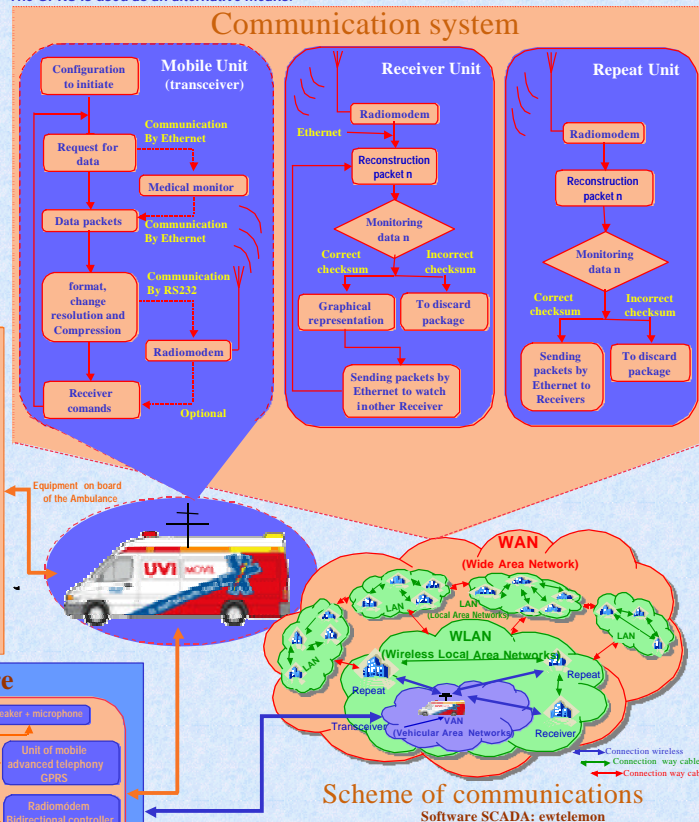
- Acquiring and treating of the data from the patient monitor.
- Transmission of the information from the vehicle to the hospital.
- Interactive application of the information - reception and presentation.

To extract the information from a standard monitor with Ethernet output, we choose for a commercial microcontroller card with Ethernet interface (microcontroller board with Ethernet driver), which questions the monitor and then selects, compresses, encodes and formats in real time the data from the monitor and send them to the communication system.



The communication system is based on an hybrid net, Radiomodem-Internet, which allows the reception of the sings sent out by radio-modem from the vehicle to many receivers situated in different places and to send back the data by internet to the receiver unit.

The GPRS is used as an alternative means.



A computer application in the node receiver (hospital) allows to select the wished information of the net, to present it efficiently form and with options of recording, treatment of alarms, etc.

