THE SENSORS NETWORKS WSN AND VSN: A THEORETICAL COMPARISON

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ABSTRACT

The development of wireless technology currently allows extending the notion of mobility for access to information and communication anywhere and anytime. With the emergence of sensor networks (Traditional (WSN) and vehicular (VSN)), new themes have been opened and new challenges have emerged to meet the needs of individuals and the requirements of several application areas. Research today is much focused on vehicular sensor networks (VSN), considerable efforts have emerged to introduce intelligence into transport systems whose aim is to improve safety, efficiency and usability in road transport. These networks will play an important role in building the Future Internet, where they will serve as a support for various communication applications and integrated into our daily lives. In this paper, we surveyed the main characteristic and applications of two type of Ad hoc networks WSN and VSN.

Keywords

Sensor networks, WSN, Vehicular sensor, VSN

1.INTRODUCTION

Progress in recent decades in the fields of microelectronics, micromechanics, and wireless communication technologies; have produced a reasonable cost component of a few cubic millimeters in volume. The latter, known as micro-sensors, embedded systems are real where the deployment of several of them, to collect and transmit environmental data to one or more collection points, in an autonomous manner, form a network wireless sensors (WSN; Wireless Sensor Network). The wireless sensor networks are likely to be widely deployed in the future because they greatly expand our ability to monitor and control the physical environment to remote locations. Recently the research group and the car companies were equipped vehicles with regular sensors, thus practically creating a sensor network based mobile vehicles (VSN). The introduction of intelligent transport systems requires the existence of networks of interconnected sensors. In the vehicle, these sensors are scattered throughout the cabin (chips), below or on the sides of the vehicle (sensors or transmitters) or above (antennas). On roadsides, at crossroads, near bridges or tunnels, larger infrastructure can be arranged: cameras, gates, infrared radar. Everything is connected to a central station that provides collection, processing, circulation and storage of data: the "back office". All these facilities make up the system. But, in the same way that a computer cannot function without software, this system must be programmed to produce results. These programs, called "applications" are exploiting the system and make it "smart": they tell it in real time how to mediate complex situations based on multiple parameters.

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The objective of this paper is to make a comparative study between the two sensor networks (traditional static sensors network and vehicular sensor network).

1. ORGANIZATION OF THE PAPER

The remainder of the paper is organized as follows. In the following section, we describe the characteristics and applications of the sensor networks (WSN and VSN), then we give a table of comparison study for the both network r. Finally, section IV concludes this paper.

2. THE SENSOR NETWORKS

2.1 The ad-hoc network

An ad-hoc network is a collection of hosts equipped with antennas that can communicate without any centralized administration, using a wireless communication technology such as Wi-Fi, Bluetooth, etc... In contrast to wired networks where only certain nodes called "routers" are responsible for routing data in an ad-hoc network all nodes are both routers and terminals. The choice of nodes that will provide a communication session in an ad-hoc network is dynamically according to network connectivity, hence the term "ad hoc» [1].

In an ad-hoc network, a node can communicate directly (point-to-point) with any node if it is located in its area of transmission, while communicating with a node outside its zone Transmission occurs via several intermediate nodes (multi-hops).

3.2 Advantages of ad-hoc networks

The ad-hoc networks have several advantages; the most important are:

- Easy deployment, fast and inexpensive: in ad-hoc networks, the tedious task of deploying base stations (wiring, installation, etc...) Is no longer necessary. Consequently, the deployment is faster and is done with a low cost.
- Fault tolerance: an ad-hoc network continues to function even if some nodes fail, this is because it has no central nodes.

3.3 Types of sensor networks

In this section, we describe two types of ad-hoc networks, i.e. Wireless sensor networks (WSNs) and Vehicular Sensor Networks (VSNs). We will also present their applications.
Although WSNs and WMNs have several common features, however, they have several differences involving naturally different communication solutions. We end this section by comparison table.

3.3.1. Wireless Sensor networks (WSNs)

The WSNs (Wireless Sensor Networks) are ad-hoc networks consist of nodes intelligent sensors powered by batteries, and they are equipped with processing capabilities and limited storage. Indeed, the sensor nodes are able to perform three additional tasks: i) the statement of a physical or environmental (e.g. temperature, pressure, pollution, etc.). ii) the possible treatment of this information and finally iii) routing. The network may contain a large number of nodes

(thousands) generally static and deployed randomly (e.g. by dropping from a helicopter) in environments that can be dangerous. In addition to the sensor nodes, a WSN consists of base stations high in energy (sink nodes) characterized by a processing capacity and greater storage. These chemicals act as gateways between sensor nodes and the end user (see fig.1).

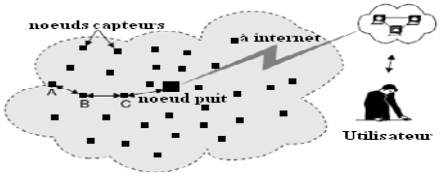

Figure 1. Routing paradigm in a sensors networks

3.3.2. Applications of WSN

We distinguish a variety of applications for sensor networks, quoting among others [2]:

• Military applications: WSNs can be used to monitor the activities of enemy forces to terrain analysis and detection of chemical agents or radiation before sending troops.
• Application security: a sensor network can be an alarm system to be used for distributed intrusion detection over a wide area.
• Environmental applications: thermo-sensors scattered over a forest may indicate a possible outbreak of fire, thus allowing greater efficiency in the fight against forest fires. Industrial sites, nuclear power plants or oil sites, sensors can be deployed to detect leaks of toxic substances (gases, chemicals, radioactive elements, oil, etc..) And alert users within a sufficiently short to enable an effective response.

3.3.3. Vehicular Sensor Networks (VSN)

3.3.3.1 The Vehicle and Embedded systems

Embedded systems consist of tangible and intangible resources integrated into the vehicle. It is the most visible face of the system. It includes systems for the collection, processing and dissemination of information within the scope of the vehicle.

As part of ITS information gathering takes place at two distinct levels. The first data collection performed by the vehicle. The second concerns the data collected outside the vehicle (weather, traffic monitoring, pollution level ...). Automobiles in use today are already equipped with multiple sensors. Among the most common are found, for example, water temperature sensor, fuel gauge, speedometer, tachometer, the radio.

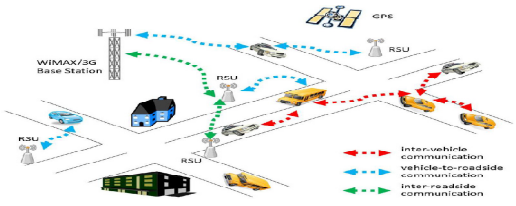

Figure 2. Wireless Vehicular Networks

Recent years more specific features have been added such as wheel rotation sensors, rain sensors, radar sensors, GPS. We can add to this list another sensor, which is still rarely secured to the vehicle: the mobile phone. This device tends increasingly to be connected to the vehicle, including through Bluetooth. Other detection systems more or less sophisticated (internal and external cameras, sensors for positioning on the floor, radar obstacle detection) are already available in several ranges of vehicles (Audi, BMW, Ford, Infiniti, Lexus, Mercedes , Opel, Volkswagen, Volvo ...).

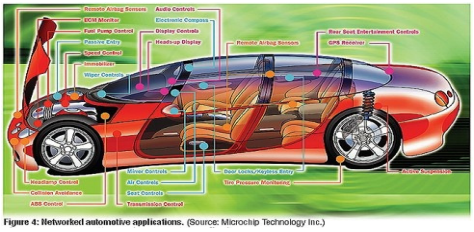

Figure 3. Sensor technologies in the vehicle

3.3.3.2 Features and benefits associated with VSN

3.3.3.2.1. Prevention of accidents

The VSN allows the driver to better control his vehicle, but also to assess its own capacity to lead. Numerous technological applications have already come in for a long time usage. Without even thinking, with a simple glance at the dashboard, the driver checks the multiple indicators critical to safety or operation from the vehicle: fuel level and oil, engine temperature , speed, mileage, Headlamp ... the high-end vehicles offer more precise indicators and more specialized tire pressure, belts hanging safety, collision avoidance radar, outside temperature, audio signal of a risk of freezing rain or fog ... All of these technologies in place during the past two decades reinforce the safety and comfort of travel. But they are based on an assumption: the driver will be able to understand the information that may put to flight instruments and he will interpret it and make the right decisions to adjust his conduct. But the statistics prove this assumption is wrong: 90% of accidents result from human error.

ITS is an answer to this paradox. This is just to increase the number, nature or accuracy indicators edge, but offset the limitations or human failures.

An example: the driver's ability to control his vehicle. For reasons of culture and habit, the driver tends to overestimate their abilities and minimize the risks it is exposed. Nervousness, stress, depression, or conversely an overly excited or euphoric joy disturb the judgment and can cause accidents. Like alcohol abuse, as is proved alcohol testing: drivers systematically underestimate the amount of alcohol consumed and difficulty in admitting their inability to respond quickly and appropriately to unexpected situations. The VSN of new generations of embedded devices will detect this weakness by measuring different parameters and can alert the driver before he takes the road, or possibly block the vehicle in case of inconsistent behavior.

It’s the same with regard to lack of sleep. Drowsy driving is the cause of many accidents. Sensors located on the dashboard or in equipment (steering wheel, seat, outside edge of the vehicle) will detect its most characteristic symptoms (frequent and prolonged blinking of the eyelids; stiff

neck, repetitive yawning; deviant trajectory of the vehicle against the benchmarks of the roadway, inappropriate speed, inconsistent or incoherent) and will give warning.

VSN can not only trigger an alarm (an audio message, a bell in the car for the driver), but still be able to prevent the danger to other road users. For example, the system can warn a driver coming the opposite direction it faces a frontal impact due to the abnormal trajectory of the first vehicle. In case of deep sleep, resulting in an off line, using the tracking of the trajectory (Lane Keeping Support, LKS) can also be activated (the system "takes over" on the vehicle and keeps him in the middle of the carriageway in order to avoid collisions longitudinal or lateral). It can even help coordinate with the path of other vehicles identified in the immediate environment. The "platooning" is to drive a vehicle group together according to established parameters in order to prevent any risk of collision. Of "Cybernetic Transport Systems" can even manage fleets of vehicles fully automated.

Another example: the view. An estimated one third of accidents are related in one way or another, lack of visibility. The VSN can compensate for the weaknesses of the human eye. It's not science fiction. Engineers do not plan to equip drivers with electronic eyes. But almost, thanks to the satellite geolocation (GPS, Galileo), we know the exact position of a vehicle on a highway; we know what direction it is progressing and we can accurately assess its speed.
Through this same process we can identified in the same way another vehicle, for example located one hundred meters behind the first vehicle. Suppose that the second vehicle is traveling at a speed much higher than the first, in heavy fog. There is a risk of collision because the driver of the second vehicle can not see the vehicle in front and toward which he directs. In this hypothesis, the VSN can establish a link between the two situations: real-time information system identifies each vehicle, reports the positions and issues a warning because of the risk of accident. The system can suggest to the first vehicle speed to maintain a safe distance from longitudinal or in adhering to the side of the road, and recommend to the second vehicle to slow or anticipation. Thanks to the mediation system, and complement systems of autonomous driving assistance on board the vehicle, the drivers of both vehicles to "see", despite the distance and fog.

But risk reduction is not limited to "dialogue" between vehicles (V2V called for "Vehicle to Vehicle"), it also concerns the relationship between vehicles and infrastructure (V2I or, for "Vehicle to Infrastructure"). When approaching a crossroads with, motorists will be informed of the danger of crossing the state possibly faulty installation, or even the presence of other risk vehicles or pedestrians.

3.3.3.2.2. The reduction of damage in a collision

The connected car will benefit from several advantages over the autonomous vehicle. The information system that could be detected just before the collision imminence thereof, he may undertake immediate measures to reduce its impact. For example, it can accurately measure the weight, shape and position of each occupant of the vehicle to determine the exact timing and triggering of airbags inflation level required to reduce the impact of inflation. It can also "take control" of the vehicle and provide the best brake system based on multiple parameters, impossible to comprehend as efficiently by the driver in a very short time, the order of a fraction of a second .
The VSN then instantly calculates vehicle speed, its position on the floor, the existence of specific barriers on it (other vehicles, pedestrians), specific weather (rain, ice) and acts on the parameters of the collision.

3.3.3.2.3. The emergency management:

The triggering of emergency is a very important step in the management of traffic accidents and determines some of the balance disorder. In a very short time, we must take steps to avoid complications of an accident (an accident caused by the additional first accident), assess the extent of damage (human, material) and trigger the alarm (to call the police, the firefighters, and other motorists).
Previously, motorists had no other recourse but to walk to the nearest village to raise the alarm. With the installation of emergency terminals on the banks of the motorway, the communication was greatly facilitated. The mobile phone can now go much further and summoning assistance immediately. But it is still necessary for this reason that the casualty is able to correctly analyze the situation (the trauma of the accident impairs judgment), and she is conscious.

The VSN can precisely react immediately regardless of the status of the passenger. The detection of the shock is immediate (GPS instantly identifies the crash and abnormal vehicle, the shock is detected by onboard sensors programmed to trigger activation of aibags). The analysis of the environment (other vehicles on the approach) is used to trigger automatic and on-the-field bounds warning (flashing lights), to reduce the risk of an accident. The VSN are then used to accurately assess the damage: using sensors and using the communication network GSM (Global System for Mobile Communication), one can quantify the number of people aboard the vehicle, determine whether they are conscious or not, estimate the risk of fire or explosion relief indicate the exact position of the vehicle, he left the floor, if turned...

Much invaluable information to adjust the rescue. Many of these applications in the near future will have an effect on the rate and severity of accidents will become mandatory in vehicles, as will soon be systems of "Emergency Call" (automatic communication with the relief collision). The emergency call is already on the market for many years in Europe (BMW, Mercedes, PSA, Volvo ...). [3]

3.4 Comparison between VSN and WSN:

To our knowledge, this time the mobility of sensor networks is not widely traded. The majority of existing research considers static networks. In this section we will briefly illustrate the differences between static sensor networks and mobile. A sensor array consists of a set of nodes deployed in an area of interest for the purpose of the monitor, and to transmit information to the end user (the observer).

A static sensor network WSN does not consider any node mobility, or the observer, or the area of interest. In this case, the sensors are combined to capture for example the temperature in a given region. This requires an initial installation of communications infrastructure to create the path between the observer and the sensors.

On the other hand, in mobile sensor network nodes VSN, the area of interest, and the observer are moving. If the nodes are moving, we are not changing the area of interest which then becomes "mobile". As the area is changed, the observer will have to reconstruct the path and break the old one. In this case the observer's interest to build more paths between itself and the nodes and choose the most beneficial. How a node can be mobile? It can be attached to a robot with a human being, vehicle, etc... For example in military applications, nodes can be attached to soldiers or trucks, or in other cases attached to animals to track their movements. The goal of mobile sensor networks is to gather more information about an environment by using

less of sensor nodes, and allow the network to organize its own nodes. In addition, he becomes able to move its sensors dynamically according to environmental changes, making it adaptable to the changing environment. [1]

Although the VSN and WSN have several common characteristics, but they differ in several aspects [2]:

- The main characteristic of a constituent node VSN is the mobility, while the sensor nodes in a WSN are static.
- In the VSN communication can occur between any network nodes, while in a WSN communication is always initiated to or from nodes wells over the communications sensor to sensor are rare, but the transmissions multicast and broadcast are common.
- The VSN are characterized by a lower density compared to the WSN.
- In a VSN all nodes are equal, thus the failure of any node has the same importance, while a WSN is more sensitive to the failure of nodes as well that of the sensors.

The main differences between VSN and WSN are summarized in the following table :

Table 1. Comparison between WSN and VSN

	WSN	**VSN**
Objective	target goal	General / Communication
Collaboration	Nodes working together for the same purpose	Each node has its own target
Data flow	Many-to-one	Any-to-Any, One-to-All, One-to-Many
identity	Very large number of nodes without ID	Presence of the concept of ID
main factor	Energy resource	Throughput, QoS
Type of communication	Broadcast	Poin to Point (Unicast), Multicast, Broadcast
mobility	Nodes are static	The nodes are mobile
Computing capacity	Low power computing	High calculation capacity
storage space	Low storage capacity	Great capacity of storage
Communication capacity	Low capacity of communication	reliable communication

energy	Nodes have a constrained battery life.	There is no battery life constraint.
Data volume	A small volume of data generated on the types of applications	A large volume of data generated

4. CONCLUSION

In this paper, we have investigated the main characteristic and applications of two type of Ad hoc networks WSN and VSN.
Unlike other networks, WSNs are designed for specific applications. Applications include, but are not limited to, environmental monitoring, industrial machine monitoring, surveillance systems, and military target tracking. On the other hand VSN will play an important role in the coming years, whether to communicate with another vehicle or with existing infrastructures. Indeed, today's cars no longer be satisfied to detect hazards through radar or cameras, they will be able to receive alert messages sent by other drivers or infrastructure (panels, gantries, etc.. ...) and to transmit this information to other vehicles. Each application differs in features and requirements.
This study allowed us to make a theoretical comparison between the two networks. In the future, we aim to make an experimental comparison based on the simulation of a routing protocol in both environments: Wireless Sensor Networks and Vehicular Sensor Networks.

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