NEW TECHNOLOGIES FOR NOTA FISCAL PAULISTA (SÃO PAULO TAX INVOICE): AUTOMATION OF THE TAX DOCUMENTS ISSUE PROCESS IN THE RETAIL OF THE STATE OF SÃO PAULO - BRAZIL

Newton Oller De Mello, Marcelo Luiz Alves Fernandez, Vidal Augusto Zapparoli Castro Melo, Eduardo Mario Dias, Caio Fernando Fontana
Power and Electric Automation Engineering Department
Polytechnic School of the University of São Paulo
Av. Professor Luciano Gualberto, Trav. 3, 158, Room A2-06
Brazil
newton.oller@gmail.com, mlafernandez@gmail.com, vidal@pirus.com.br, emdias@pea.usp.br, caioffontana@uol.com.br

Abstract: This article presents requirements and a technological proposal for improvement of the project of Nota Fiscal Paulista (São Paulo Tax Invoice) of the Government of the State of São Paulo – Brazil, aiming at the automation of the process of issuing the electronic tax documents in the retail. The work has been developed based on the analysis of the current environment of São Paulo Tax Invoice and other electronic document projects implemented by the Secretariat of Finance of the State of São Paulo and presents new operating and technology use concepts that may meet the requirements of the business. The term “technological” in this work is employed to define equipment, communication means and software engineering that permit to extend the computing support to the field, with the purpose of improving and speeding up the operations.

Keywords: Electronic Tax Documents, São Paulo Tax Invoice, Wireless communication, Tax inspection

1 Introduction
Brazil is a Federative Republic comprising 26 States and 1 Federal District, it counts on over 183 million inhabitants, it occupies an area of 8.5 million square kilometers, and presented a gross domestic product – GDP of over 1.5 trillion dollars in 2008 [3].

São Paulo is one of the main Brazilian States, occupying an area of 248,808.8 square kilometers, a little larger than the United Kingdom. It is the administrative unit with the third large population in South America, surpassed only by the country itself and slightly by Colombia, surpassing Argentina and all other South-American countries. It has the largest population in Brazil: with more than 40 million inhabitants distributed in 645 municipalities [11].

As is the richest of the federative unit, São Paulo is also responsible for over 31% of the country’s GDP, legitimating its status of “economic engine” of Brazil for having the better infrastructure, qualified labor force, manufacturing high technology products, besides having the largest industrial system and the largest economic production [11].

One of the most important taxes in Brazil, intended to supply funds to the 26 States and the Federal District is the tax on the circulation of goods, the so-called ICMS - Tax on the Circulation of Goods and on provision of interstate and intermunicipal transportation and communication services, a kind of Value-added tax.

In 2008, the collection of ICMS in Brazil exceeded the mark of 110 billion USD, and São Paulo was the State with highest shares in this tax, with about 34.3% [4].

The most common means used for the control of ICMS by the States is by requiring the issue of tax documents: at every operation with a good, the company is compelled to record this operation in tax invoices or tax vouchers. These documents must then be recorded in specific books (this activity is called bookkeeping), in which the taxes due are assessed by the compensation with credits resulting from the entries (purchases) over the debts of exits (sales). If in this assessment a payable balance remains, the company must pay the amount due to the public treasury.

This system applies to all sectors of the economy that handle goods, in particular the industry and commerce.

In the case of the industry and wholesalers (that is, the trade of goods intended for resale, and not individual consumption), the issue of the tax invoice is a demand that aims at detailing the data of the seller and the purchaser of the good, as well as the
items traded, with a specific concern with the amount of tax to be transferred by the tax document.

Aiming at improving the control in these segments, the Brazilian government has started to adopt, since 2006, the Nota Fiscal Eletrônica (NF-e) (Electronic Tax Invoice), an electronic modality of issue of a tax document that provides, among other advantages, the knowledge, in real time, by the tax authorities, of the operations occurred in the country [9].

In the retailing segment, in turn, as the last ring in the consumption chain, the tax control is made, as a rule, by the requirement of issue of a simpler tax document, called cupom fiscal (tax voucher), which is issued by a piece of equipment called tax voucher issuer – ECF.

However, there is much difficulty to properly inspect the retailers, either for the large number of commercial establishments (only in the State of São Paulo it exceeds for 400 thousand), for the cultural and tax education aspect, since many times the end consumers do not demand the issue of the tax voucher, causing a reduction in the collection and, consequently, of funds for the State.

In this context, with the purpose of facing this problem, the Secretariat of Finance of the State of São Paulo institutes in 2007 an incentive program for the consumers of São Paulo to request the tax document in all its purchases in retailers, motivated by the return of a portion of the tax paid by the commercial establishment to the consumer. This measure called “Program for Incentive to Tax Citizenship of the State of São Paulo” had as main initiative the institution of the São Paulo Tax Invoice [12].

Basically, by the São Paulo Tax Invoice Program, the commercial establishment must, besides issuing the tax voucher in all its sales of goods, include the identification of the consumer that so requests and make an electronic registration of this document in the Secretariat of Finance website. Based on these electronic records, the Secretariat of Finance can calculate and grant the premium-credits to the consumers that request the São Paulo Tax Invoice.

São Paulo Tax Invoice showed to be a very successful initiative, either for the increase in the tax collection it caused, or by the numbers of participating consumers and commercial establishments.

In spite of the success already conquered, some points of the model still need to be improved, for the consumers to have access, in a faster manner, to the information of its tax documents and, thus, more closely follow up their credits, and for the commercial establishments also to have some benefits in reducing costs and simplifying accessory obligations with the program.

This article aims, then, based on the current scenario of the São Paulo Tax Invoice Program and the survey of potential points for improvement, at beginning the design of a proposal for use of the communication technology for the transmission of information related to tax documents in the retail, thus simplifying the process of electronic registration by the commercial establishments and opening new possibilities of monitoring and follow up of the commercial operations by the São Paulo Tax Authority.

2 São Paulo Tax Invoice

The São Paulo Tax Invoice is inserted in the Program of Incentive to Tax Citizenship of the State of São Paulo (State Law 12.685/2007) and has as purpose to encourage the consumer to require the tax in all their purchases of goods in the retailer [12].

As incentive for this cultural change, the government of São Paulo decided to return 30% of the tax paid by the commercial establishment to those consumers that request the tax invoice in their purchases. This credit may be used by the consumer as a discount in other state tax, the tax on the ownership of automotive vehicles – IPVA, and may even be withdrawn in cash directly to the current account of the consumer.

Besides the credit, for every US$50 registered in the website of the Secretariat of Finance in São Paulo Tax Invoices in name of the consumer, he/she will be entitled to an electronic bill to compete for casting of lots of premiums in cash.

When the consumer requests the São Paulo Tax Invoice in its retail purchases, he/she contributes to a process of fighting evasion, leading to a regularization not of the commercial establishment where the acquisition was made, but also of all the consumption chain, compelling the wholesalers and the industry also to issue their tax invoices and pay their taxes.

Some numbers of the São Paulo Tax Invoice demonstrate the magnitude of the project and its success. Since the implementation of the São Paulo Tax Invoice in October 2007 up to July 2009 more than 600 million dollars have been returned to the almost 5.4 million consumers of São Paulo who participating the program. For that purpose, the Secretariat of Finance of the State of São Paulo received and processed over 4.8 billion records of tax documents sent by over 490 thousand commercial establishments [10].

The operating model of the São Paulo Tax Invoice is relatively simple. When acquiring his/her
goods, the consumer informs his/her registration number with the Brazilian Federal Revenue Service to the commercial establishment, to that it is recorded in the tax document related to the acquisition.

The commercial establishment shall issue a manual tax invoice or a tax voucher and must provide the Electronic Registration of the Tax Document - REDF, in the website of the Secretariat of Finance up to 19th day of the month after that of the sale. It is worth highlighting that over 85% of the tax documents recorded with the Secretariat of Finance of São Paulo refer to tax vouchers issued by ECF [10].

The consumer, through his/her password registered on the Internet, has access to several functionality in the portal of São Paulo Tax Invoice. Among them, the consumer may check whether the tax documents he/she requested have been recorded in the system by the suppliers, and may even make denouncements by the system, as well as he/she may follow up his/her credits and make use of them.

It is interesting to highlight that, in the purchases in which the consumers do not inform their CPF or CNPJ, the value of the corresponding credits may be intended to social assistance non-profit entities registered by the Secretariat of Finance.

In spite of the great success reached by the São Paulo Tax Invoice, there are still points that could be improved in the model.

For the consumers, the delay for the registration of the tax documents by the commercial establishments is non incentive since, as a rule, only in the month after that of the purchase the consumer may know whether their tax documents were registered or not. Besides, the long term for registration also implies in the delay for processing of credits by Secretariat of Finance.

On the other hand, for the commercial establishments, the introduction of the São Paulo Tax Invoice represented another accessory obligation imposed by the Tax Authority, with no apparent benefit, becoming an additional cost. Besides issuing the tax document, the commercial establishment has, with the São Paulo Tax Invoice, the obligation to make the electronic registration of the information of this document in the website of the Secretariat of Finance.

In order to comply with the obligation of this registration, many times the commercial establishment has to hire an accountant or a technical assistant to extract the information of the tax documents of ECF and transmit it to the Secretariat of Finance.

3 Tax Voucher Issuing

Equipment - ECF

Currently, the legislation of the State of São Paulo defines that every registration of sales to the consumer made by commercial establishments with turnover above US$ 60 thousand per year must be registered in equipment called ECF – a tax voucher issuer.

ECFs have been created with the intention of standardizing the several kinds of tax documents that were accepted by the state tax authorities through special regimes, where each State understood and accepted a kind of document automatically issued by a cash register as a tax document.

Starting in 1983, groups of manufacturers have joined and proposed to the Tax Authority the standardization of a tax legislation which would benefit the tax authorities, manufacturers and mainly the traders.

The result of this union permitted the definition of national standards in replacement for the special regimes for automatic issue of the tax vouchers, which have been modified and improved along the years. The standard currently used has been defined by a national legislation, Convention ICMS 85/01 [2].

This Convention was published in October 2001 and establishes the hardware and software requirements for the development of a Tax Voucher Issuer (ECF) equipment, as well as the procedures applicable to the ECF user taxpayer [2].

The tax voucher is a simplified tax document in relation to the tax invoice, issued from this specific piece of equipment, called Tax Voucher Issuer – ECF, certified by the Tax Authorities, in which all information of the operations performed by the commercial establishment are recorded in the “paper coils”.

We present below a summary of the technical characteristics of the ECFs currently in use in Brazil.

3.1 Type of equipment

Basically, there are 3 types of standardized ECFs in Brazil:

- ECF – MR: Cash Register – ECF with operation independent from an external application program – called in this document as Tax Application Program (PAF), of specific use, provided with its own keypad and display.
- ECF - IF: Tax Printer – ECF implemented as a specific purpose printer, that receives commands from an external computer.
ECF – PDV: POS Terminal – ECF that comprises in one single system the equivalent to an ECF-FI and the computer that sends it the data.

The ECF most used by the commercial establishments is the ECF-IF, that can be understood as a printer comprising special functionality to store and control the tax documents issued.

3.2 Components of the ECF

The following are integral parts of the ECF solutions:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax controlling card</td>
<td>A set of internal resources of the ECF that concentrates the functions of tax control</td>
</tr>
<tr>
<td>Detail Tape Memory</td>
<td>A memory for storage of the data required for the full reproduction of all documents issued by the equipment</td>
</tr>
<tr>
<td>Basic Software</td>
<td>A fixed set of routines, residing in the Tax Controlling Card, that implements the functions of tax control of ECF and functions of hardware verification of the Tax Controlling Card</td>
</tr>
<tr>
<td>Tax Memory</td>
<td>Set of data, internal to the ECS, that contains the identification of the equipment, the identification of the user taxpayer, the tax logo, the control of technical intervention and cumulated amounts daily recorded in the equipment.</td>
</tr>
<tr>
<td>Work Memory</td>
<td>Changeable storage area in the Tax Controlling Card, used for registration of information of the equipment and parameters for the programming of its operation, the user taxpayer, accumulators and identification of products and services.</td>
</tr>
<tr>
<td>Technical Intervention Mode</td>
<td>State of the ECF in which the direct access is permitted for purposes of maintenance</td>
</tr>
<tr>
<td>Basic Software Version</td>
<td>Identifier of the version attributed to the basic software by its manufacturer or importer</td>
</tr>
<tr>
<td>Tax Logo</td>
<td>Are styled letters “B” and “R” that appear in the end of all valid tax voucher</td>
</tr>
<tr>
<td>Programming parameters</td>
<td>Configurable parameters that define the operating characteristics of ECF</td>
</tr>
<tr>
<td>Manufacturing Number</td>
<td>Set of 20 characters that identifies an ECF</td>
</tr>
</tbody>
</table>

As the Secretariat of Finance of the State of São Paulo understands that this scenario is not enough to meet the new tax demands, as well as to cure the several deficiencies of the ECF currently in use in the country, it established a partnership with the University of São Paulo to make a task force comprising specialists in the tax and technological area to study new alternatives for access for the retail tax information.

4 Methodology of study

The purpose of the task force was to correlate the existing technologies with the needs of control indicated by the tax authorities and to improve the program of the São Paulo Tax Invoice, resulting in the proposition of a new concept of equipment for tax control.

4.1 Fragility of the Current ECF

The concept of ECF has been changing and being adapted along time, based on the technologies and security concepts available at each time.

Clearly, the currently in use ECF has been built based on the concept of a safe box, where the tax information stored should be protected by mechanisms against removal and change at hardware level, making the equipment expensive and hard to manufacture.

The large number of memories, processors and controllers have been demanded along the evolution of the equipment, increasing its costs, complexity and demanding technical intervention by third parties.

Each check-out or Point of Sale must have an ECF, generating a unit cost to the commercial establishment, that varies from US$ 1,000.00 to US$3,000.00.

The seals are physical and visible, not evidencing to the inspectors, and much less to the consumers, the possible changes to the content or to the internal mechanisms of ECF.
The current ECF also does not have mechanisms to transmit the tax information directly to the Secretariat of Finance, thus making the process of inspecting and accounting the amounts related to the São Paulo Tax Invoice difficult.

In spite of all this technical complexity of ECF, it was not enough to discourage the frauds in the equipment with the purpose of tax evasion.

The technical intervention, for instance, is one of the processes that serves as one of the entry doors for frauds, as it permits the internal components of ECF to be changed.

The main frauds already identified with ECF and its feasibility of occurrence are listed in the following table:

<table>
<thead>
<tr>
<th>FRAUD</th>
<th>Description</th>
<th>FEASIBILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change to the Basic Software of the Equipment with the recording of another basic software in the EPROM, that corrupts the information sequence.</td>
<td>It is technically feasible, as the equipment permits technical intervention.</td>
<td></td>
</tr>
<tr>
<td>Bypass – It bypasses the tax controlling card, not recording anything and ignoring all the logical protection of the equipment</td>
<td>It is technically feasible, as the equipment permits technical intervention.</td>
<td></td>
</tr>
<tr>
<td>The purchase of two pieces of equipment by the taxpayer, one that is regular and another that is irregular. The irregular equipment issues a fake tax voucher and the regular equipment issues the vouchers that will be recorded with the tax authority.</td>
<td>It is technically feasible, as the tax document does not have any kind of authentication or validation.</td>
<td></td>
</tr>
<tr>
<td>Change of the Eprom that permits the operation of Cleaning of working memory along the day through a &quot;software&quot; to erase the information before it is sent to the tax memory.</td>
<td>It is technically feasible, as the equipment permits the technical intervention and partially solved with the Detail Tape Memory.</td>
<td></td>
</tr>
</tbody>
</table>

Components in the tax controlling card – made by the manufacturer – which once driven by a physical command defraud the records of ECF.

**FEASIBILITY**

Equipment not certified or defrauding manufacturer.

**FRAUD**

The so-called evil key, only sending the tax information to the ECF if the consumer requests a voucher.

**FEASIBILITY**

Executed in the PAF (Tax Application Program), it performs a buffer of information and disregards it in case the consumer does not request a voucher for the sales.

In order to fight and make the ECF frauds harder, the tax authorities started to demand from the commercial establishments a series of other complementary tax control procedures, called accessory obligations.

The main accessory obligations performed by the ECF user taxpayers are:

- Obtaining of authorization by the Secretariat of Finance for the acquisition and use of ECF;
- Use of seals with numbering controlled by the Tax Authorities;
- Any intervention in the ECF may only be made by an intervener authorized by the Secretariat of Finance;
- Obligation of making a daily reading by ECF of the operations performed in the day and it must be printed and stored for 5 years;
- Obligation of keeping for 5 years the paper coils containing the 2nd copy of the vouchers that were issued by the ECF;
- Obligation of registering in the book of registry of sales of the operations performed by ECF, with entries per day and piece of equipment;
- Obligation of generating an standardized electronic file containing the information of the tax vouchers generated by ECF;

### 4.2 Definition of the requirements

In order to be able, on one hand, to improve the program of São Paulo Tax Invoice, by reducing the term of registration of the tax vouchers and simplifying the accessory obligations for companies, and, on the other hand, to be able to have a technologic alternative to ECF that permits to face the frauds carried out through this piece of
equipment, some requirements and functionality have been established that the new concept should contemplate.

- Reduction of cost in relation to the current ECF;
- Simplicity for the taxpayer by reducing the number of accessory obligations;
- The equipment should be easy to use and install (Plug-and-Play);
- Not permit or demand technical intervention;
- Facility for acquisition;
- Guarantee of security in all process;
- Legal validity of the tax documents generated;
- Guarantee of the time of issue of the tax documents (time stamp);
- Automated transmission of tax information;
- To permit the follow-up and monitoring by the Tax Authorities at a distance;
- Possibility of the Secretariat of Finance to change the parameters at a distance;
- Generation of the tax document number by the equipment;
- To permit more efficient audit and inspection processes by the Tax Authorities.

The model should not further be bound to a certain technology, always aiming open standards and general-use technologies found in the market.

To meet the goals of the project, the team needs to address three different areas: hardware, software and communication. The inter-relationship of these areas comes from the need for compatible technologies in accordance with the availability in the market at the time of execution of the project, following international standards, with the purpose of allowing evolution.

The combination of the three areas should ensure data security, availability in the event of failure, integration with existing systems, integration with future systems and scalability.

4.3 Creation of scenarios for work

During the work of analysis of the current situation, 3 possible scenarios have been identified for the continuity of the works, as follows:

4.3.1 Scenario 1

Scenario 1 considers a tax module that is fully integrated into one single piece and uses a non-tax external and common printer.

The tax module comprises two external interfaces:

- USB Port: It permits the communication between the cash front software (application) and the tax module, besides being the feeding port for the tax module;
- GPRS Modem: It performs the transmission through a private cellular network.

Scenario 1 does not need technical intervention and, therefore, must be shielded to reduce the possibility of frauds.

4.3.2 Scenario 2

Scenario 2 is the one that adheres the most to the current situation of ECF, and it is defined as a printer plus a tax module and a communication module.

Scenario 2 has three external interfaces:

- USB Port: It permits the communication between the cash front software (application) and the tax module, besides being the feeding port for the tax module;
- GPRS Modem: It performs the transmission through a private cellular network.
- External feeding: External feeding port for the printer.

Scenario 2 must create internal sealing mechanisms, as the equipment may suffer technical intervention (i.e., printer maintenance). Therefore, it has the same possibilities of frauds of the current ECF.

4.3.3 Scenario 3

The difference between scenario 3 and scenario 2 is that in this scenario all modules (printing, tax and communication) must be integrated into one single card, as it is currently used in the Point of Sale – POS.

Scenario 3 has three external interfaces:

- USB Port: It permits the communication between the cash front software (application) and the tax module, besides being the feeding port for the tax module;
- GPRS Modem: It performs the transmission through a private cellular network.
- External feeding: External feeding port for the printer.

Scenario 3 does not need the technical intervention, however it cannot be completely shielded, as it needs movable parts for the exchange of printing paper coils.
5 Technological proposal

Taking as basis the requirements established for the new concept of tax control equipment and the alternatives existing in the several scenarios, the best option was understood to be scenario 1.

For the development of the new piece of equipment the deepening of the technical studies will be necessary, in particular, to assure:

- that the tax documents generated by the equipment have legal validity, leading the equipment to incorporate the use of a digital certification technology;
- the control of the temporality of issue of the tax documents, incorporating the clock synchronism and time stamp technology;
- the security of equipment, incorporating tax protections as regards undue intervention, as well as logical protection of the software and the serial identification of the equipment;
- The two-way communication, both for transmission of tax vouchers issued and for the monitoring, and the update of parameters by the Secretariat of Finance through the use of a data communication network with a GPRS cellular technology;
- the capacity of the system against the expected volume of hundreds of thousands of pieces of equipment simultaneously in use in the State of São Paulo at the time of its implementation in replacement of the current ECFs throughout the São Paulo retail business;

6 Conclusion

Brazil has significantly advanced in the last years in the modernization of its tax administrations (either federal or state), with the use of new technologies [9].

A proof of this fact is the success of the implementation of the Electronic Tax Invoice project, replacing for the paper tax invoices in commercial operations between companies with electronic documents with legal validity based on digital certification. The electronic official Bill/Electronic Tax Invoice will have its definitive influence in 2010 with its use starting to be required for all Brazilian industry and wholesale business.

In the commercial retailing operations, Brazil has been using, for several decades, a piece of tax voucher issuing equipment, that has as basic characteristic to serve as a true safe box for the tax information.

However, this piece of ECF equipment, besides representing a very high cost for the commercial establishments because of several security requirements that have been incorporated along the years by demand of the Brazilian Tax Authorities, also continues to present fraud problems.

However, the Brazilian tax modernization scenario has also started to cover the segment of retail sales starting in October 2007, with the implementation by the Secretariat of Finance of the State of São Paulo, of the São Paulo Tax Invoice program that returns a portion of the tax paid by the commercial establishment to the consumers that request the tax voucher in their purchases of goods in the retailing establishments.

With the studies that are in progress by the Secretariat of Finance in partnership with the University of São Paulo, aiming at the development of a new piece of equipment of tax control that replaces for ECF, a new age in the inspection of the commercial operations in Brazil’s retail sales is developing with benefits for the companies, the consumers and the Tax Authorities.

In this regard, the proposal under study is the development of a piece of equipment that assures security to the tax information, with legal validity and time stamp, and that permits not only the transmission of tax vouchers issued by a cellular communication network, but that permits the remote monitoring and update of parameters by the Secretariat of Finance.

The innovative aspect of the proposed solution should be mentioned, since it was worked on top of the convergence of different technologies and protocols, and the adoption of mobility was a decisive factor in the success of the process.

The scaling of the solution is a challenging issue, which requires a careful study of the workload from real situations, characterization of users and
almost realistic simulations, allowing to determine the best settings and possible bottlenecks in the system.

With the success of implementation of the Electronic Tax Invoice and now with the development of a new electronic solution, also for the tax documents of the retail segment that starts in the State of São Paulo, Brazil is in its way to the construction of a new tax paradigm where the valid tax documents will be only the electronic documents contained in the database of the Tax Authorities [5].

References: