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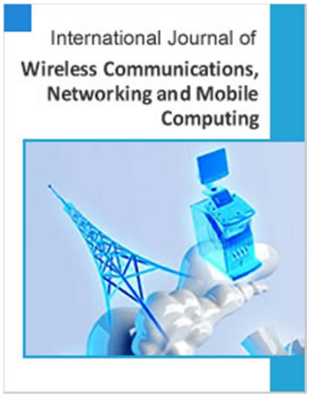

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Wireless Sensor Networks, Towards a New Architecture

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Abstract

Wireless sensor networks are designed to extract data in hard to reach environments by man. For this, as soon as they are put into use are considered self that is to say, the life of the network, its response time, coverage, data security, routing and several other settings depend only devices used include sensors and base stations. The parameters cited above are features you need to evaluate the functioning of a wireless sensor network. These parameters depend on the architecture used. In that context, we introduced a new architecture of wireless sensor network based on standard modular architecture, which ensures the proper functioning also improved performance in the quality of services.

1. Introduction

With the technological evolution, wireless networks have taken the place of traditional networks. In fact, they give us the opportunity to avoid all the expensive process using cables to connect all network elements.

Research in the field of new communication technologies and wireless in the field of electronics have Successful discovering the sensors.

Tiny entities, not expensive and with low power consumption compared to previous technologies. The sensors have three main functions and primordial occurring in three stages, detect data then perform the necessary calculations of data to transmit them to their destination. Their use is manifested dramatically today in the field of wireless networks; there are a large number of sensors that make up an entire wireless sensor network.

In order to have high performance of wireless sensor networks, several studies were performed to design new architectures that meet the functional needs at that bring improvements on the network at several parameters such as response time system, the network coverage, security and many other criteria.

This manuscript has four major parts:

First, we will start by studying wireless sensor networks, their characteristics and model In the second part of this work will look at the definition of the limitations of this architecture and therefore the need to design a new one that meets the functional needs. In the third part, we will we will show the need for a new architecture citing various challenges from their use.

In the fourth part, we will treat some researches made about the design of a new architecture of a wireless sensor network and focus on the points that we will improve later.

Finally, the manuscript ends with a conclusion recalling the main results of this work with a presentation of prospects.

2. Introduction to Wireless Sensor Networks

2.1. Wireless Network

A wireless network is generally composed, of a base station, a "backbone" element and a set of "nodes" entities communicating between themselves and with the base station. Wireless systems are frequently used and application can affect several areas:

- Detection of environmental disasters.
- Communication between the machines "M2M".
- Military domain
- Personal Use

2.2. Limitations of Ordinary Wireless Networks

Ordinary wireless networks have several limitations:

- What would happen if no infrastructure were available?

Take the example of crisis areas, disaster...

- If it is too expensive to set up this infrastructure?

Large remote areas.

- If there is not time to put in place?

In military operations...

For all the reasons mentioned previously, the use of ordinary wireless networks becomes impossible.

This forces us to look to find the right solution.

2.3. Solution

2.3.1. Mobile Ad hoc Networks «MANET»

This solution consists in not trying to build a network and without expensive infrastructure, which can only be an ad hoc network. In Latin, ad hoc literally means "for this" ad-hoc network is a local area network "LAN" which is built with a special purpose devices that communicate. [2]

Instead of relying on a centralized access point (base station) to coordinate the flow of messages to each node in the network, the individual network nodes transmit packets to and from each other.

Ad hoc networks are mobile, hence the name MANET "Mobile ad hoc Network", these networks are generally close to the man in the sense that most network nodes are devices that are intended to be used by humans (laptops, mobile radios etc...). As shown in the figure below:

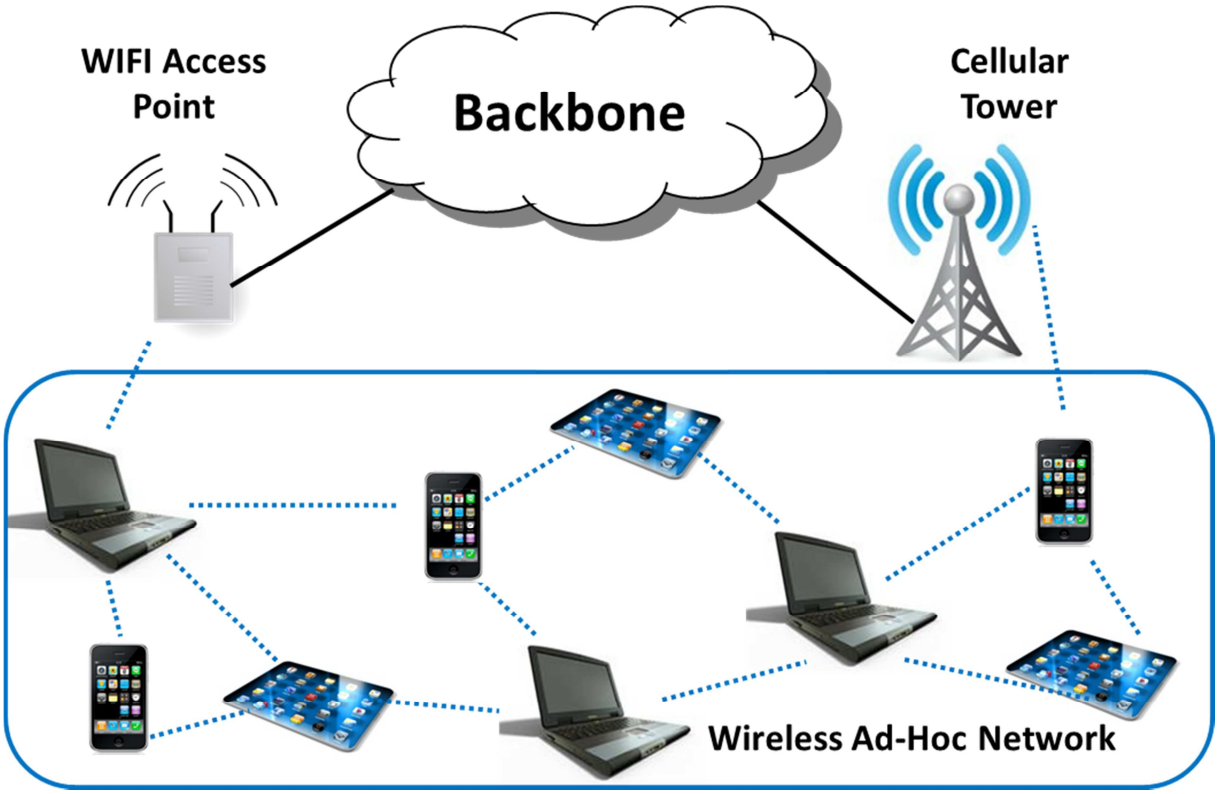

Figure 1. *MANET.*

2.3.2. Wireless Sensor Network «WSN»

Unlike MANET networks that are close to human use devices, WSN interested in the interactions with the environment once they are integrated into the environment.

A wireless sensor network consists of several monitoring stations called sensor nodes, each of which is small, lightweight and portable. A sensor is a device that converts the physical, chemical or biological, in a converted electrical signal to another device. Generally, the monitored parameters are temperature, humidity, pressure, wind direction and speed, light intensity, the intensity of the vibration, the sound intensity, chemical concentrations, and pollution levels. [3]

The figure below models an entire WSN:

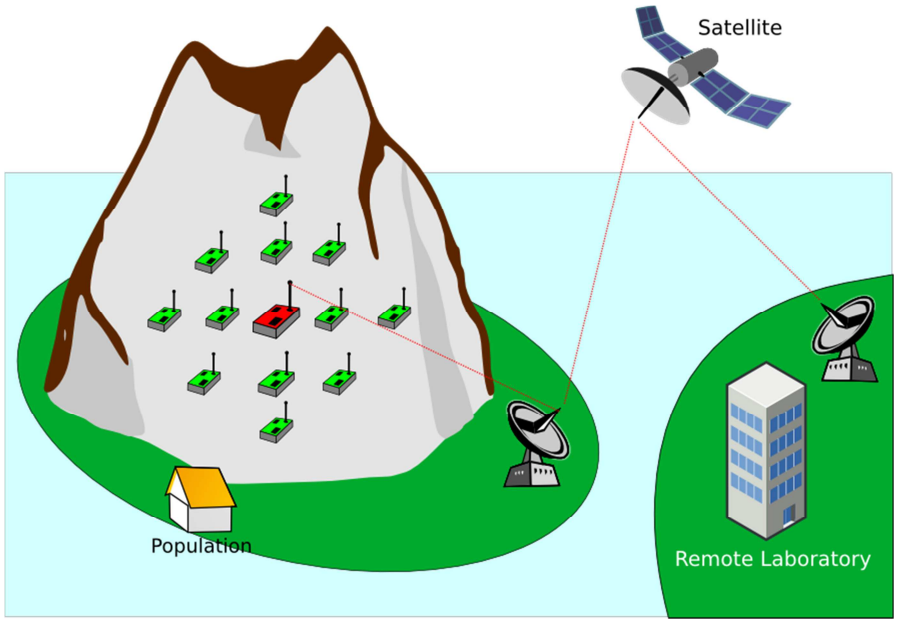

Figure 2. *WSN [26].*

2.4. Comparison of MANET and WSN

There are many differences between mobile ad hoc networks and wireless sensor networks that are presented in the following table:

Table 1. *Comparison, MANET & WSN [1].*

	MANET	WSN
Interactions	**With humans**	**with the environment**
Deployment of nodes	Not much	Very large
Population of the nodes	Low density	High density
Error rate	Down	up
Communication	A point to point	At diffusion
Scope	long	Short
Energy	Is not a problem	limited
Memory	great	Limited
Data redundancy	No	Sometimes
topology	dynamic	dynamic
Poor bandwidth	Yes	sometimes

Our research is directed toward the detection of environmental disasters using a wireless network, so no doubt we will proceed with wireless sensor networks "NSR".

3. Wireless Sensor Network “Layered Architecture”

Like all types of networks, WSN using a communication architecture in layers, which are the first five layers of the OSI model, the physical layer, data link layer, the network layer, transport layer and application layer. [8]

The difference between the two models is presented in the following table:

Table 2. *WSN Layered Model.*

OSI	WSN
APPLICATION	APPLICATION
Presentation	
Session	
Transport	Transport
Network	Network
link	link
Physical	Physical

3.1. Application Layer

This layer is the source and final destination of all data transport. It is the meeting point between the user and the network. Therefore, it will bring the user the basic services offered by the network, such as file transfer, messaging, etc.

In this layer, communication protocols are used to ensure data integrity and security for encryption. We include the HTTP "Hypertext Transfer Protocol" that is used for encryption of data transferred.

HTTPS ensures the safety of users and the confidentiality of the information received by the server. [24]

3.2. Transport Layer

The basic function of this layer is to accept data layers above and split into smaller units, and then forward them to the network layer and ensure delivery of all parts at the other end via a variety of protocols such as TCP "Transmission Control Protocol" UDP "User Datagram Protocol" as shown in the following figure:

3.3. Network Layer

The network layer supports the routing data provided by the transport layer. This layer determines routes between the sensor nodes and the "SINK" and selects the best in terms of energy, transmission delay and throughput.

3.4. Link Layer

This layer specifies how data is sent between two nodes / routers on a definite distance. It is responsible for multiplexing data and error control.

3.5. Physical Layer

The physical layer can provide an interface for transmitting a bit stream over a physical medium, it modulates the data and route in physical media while choosing the right frequencies.

4. The Need of a new Architecture, Issues and Challenges for Wireless Sensor Networks

4.1. Energy Management and Real Time Response

One of the biggest problems that opposes the operation of wireless sensor networks is energy consumption. Indeed, sensor nodes use batteries whose life is not long.

This feature becomes an obstacle in the case of using the NSR in remote areas such as mountain forests, therefore the battery change every day becomes impossible.

Another term of the NSR is that they are still before the obligation to respond to users in a minimal possible time and saving energy consumption.

Sensor networks are required to provide specific answers and minimal time applications to meet various critical needs that can have serious consequences, such as wars, environmental disasters, etc.

These systems do not have the necessary efficiency without the characteristic of a real-time response. Take the example of an outbreak of a fire in a forest, if the sensors do not respond within a short time the disaster will increase and the damage too.

For this, the real-time communication becomes an essential feature of sensor networks to address the constraints that require rapid intervention.

The topology and routing type used affects energy consumption and real-time response.

Routing is the selection of routes in the wireless sensor network to transmit data from the source to one or more destinations.

In some cases of applications using wireless sensor networks, the nodes are presented with a number that can reach thousands or millions.

Communication between these can cause unwanted problems because we have to find the end routing path appropriate end, explained by the absence of references of positions of the various sensor nodes.

4.2. Storage

A network that can grow into many thousands of sensor nodes manages a flow of huge given that must be saved and archived. This feature presents one of the major constraints of WSN since the sensor nodes are characterized by their low storage capacity.

For this, several searches are done in order to increase network memory to store archive data and use them later.

4.3. Coverage

Ensure the proper functioning of the network and ensure they have the information at the desired time depends on the coverage.

Indeed, with the risk of the fall of the network nodes and some numbers, maintaining coverage is becoming a major constraint due to the importance given to retrieve sensor nodes and hence the need for their continuous availability.

4.4. Security

Ensure the security of data during transfer is an important detail for the success of communication in the sensor network.

Indeed, this task is performed on three steps at the transmitter and receiver, which are:

- Encryption.
- Decryption.
- Authentication.

Encryption is a technique that makes the information sent by the sensor cannot understand, and it transforms communication into a safer and more secure.

Decryption is the reverse action, the act of deciphering el message received. [15]

Authentication is a procedure that aims to certify the identity of someone or a computer to allow access to resources, this action is done by using various protocols such as RESTful, COAP, and SOAP [29]

4.5. Effective Sampling Rate

The major constraint of sampling is the energy conservation sensors why it is mandatory to get rid of unnecessary sampling.

Indeed, with the large number of sensor network in the probability of having redundant information is very strong and there is no need to communicate with the base station because the communication of redundant data because an energy consumption level sensor. [30]

4.6. Fault Tolerance

A system fault occurs when the behavior becomes inconsistent and does not provide the desired result because of a failure that is the consequence of one or more errors. This constraint requires taking several rapid response care to correct the error. [32]

5. The Used Architecture

Before presenting our own architecture, we must first study and demonstrate solutions already proposed by some researchers in the field of wireless sensor networks.

We begin with "Mr. Ahmed Abed Alhameed Alkhatib" and "Mr. Singh Guvinder Baicher" University of "Wales Newport," which published an article in 2012, which introduced a WSN architecture, as “Wireless Sensor Network Architecture”.

«Deepali Virmani» and «Satbir Jain» proposed another architectural model in their article "Scalable, Robust and Real Time Communication Architecture for Wireless Sensor Networks," published April 22, 2013.

After studying these two WSN architecture models, we found that there is several aspects they have not treated or enhanced, and on which we will work in our research.

We include network security, which is an important feature for the proper functioning of the network and to meet the functional requirements, by protecting data of different possible attacks on issue by the sensor node until they reach the station base or by the user.

Another thing that has one of the largest constraints of WSN they have not improved is storage. How to improve network storage capacity due to the low memory and number of sensors that can reach millions of sensors in a single network that provide a huge flow of information that can be of any type. Thus improve and increase network storage capacity must be considered in the modelling of the network architecture. We also talk about the problem of network coverage that was not treated with either of the two searches. The cover ensures the integrity of the network and therefore the integrity and all data from all sensor nodes.

Finally, linking the wireless sensor network to social network and use this technology as a solution to improve data storage was not mentioned by these two studies because nowadays the sensors are introduced as the actor in the daily lives of humans by providing data that can influence their lives and therefore interface with social networks will strengthen the link between the two.

These different features will be detailed and treated all along our research.

6. Conclusion and Prospects

Having a wireless sensor network for monitoring of the environment that meets various functional requirements requires a thorough study and improvements in architectures used.

Thus, we were led to design a new architecture of WSN given the limitations posed by modelling standards to constraints such as network response time, storage capacity, coverage, security and management energy.

To make this work, we first started with a thorough study of wireless sensor networks, their characteristics and modelling. We also defined the limitations of this architecture and therefore the need to design a new meeting the functional requirements.

To introduce our work, we have presented some research on the design of a new architecture of a wireless sensor network and we presented the points that will improve our new contribution.

As future work, introducing our new architecture design of the wireless sensor network will be our priorities.

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