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THE USE OF RFID TECHNOLOGY IN AUTOMATIC VEHICLE IDENTIFICATION – PROPOSAL FOR SINIAV

Rone Evaldo Barbosa
Universidade Estadual de Goiás / Ministry of Infrastructure, Brasilia, Federal District, Brazil
http://lattes.cnpq.br/5991735511068871

Pastor Willy Gonzales Taco
Universidade de Brasilia, Faculty of Technology, Department of Civil and Environmental Engineering, Brasilia, Federal District, Brazil
http://lattes.cnpq.br/9878324695903634

Alexandre Garces de Araujo
Universidade Estadual de Goiás, Anapolis, Goiás, Brazil
http://lattes.cnpq.br/3321527696885052

Abstract: This work presents the Brazilian experience in the development of the National System for Automatic Vehicle Identification – SINIAV, which consists of the use of radiofrequency identification technology. (RFID) for the entire vehicle fleet in the country. It also highlights aspects related to the use of technology in the regulatory and institutional context, aiming at its functionalities and applications in solutions for smart cities (Smart Cities) and intelligent transport systems (Intelligent Transport Systems - ITS). It then presents a proposal for a technological update of the model, with the reduction of costs and joint implementation with the vehicle identification plate with digital security, in the process of implementation in Brazil. Finally, it presents SINIAV as a proposed model for the integration and exchange of information between Latin American countries, through the standardization of protocols and systems, guaranteeing the interoperability and the safe flow of information, with a focus on reducing logistical costs, as a tool for preventing and combating theft and theft of vehicles and cargo, for controlling tax evasion, for automated data collection for planning and operational traffic control and transport, as well as the provision of numerous services to society.
Keywords: RFID, SINIAV, ITS, Intelligent Systems, Intelligent Cities.

INTRODUCTION

The National System for Automatic Identification of Vehicles - SINIAV was created by the National Traffic Council - CONTRAN in 2006, with the initial objective of being one of the instruments of the National Policy for Preventing and Combating Robbery and Theft of Vehicles and Cargo, in compliance with the provisions of Complementary Law No. 121 (Brasil, 2006). SINIAV consists of equipment and systems and consists of the electronic identification of vehicles by radio frequency (RFID), through a tag (chip), whose technical specification, information and approval procedures were established by CONTRAN resolutions, complemented by ordinances of the National Traffic Department – DENATRAN.

According to Barbosa (2017), technological evolution has brought numerous solutions to the transport, traffic and urban mobility sectors to make life easier for citizens or even to improve the control and supervision of the operation by the public sector. Intelligent transport systems – ITS have evolved as solutions for this purpose, and presuppose the existence of equipment and systems infrastructure that allow their use on the intended scale. Most of these solutions are aimed at solving specific problems or serving a specific economic and/or social segment. There are few ITS solutions implemented on a national scale, especially those that allow the collection and automated flow of vehicle and cargo data between government agencies and the provision of information to the productive sector and citizens. SINIAV presents itself in this context as a facilitating instrument for the application of intelligent solutions in the transport sector, which enable the development and evolution of models and intelligent systems for other sectors as well. Among the possibilities of use in information and communication technologies - ICT in intelligent transport systems - ITS, the following applications stand out:

- Public safety and preventing and combating "crime on wheels" (theft, theft and cloning of vehicles and other crimes associated with them: cargo theft, drug trafficking, smuggling, kidnappings, robberies and murders using these vehicles);
- National Defense Policy and Strategy;
- National Intelligence Policy;

- Inspection and tax control;
- Inspection and control of road freight and passenger transport;
- Operational planning of road freight and passenger transport;
- Reliable and effective information for transport planning;
- Traffic planning and management;
- Monitoring and availability of traffic information in real time;
- Inspection of traffic and urban transport;
- Solutions for smart cities, including intelligent traffic light networks, operational control centers - CCO, intelligent rotating parking, vehicle rotation and access controls on roads or restricted areas;
- Various private services, such as access control in condominiums and parking lots, automatic payment of tolls and fueling at gas stations, among others.

The use of RFID technology in the planning and operational control of transport, particularly in the automatic identification of vehicles, is presented as a facilitating instrument for the implementation of intelligent solutions in transport (ITS, Smart Cities and other solutions related to the broader concept of Internet of Things - IoT). It also presents the model of integrated solutions that is being implemented in Brazil, in which RFID technology is associated with other technologies, such as Weigh-In-Motion (WIM), video surveillance and electronic speed inspection, among others.

The project under implementation is being consolidated into an Integrated Transport Information System, which will allow real-time monitoring of the country's main logistics corridors. The vehicle identification information will be, in a systemic way, compatible with the transported cargo and passenger information, necessary for planning and operational control purposes, as well as the intelligence actions of the tax and public security areas. This model was initially developed as a a project for Brazil. However, it is also presented in this work as a possibility of integration and exchange of transport information between Latin American countries, in an automated way,

CONTEXTUALIZATION ABOUT SINIAV

SINIAV enables applications that result in numerous benefits for the State and for users of services that use vehicle identification. Thus, it is necessary to highlight, from technological, institutional and regulatory aspects, the means to enable its full implementation in Brazil, enabling the use of such technologies and information for integration with other Latin American countries.

REGULATORY ASPECT

The National Automatic Vehicle Identification System – SINIAV was created through Resolution No. 212 (CONTRAN, 2006), which also provided for its implementation throughout the national territory. This model was updated in 2012, but the SINIAV implementation process did not evolve as intended and had to be extended other times, due to mistakes in the business model initially conceived. The last regulation published by CONTRAN was Resolution nº 537 (CONTRAN, 2015), through which the Council established that the process of electronic registration of SINIAV vehicles must be started throughout the national territory from January 1, 2016, no deadline has been set for its completion.

INSTITUTIONAL ASPECT

The difficulties faced by the initially conceived SINIAV project made evident the failures of the adopted management model, ranging from the process of choosing the technology, to the business model adopted in the relationship between the technology manufacturers and suppliers and the transit executive bodies. Attempts to start the process in some states were based on a business model where costs were fully transferred to society, from the acquisition of the tag to the system's infrastructure and operating costs. This would imply charging an annual fee, entitled "Electronic Licensing", which remained frustrated due to actions by the Public Ministry, given the existence of the "Annual Licensing" already paid by the vehicle owner.

Faced with this impasse, the private sector retreated from the use of the SINIAV model and advanced in the use of technologies and systems already in operation in automatic toll collection systems on concession highways. Gradually, the operators of these services have added other facilities to their customers, such as refueling at partner stations and access to private parking lots. There is a tendency for SINIAV to converge with the systems already in operation, which in Brazil have around 7 (seven) million vehicles with RFID tags. In view of this, SINIAV is already being reassessed, regarding its technological model, institutional arrangement and regulatory instruments to make its use possible as an instrument for automated collection of traffic data, enabling the implementation of numerous solutions for transport,

TECHNOLOGICAL ASPECT

Countless experiences have been implemented all over the world, aiming at the application of varied technologies, creative solutions and even conceptually revolutionary models, in the face of the current reality observed in cities that intend to become smart cities (Smart Cities). The vast majority, however, adopt technologies or solutions for specific needs, either to improve operational traffic control in certain areas, or to control urban transport systems. In urban spaces, Intelligent Transportation Systems (ITS) are an interesting solution for resource optimization, both for urban transport systems and for urban cargo logistics and road system control. The use of different technologies and systems makes it difficult,

In vehicle identification, RFID technology is most used: (a) in parking access control; (b) automatic release in tolls; (c) controlling access to restricted areas; (d) in vehicle rotation and; (e) in fleet control and management. In this case, the tag, normally in the form of an adhesive label with an internal microchip, is affixed to the vehicle's windshield, being identified as the vehicle approaches, as shown in Figure 1.

The technological model initially conceived for the SINIAV (Zero Generation), called the IAV Protocol, is based on the use of semi-active (or semi-passive) tags attached to the windshield. More recently, operators of services based on the automation of vehicle identification are migrating to passive adhesive tags of the stiker type, also attached to the vehicle's windshield. However, some reading problems have been recorded in vehicles whose glass is composed with the addition of metallic fibers. In addition, these models proved to be unfeasible for the automatic identification of motorcycles and road implements (trailers and semi-trailers), which do not have windshields, in addition to the wide variety of implement configurations, making it difficult to define a common point for tag fixing. It must also be considered

A NEW PROPOSAL FOR SINIAV

Through GMC Resolution No. 33

(Mercosur, 2014), the member countries of the bloc decided to standardize their vehicle identification plate models, called "Mercosur Patent". This regulation established the basic specifications of the new plaque, whose implementation must have been carried out by all member countries by January 1, 2016. After the deadline, only Uruguay and Argentina implemented it. Despite being the first to regulate (in 2014), this process was postponed, under the justification of the lack of a system for the integration of information, which is not justified, since the RENAVAM system already integrates with the Federation units through access links to the national database. Similarly, each member state of the bloc can open links to the others, allowing the exchange of information.

The evolution of the technological model of RFID tags, according to studies carried out by Barbosa (2017), allows the use of this device coupled to the primary plates (blank) of vehicle identification plates, so that its structure is used as an antenna to amplify the signal of radio frequency. The new generations of chips have proven to be more effective and at much lower costs than the technology regulated through the IAV Protocol, the SINIAV Generation Zero, with a natural tendency for the market to migrate to new technologies. THEFigure 2:shows the evolution of RFID technology in vehicle identification, since the Zero Generation of SINIAV, comparing it to the model proposed by Barbosa (2017).

Note that the proposed model is based on passive technology (without battery) and vehicle information was excluded, whose linkage will be systemic, maintaining all information security in the backoffice. This alternative brings only the identification of the chip (ID), encrypted and installed on the primary plate (blank) by the Casa da Moeda do Brasil, which holds the exclusivity for the production of federal tax stamps in Brazil. The absence of information about the vehicle or its owner on the tag (chip) preserves the constitutional right to privacy, reduces costs and allows the SINIAV to be implemented together with the new Vehicle Identification Plate with Digital Security. Additionally, Brazil has adopted other security elements, in addition to those provided for in GMC Resolution No. 33 (Mercosur, 2014), in order to use it as one of the instruments of the National Policy for Preventing and Combating Theft and Robbery of Vehicles and Cargo, established by Complementary Law No. 121 (Brasil, 2006). The proposed model will even allow the automatic identification of motorcycles and road implements (trailers and semi-trailers), as Figure 3.

NATIONAL INTEGRATED TRANSPORT INFORMATION SYSTEM

Some bodies of the Brazilian Federal Government have already adopted measures to move forward in automating the process of collecting traffic and load data on federal highways, including the use of RFID technology, with a view to integrating such information into unified bases. However, the guarantee of interoperability between the technologies and systems to be implemented and the effective integration will, in fact, occur with the implementation of SINIAV. In view of the discussions already held within the scope of the Brazilian Government, there is a guideline that the SINIAV is the basic element for important projects of national scope, such as Brasil-ID, the National Weighing Program, the National Traffic Counting Program, Canal Verde Brazil,

With the development of this new proposal for RFID technology embedded in the license plate, ANTT maintained its focus on expanding the installation of RFID

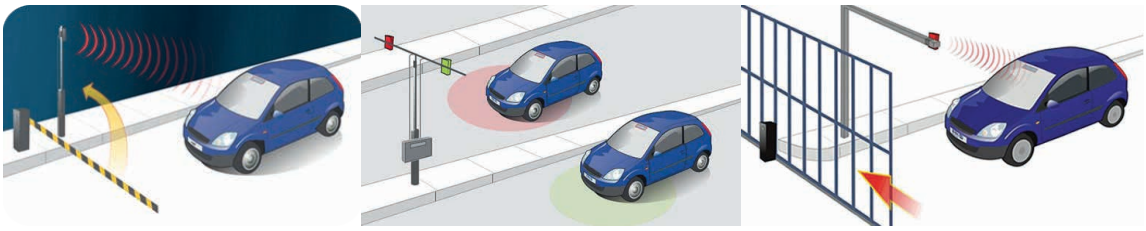

Figura 1: Use of RFID in vehicle location and identification (Oxxcode, 2011)

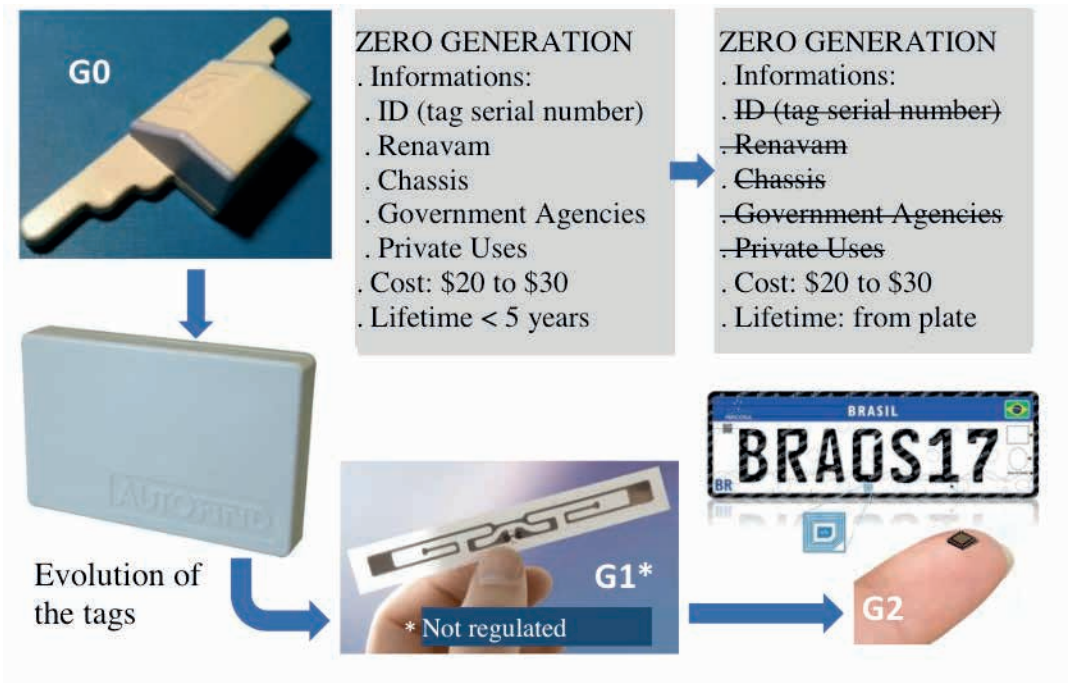

Figura 2: Evolution of the proposed technology for the new SINIAV generation (Barbosa, 2018).

Figura 3: Automatic identification of road implements and SINIAV with a chip on the new vehicle identification plate (Barbosa, 2018).

readers (Figure 4:) and in the development of the integrator system, containing data on the vehicle fleet, cargo transport operations declared electronically, and the compatibility of declared information with that registered with the Federal Revenue and state revenues. In the Canal Verde Brasil Project, 55 RFID readers were installed by December 2017. However, readers may be installed at around 3,600 points where there is already electronic speed control on federal highways, expanding the capacity and capillarity of inspection actions and uninterrupted collection data for operational control and transportation planning.

The National Integrated Transport Information System has been improved on a platform called the Transport Information Bank - BIT, in which analytical databases and georeferenced bases of the existing transport infrastructure in the country are already available. In the development stage, technologies and systems are being added that allow the selection of data by the user (internal or external), allowing the combination of different bases in a Business Intelligence – BI solution. In the next step, automated data collection through SINIAV will be added, as shown in the Figure 5.

Developed by the Ministry of Transport, Ports and Civil Aviation, the project was initially called "Intelligent Transport Solutions", later converging on the BIT information management platform, whose integration process will allow the uniformity of the information used for intersectoral planning purposes. , involving all bodies and entities linked to the Ministry of Transport and others, whose need for integration is necessary, such as the Federal Police, Federal Highway Police, Military and Civil Police, Federal and State Revenue and management bodies and traffic regulators and transport. THEFigure 6:schematically presents the proposed integration.

SINIAV AND INFORMATION INTEGRATION IN LATIN AMERICA

Although the SINIAV project was created as an instrument of the National Policy for Preventing and Combating Vehicle and Cargo Theft, its functionalities will allow for the improvement and consolidation of Latin American integration, since the same Protocol will be used to identification of containers and rail cars, as shown inFigure 7:, which can also be adopted for cargo, in the context of the Brasil-ID Project.

Identification of vehicles, containers and cargo will enable interoperability and integration of information between the various government agencies, at all jurisdictional levels, as well as use by the private sector for its management and operational control. This process, when adopted in other Latin American countries, will allow not only greater control over the flow of vehicles, but also as an instrument for preventing and combating crime and tax evasion. This measure will certainly strengthen Latin America economically, improving its competitiveness in the export of its products, as well as reducing logistical costs in the intracontinental flow. To this end, it is necessary to ensure the interoperability of the technologies and systems adopted by the countries that opt for the integration process,

CONCLUSIONS

Although the dynamics of the circulation of people, goods and services obey a known logic and, to a certain extent, controllable, not everything can be identified and/or monitored. It is clear that when using recent concepts such as the internet of things (IoT), or the internet connected to objects (ICO), intercommunication between everything

Figura 4: RFID readers installed in the Canal Verde Brasil Project (Barbosa, 2018).

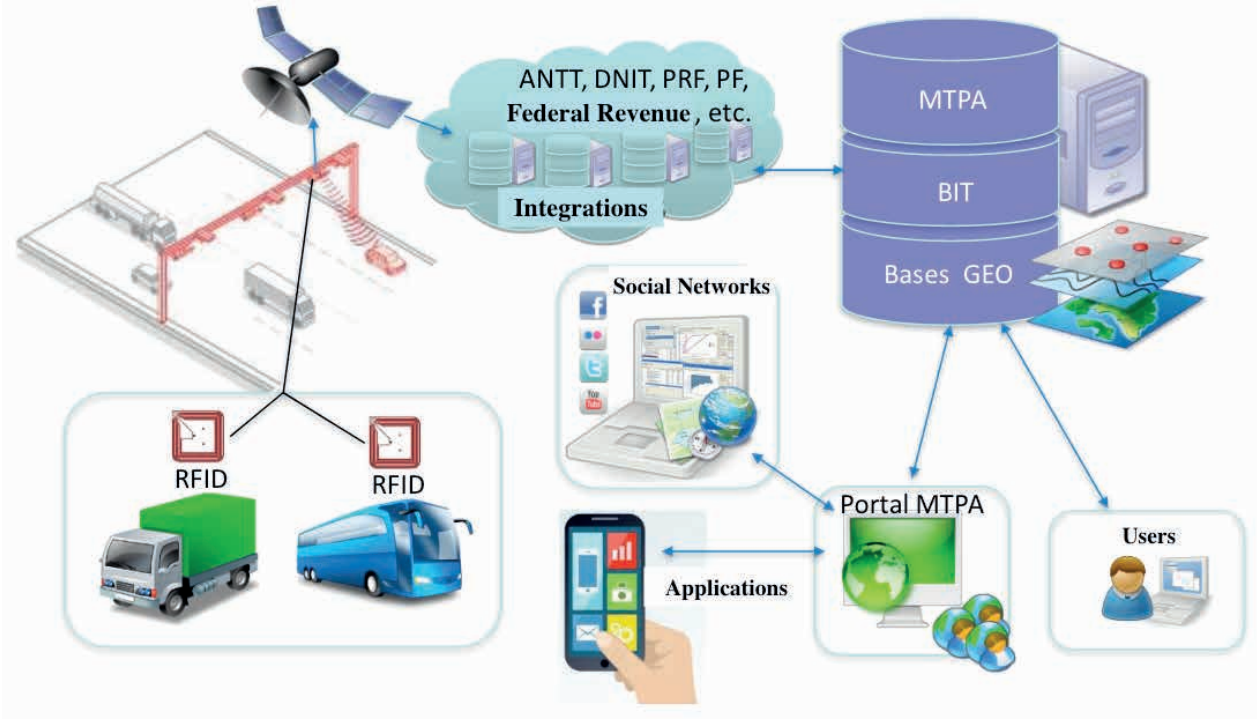

Figura 5: Information flow and management at BIT (Barbosa, 2017).

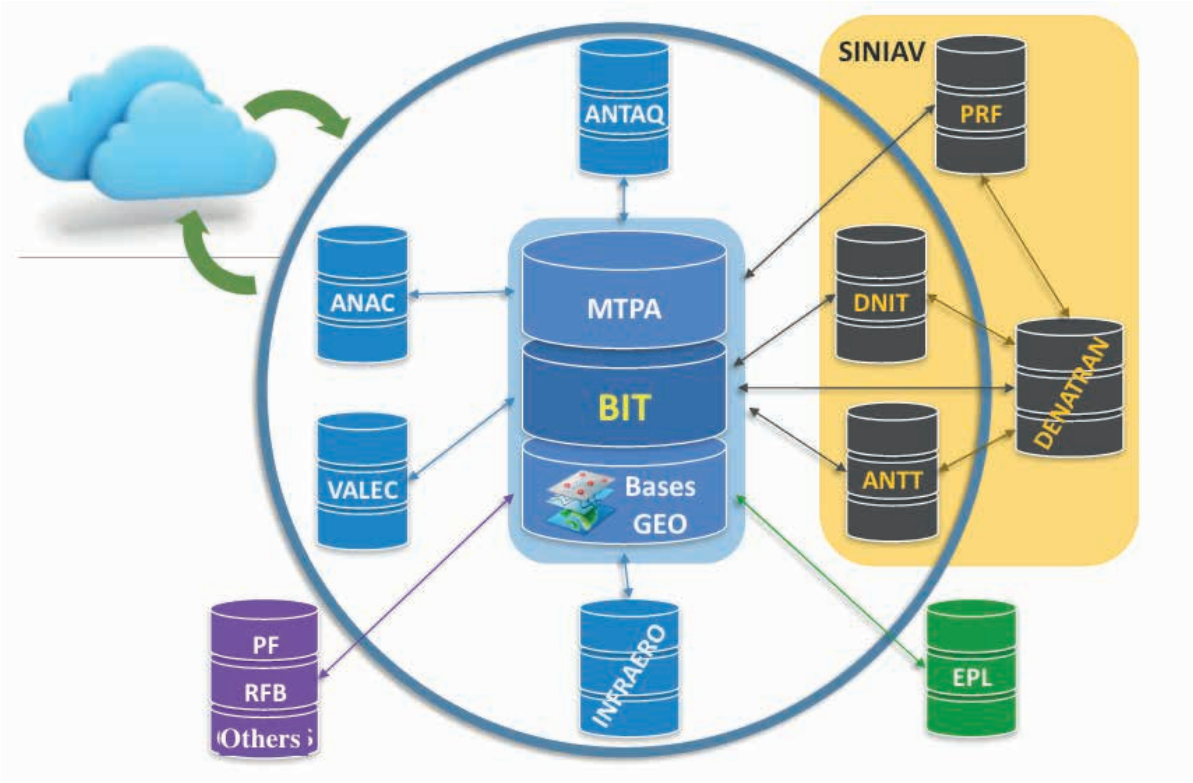

Figura 6: Integrations between external databases and BIT (Barbosa, 2017).

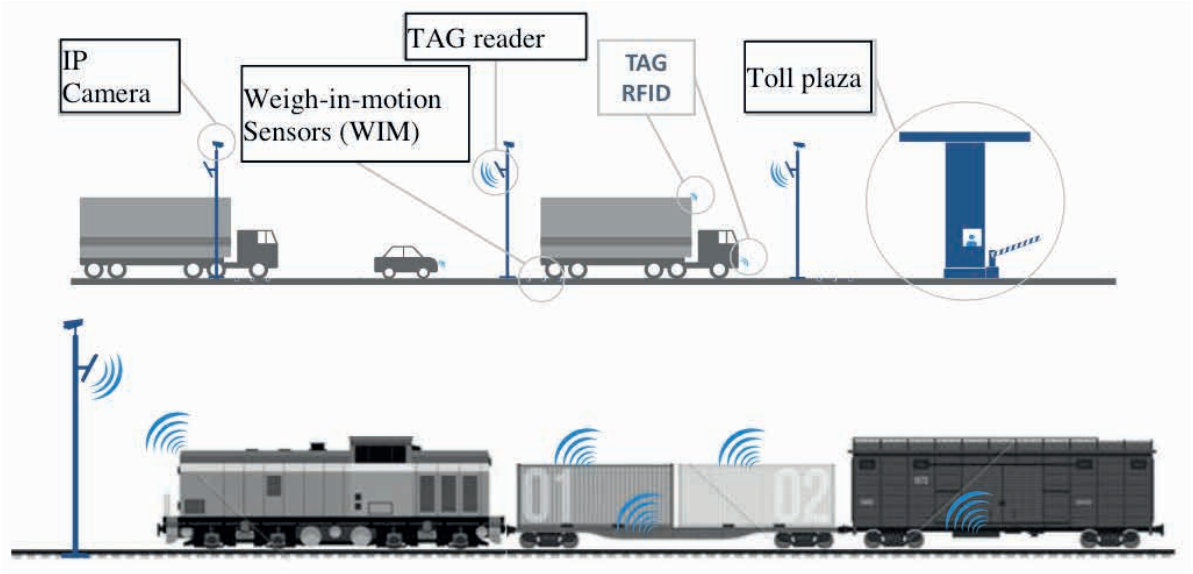

Figura 7: Operation of SINIAV on highways and railways (Barbosa, 2018).

and everyone is not assumed, but what one is interested in knowing (what) , the volume, weight or other dimension (how much), its location and movement (where) and the mode of transport (how) used in its movement. Thus, it becomes necessary to adopt a solution that allows interoperability between technologies, integration between systems and that has national coverage. In this context, SINIAV constitutes the tool established by the Brazilian Government for this purpose,

The SINIAV project, like other Information and Communication Technologies (ICT), involves an approach to institutional, regulatory and technological components, observing its technical, economic, environmental and social viability. As a result, the project had to be updated to the new technological models existing in the world, associating this need with the reduction of the economic and social costs of its implementation. As for the functionalities or applications of SINIAV, it represents economy for the public sector with inspection, information management, public safety, traffic management, logistics and cargo transport, passenger transport, in addition to providing data for planning and operational control of transport and transit. For the private sector and society in general, the project represents an important measure in preventing and combating theft of vehicles and cargo and enables the provision of numerous services to citizens, as demonstrated in this work. The integrative role of SINIAV in Latin America may take place gradually, starting with the automatic identification of Mercosur member vehicles, starting with the adoption of vehicle identification plates with digital security. For other countries, the process may occur through adherence to the IAV Protocol or compatible solutions that guarantee interoperability between technologies and systems. starting with the automatic identification of Mercosur member vehicles, starting with the adoption of vehicle identification plates with digital security. For other countries, the process may occur through adherence to the IAV Protocol or compatible solutions that guarantee interoperability between technologies and systems. starting with the automatic identification of Mercosur member vehicles, starting with the adoption of vehicle identification plates with digital security. For other countries, the process may occur through adherence to the IAV Protocol or compatible solutions that guarantee interoperability between technologies and systems.

REFERENCES

BARBOSA, R. E. (2017). Metodologia para o Estabelecimento de Diretrizes para a Implantação do Sistema Nacional de Identificação Automática de Veículos - SINIAV. Tese de Doutorado em Transportes, Publicação T.TD-006/2017, Departamento de Engenharia Civil e Ambiental, Universidade de Brasília, Brasília, DF, 259p. Disponível em http://transportes.unb.br

BARBOSA, R. E. (2018). ***Placa MERCOSUL e SINIAV***. Apresentação. Brasília, DF.

BRASIL (2006). Lei Complementar nº. 121, de 9 de fevereiro de 2006.Cria o Sistema Nacional de Prevenção, Fiscalização e Repressão ao Furto e Roubo de Veículos e Cargas e dá outras providências. Brasília/DF.

CONTRAN – Conselho Nacional de Trânsito (2006). Resolução nº 212, de 2006. Dispõe sobre a implantação do Sistema Nacional de Identificação Automática de Veículos – SINIAV em todo o território nacional. Brasília/DF. Disponível em http://www.denatran.gov.br/resolucoes.

CONTRAN – Conselho Nacional de Trânsito (2014). Resolução nº 510, de 2012. Estabelece sistema de Placas de Identificação de Veículos no padrão disposto na Resolução MERCOSUL do Grupo Mercado Comum nº 33/2014. Brasília/DF. Disponível em http://www.denatran.gov.br/resolucoes.

CONTRAN – Conselho Nacional de Trânsito (2015). Resolução nº 537, de 2015. Dispõe sobre a implantação do Sistema Nacional de Identificação Automática de Veículos – SINIAV em todo o território nacional. Brasília/DF. Disponível em http://www.denatran.gov.br/resolucoes.

MERCOSUL (2014). ***Patente Mercosur***. Resolução GMC nº 33/2014. Grupo do Mercado Comum.

OXXCODE (2011). ***Mobility Solutions***. Apresentação. Oxxcode, São Paulo, SP.