Intelligent Traffic Management – Chisinau Smart City

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***Abstract* — In the XXI century, the state of the urban environment is determined not only by the presence of infrastructure, ie, material resources. Smart cities need smart solutions that provide high quality new development.**

I. INTRODUCTION

Today, the Internet of Everything (IoE) consists of weakly interconnected disparate networks, each of which has been deployed to meet their specific needs. For example, in modern cars run multiple networks: one controls the operation of the engine, the other - security systems, a third support communication, etc. In office and residential buildings - multiple networks control the heating, ventilation, air conditioning, telephone, safety lighting. As the IoE these and many other networks will be connected to each other and to acquire more and more opportunities in the field of security, intelligence and control [1].

As interpreted by specialists from the Cisco, Business Solutions Group (CBSG), the Internet of Everything is a state of the Internet since the time when the number of "things or objects" that are connected to the global network, more than the population of the planet. The explosive growth of smartphones and tablet computers brought the number of devices connected to the Internet, to 12.5 billion in 2010, while the number of people living in the world, has increased to 6.8 billion; thus, the number of connected devices was 1.84 units per person. On the basis of this simple arithmetic, CBSG has identified actually point of IoE (fig.1). Somewhere between 2008 and 2009, the number of connected devices exceeds the population of the planet, and that marked the transition to the "Internet of Things" (IoT).

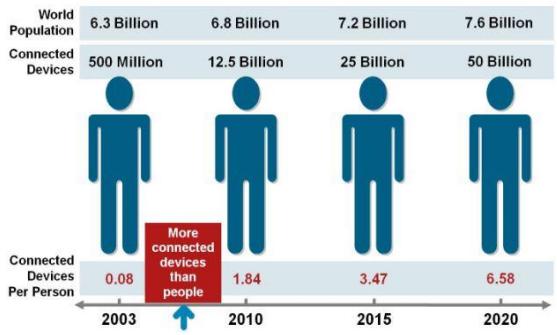

Fig. 1. IoT was "Born" between 2008 and 2009.

If today's 4 billion people are connected to the Internet (1 zettabytes = 10^{21} = 2^{70} bytes) by 50 billion gadgets in five years, each active user will have at least 10 devices to connect to cyberspace. It becomes impossible to use personal computers without replicating data to all devices. Economic factors efficient use of purchased applications hosted in gadgets and personal computers, forcing the user to give up their purchases in favor of almost rent-free services in the clouds. All mentioned above is an essential argument of imminent transition in the space of virtual networks, located in secure cloud services [2].

Today IoE suited to the stage at which the heterogeneous networks and a variety of sensors to be united to interact under the control of common standards. This goal requires commercial organizations, government agencies, standard forming organs and institutions of the overall effort to achieve a common goal. In his works, Kayvan Karimi, vice president of Wireless MCU from Atmel graphical present interpretation of the entire IoE ecosystem (fig. 2).

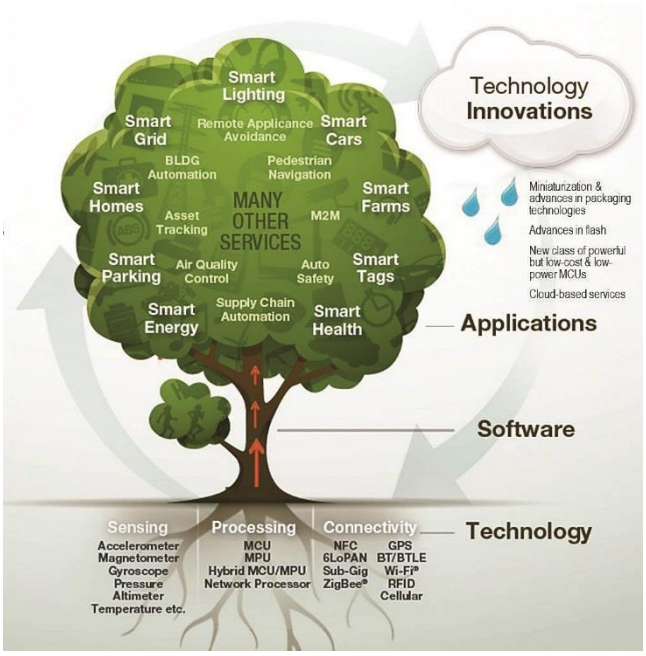

Fig. 2. Ecosystem "Internet of Things".

Purpose - improving the quality and safety of traffic through the creation of intelligent traffic infrastructure, including cloud traffic monitoring and traffic control in real time.

The object of study - control technology vehicles, integrated with cloud services, based on use of RFID (Radio Frequency IDentification), radar and navigation.

Subject of investigation - traffic flows, road communications infrastructure of the Republic of Moldova, modern hardware and software radio frequency identification, monitoring and management of traffic through the use of street controllers, global positioning systems, navigation, cloud services and the Internet of Things.

II. Main Part

Smart City ensure modern quality of life through the use of innovative technologies that provide economically and environmentally prudent use of urban systems of life. Smart City include smart management, smart living, smart people, smart environment, smart economy and smart mobility.

Republic of Moldova don't have intelligent transport solutions, everything works according to the old type of adjustment of traffic and it now leads to the fact that our roads can not withstand the increased flow of traffic, not to mention the units of urban services, such as those intended for waste disposal, food industry and public transport. But the most difficult problem is a private transport and inability to deal with it in rush hour and holidays, which leads to the formation of traffic jams and reduce the speed of vehicles in the city.

Currently, measurement and classification of traffic in Moldova is carried out by CCTV (Closed-circuit television) cameras, established by the Ministry of Internal Affairs on 41 metropolitan crossroads in Chisinau and some roads in the country.

Scientific novelty of the project is determined by the cloud system integration monitoring and RFID transport control, which makes it possible to automate the process of optimal control of vehicles and traffic in real-time to meet the social, economic and environmental problems.

Model of the interaction of clouds with the monitoring and control of vehicles is shown in fig. 3, where the cars are put on on-line, delegate their IDs (personal data), the motion parameters and the current coordinates of the cloud, and in return receive a real-time services of an optimum route and mode of movement to reach the final destination, so we will use an innovative project which is the ideal solution to existing problems with other traffic [3].

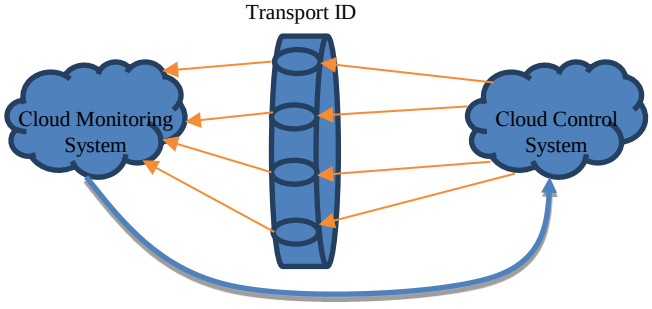

Fig. 3. Structure of the interaction of transport and clouds.

The above idea of the project can be developed to effectively collect the necessary data for the corresponding segment. It is building on this idea, Chisinau Smart City will be the basis for a new phase of management traffic, which will cover both the convenience and safety of all participants in traffic, be it drivers, motorists, motorcyclists, cyclists or pedestrians.

To begin to implement this project, the initial stage of which is intelligent and automated solution for intersections of Chisinau, in order to understand and prove almost its essence and purpose of implementation, as well as entirely its further development.

The interaction of the real world (the car and infrastructure) with a cloud forms two types of relationships, fig. 4:

a) transport infrastructure with cloud monitoring and management;

b) car with the cloud to optimize and efficiency of movement.

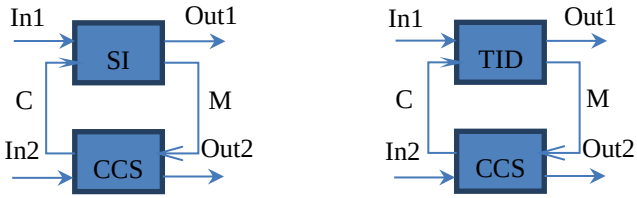

Fig. 4. Interaction of infrastructure and transport cloud management.

Presented signals: In1, Out1, In2, Out2, C, M - input conditions or operands necessary for the execution of the ordered services; informational output signals; input control actions; output variables, identifying the state of the system; signals intelligent driving or road infrastructure; informational signals about performance and operational services.

Model traffic control system and the vehicle in the form of the interaction variables are presented transition and output functions of the automaton of the first kind:

$$CCS = \{In, Out, C, M, f, g\}$$
$$\begin{cases} Out(t) = f[In(t), M(t), Out(t-1)] \\ C(t) = g[In(t), M(t), Out(t-1)] \end{cases} \quad (1)$$

Here, each of the two machines and transport infrastructure interaction with the cloud has two input variables (order services and state facilities management), as well as two outputs for monitoring the state of the automaton (clouds) and managing cloud services.

Transport "smart city" is based on intelligent transport systems. This means the integration of operational management of all types of transport and the ability to respond to events in real time. It is important that the transport system is an integral part of the whole system "smart city" and therefore should have a user friendly interface. The main innovation "smart city" in relation to transport is the creation of the city, pedestrian-oriented and striving to reduce the use of private transport to a minimum, attention is paid to the public transport system [4].

Critical to the success of the system components is primarily a transport interchange nodes, which are included in the same intercept parking.

In order to ensure their functioning, require the integration of information and navigation systems into a single platform "smart city". Of great importance in intelligent transport systems is the presence of a single transport interface, based on the needs of the residents and guests of smart city, inside of which you can find and use a variety of services - from tips on how to drive the car parking, prior to the notification of the date of arrival of the local public transport.

At the same time, intelligent traffic system Chisinau Smart City will reduce the number of accidents and traffic jams in rush hours and holidays, something that until now has been possible only through the intervention of controllers on the roads.

Consider one of the smart solutions for traffic lights in this project: one crossroads in Chisinau there are several traffic lights. At each of these proposed to install traffic lights sensors that detect the number of cars behind and in front, along different distances. Traffic will also be able to "talk" to each other by using radio, Wi-Fi, Ethernet, GSM, or any other method of communication. Furthermore, the signals can record historical data from its sensors. With all this information should be made a rational decision to improve the current situation on the roads. This solution may be to maintain or change the traffic lights and the indicator can be made either by the local controller in place of signal or via the central controller. We have decided to introduce the latest in this project. In this case, all the data collected by the sensors and sent to the central control unit. When the decision is made, the central controller sends the information back with the new state on the traffic light. Of course, with this approach, the relationship between the lights should be modeled.

In the future, the population will be able to calculate and feel more accurately period for their transportation in the city, and the presence of real-time traffic, thereby starting the choice depending on the way of predictions synchronized system. Authorities, for their part, can much more easily and with greater accuracy to track traffic offenses commensurate risks and feel their correlation with a certain time of day, and to understand what changes and adjustments should be made on some problem areas of the city. Last will bring a significant increase in the city budget [5].

The objective of "smart dust":

1. Monitoring of vehicles movement;
2. Monitoring the frequency of movement, speed, size of moving objects;
3. The interaction between a moving object to determine the coordinates, identification of moving objects, the transmission of information about objects moving towards each other, in a cloud management;
4. Formation of the electronic passport of a moving object;
5. Countering the hijackings of vehicles;
6. Ensuring a high level of protection of electronic identifiers from unauthorized access;
7. Environmental monitoring (temperature, pressure, humidity, precipitation etc.).

The cost of RFID tags is usually less than 1% of the value of the object identification. Its functionality is to maintain a one-to-one correspondence between the label and the object throughout the product lifecycle. The real world, in need of improved processes of cloud management, long recognized the need absolutely accurate radio frequency digital identification of all production and natural sites on the planet, including humans and animals [6].

Thus, the ID of the object is, in fact, stand-alone digital system-on-chip with transceiver, which is capable of storing information about object identity, modify it at the command control center, as well as store information about the interactions with the environment to transmit data cloud management.

The advantages of smart dust, based on low-power transmitters active RFID:

1. Low cost microsystems implemented thus in vehicle electronic devices;
2. Enough low cost digital radio frequency transponders monitoring nodal points of traffic infrastructure;
3. High precision and speed of removal of digital information from moving vehicles, including speed, license plates (which are no longer needed), data about the driver;
4. Monitoring and prediction of traffic through the analysis of information in the areas of roads and intersections;
5. The possibility of mutual communication microsystems moving towards each other vehicles with the provision of traffic information on the route of the road sections;
6. Simplify the problem of tracing stolen vehicles through global or local monitoring of vehicles;
7. Alarm and monitoring of accidents with the exact coordinates of the place and time of the incident.

World experience of RFID application in the field of transport allows to make optimistic predictions about the introduction of such technologies in Moldova. In 2012, the Ministry of Interior of Russia successfully tested RFID-tags on the number of cars in the framework of the "smart city". In this case, the RFID chip has been integrated with the plate. In Malaysia, the mandatory statement of RFID-chip for car number was introduced in 2007. Traffic police can check for any car, not even stopping him, as from a fixed post, and from the mobile patrol car. In the United States since the early 1990s, GM had a system of 3M Automotive Adhesive, which can be considered the prototype of the modern RFID technology.

Studies conducted by the Moscow University of Technology in 2001, showed that RFID technology allows us to identify as stationary objects and moving vehicles with high accuracy, but also has high reliability, durability and security. However, along with the many benefits of this technology have also been its shortcomings. First of all, the range of RFID-tags is poor. There is also a negative impact of electronic chips into living and non-living matter. Electronic interference from RFID, reprogram pacemakers and contribute to malfunction of medical equipment. More than a third of the tests did reveal failures in the medical equipment is located at a distance from centimeters to six meters from the source of

RFID. In another third of the tests were reported serious irregularities in the ventilators, dialysis machines, monitors, electrocardiogram [7].

The proposed RFID system takes into account the above-mentioned factors, and will be used active RFID tag with two data channels - radio and optical. In applying the active tag range is limited primarily an output label at constant antenna gain, receiver sensitivity. The RFID system has the ability to adjust the operational transmitter output power at mandatory restrictions on the maximum level of + 4dBm. This excludes any impact on the living and non-living matter, as several orders of magnitude smaller than normal allowable SAR (Specific Absorption Rate) of electromagnetic radiation by the human body.

CONCLUSIONS

According to some studies, in 5-10 years, we should expect the service automatically driving a route without a driver.

It is difficult to predict and list all the positive social and technological implications of the revolutionary transformation of the existing world after the introduction of cloud services traffic, however, on the way to full automation below shows some obvious and demonstrative innovative science and technology solutions to social, humanitarian, economic and environmental problems, associated with the appearance of a cloud monitoring and management.

1. Special switching control of road traffic in on-line mode to automatically ensure smooth movement of a route, specialized machines or tuples;
2. Optimal on-line control traffic lights on the roads and intersections with an accurate digital traffic monitoring through the use of RFID tags the car, giving the opportunity to minimize the route by all road users;
3. Planning the optimal route to achieve one or more destinations car in time and space, enabling to reduce the time and cost for a given quality of comfort (time of day, year, road surface, weather conditions, traffic jams) movement of the vehicle tools;
4. Intellectual history of the movement of a vehicle having a virtual model - an individual cell in the cloud, which is invariant with drivers, service vehicles, which makes it possible to track the movement of any vehicle in the past; as well as to predict the desired routes and trips in the future without the driver;
5. Intelligent control of traffic lights controller when switching signals are generated based on availability (quantity) vehicles, sends a request from car blocks C-RFID.
6. Cloud on-line service monitoring RFID tags vehicles eliminates the license plates of the system that makes it possible to:
   a. exclude direct involvement in the traffic police commit violations of traffic rules;
   b. save metal for the manufacture of the plate and simplify the registration of vehicles;
   c. automate the design of an accident without traffic police by monitoring the digital map of the event, imported from the clouds;
   d. history of the car movements and its traffic violations becomes transparent for the cloud that will automatically write off the cost of driver violations in accordance with the laws of the country;
   e. to completely eliminate corruption against the driver with the traffic police, due to the impossibility to erase information about the violation in the cloud;
   f. reduce or virtually eliminate car theft, thanks to built-in car radio frequency identification unit that provides around the clock observability of transport;
   g. facilitate the legalization of the driver by identifying the driver's license in the list of authorized persons with RFID car radio protocols, such as - "blue tooth", which eliminates paper and powers of attorney for driving other persons;
   h. to reduce the number of road accidents and significantly improve the quality of life for drivers and passengers due to on-line monitoring;
   i. reduce of carbon dioxide emissions by reducing congestion at intersections and selection of optimal modes of transport and travel routes.

Smart cities present an enormous opportunity to achieve social, economic and environmental benefits. However, finding the right platform can be difficult. Only the right platform, to collect the right data, will drive mass market adoption to millions of consumers.

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