ELECTRONIC INVOICING MODELING

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ABSTRACT

One of the most important subjects in the European Commission's initiative named Digital Agenda for Europe is electronic invoicing (e-invoicing). Having in mind enormous savings and ecological benefits compared to paper invoices, it is a high priority to migrate to machine readable format. But the job is not that easy, since there are still a lot of legal obstacles, different data formats and security implementations that should be harmonized. This paper suggests an applicable model for electronic invoicing, taking into account the latest EU recommendations.

I. INTRODUCTION

Invoicing is one of the key processes in the business relations between the seller and the buyer. It is an essential part of every commercial transaction for supplying goods or services. Since it contains all important information about payment and taxes, it is also the document of the highest interest for the Tax authorities.

According to the final report of European Commission Expert Group [1], electronic invoicing is "sending or making available of an invoice and its subsequent processing and storage, wholly by electronic means".

Transition from paper to electronic invoices (e-invoices) brings numerous benefits for all involved parties. Firstly, companies have straight savings in material and transport costs, because of a reduction of printed invoices and postal or courier services. These two factors also bring positive effect on the environment. Then, the payment cycle is being accelerated, thus improving the financial liquidity. But, the biggest advantage arises from the automation of the processes. When e-invoices are exchanged in a machine readable format, companies can automate the procedures for sending and receiving invoice data. Compared to the manual processing of invoice, this reduces the possibility of errors virtually to zero. One European funded research [4] shows 70-75% of cost savings in favour of electronic over paper invoice, which brings projected savings of about EUR 240 billion for six-year period.

It is estimated [1] that there are over 400 service providers for e-invoicing in Europe that operates mainly on national level, working with various formats and platforms. The market is still very fragmented and unexploited, and currently less than 10% of all invoices in Europe are exchanged by electronic means [3]. The market penetration of e-invoicing in Europe is shown in Fig. 1. These facts drive several European bodies to work on enabling wider acceptance of e-invoicing, especially by the SMEs (Small and Medium Enterprises). It is stated in the Communication [2] that "the Commission wants to see e-invoicing become the predominant method of invoicing by 2020 in Europe". To achieve this goal, there are several priorities to be accomplished, such as legal harmonization and certainty, clear technical environment, promotion of open solutions based on common standard, and setting up organizational structures for implementation within EU and member states.
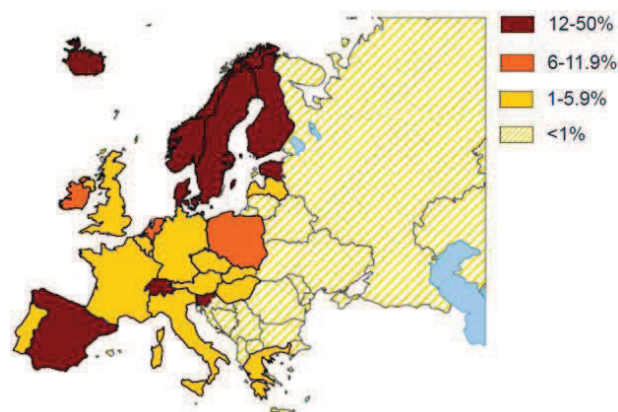

Figure 1: E-Invoicing B2B Market Penetration
(Source: Bruno Koch, Billentis, estimation 2010)

This paper proposes a model for electronic invoicing that can be implemented in Republic of Macedonia, knowing that no such system exists yet. The main objectives are to build a system which is aligned with EU references, secured to use and yet to create the lowest possible difficulties for acceptance of domestic companies, including SMEs. It should offer them benefits from using it and serious cost reduction.

The organization of the paper is as follows. The next section contains an overview of basic referent models, some legislative issues and EU standard data formats. The model itself is presented in the third section. The fourth section deals with the problem of long-term signatures. The final section concludes the paper, also giving several directions for future work.

II. OVERVIEW

As described in [5], there are three referential Electronic Invoice Presentment and Payment (EIPP) models:

i. Seller direct - the seller provides all necessary functions for the buyers to receive, dispute or even pay invoices;

ii. Buyer direct - all applications are hosted at buyer's side, providing sellers with interface for delivering invoices, dispute management, notifications etc.;

iii. Consolidator (shown in Fig. 2) – there is a third party (service provider) that establishes connections between multiple sellers and buyers. It provides functions for both parties, such as registration, invoice delivery and collection, dispute management and payment processing;
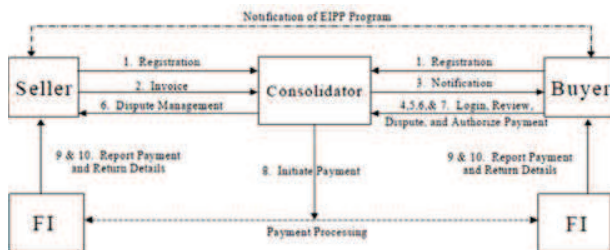
Figure 2: Consolidator Model (Source: CEBP, 2001 [5])

Consolidator model enables companies to have access to their business partners by connecting only to one point, via standardized interface. Consolidators may also offer various additional services to its clients. The proposed system in this paper is based on consolidator model.

A. Legislative Issues

Invoicing concept, definition and obligations are regulated in the EU Council Directive 2006/112/EC [6] on the common system of VAT. However, there is a big diversity of legal conditions in different Member States regarding invoicing and value added tax (VAT), which causes difficulties in cross-border operations inside EU as one internal market. Having regard to that, the EU Council adopted Directive 2010/45/EU [7] on 13 July 2010, which amends Directive 2006/112/EC on the invoicing rules. The major consequence of this Directive is that paper and electronic invoices are treated equally, with one difference remaining, as stated in Article 232, that electronic invoice is used if accepted by the recipient. For both forms of invoices authenticity, integrity and legibility must be guaranteed from the issue time until the end of storage period. These conditions "may be achieved by any business controls which create a reliable audit trail between an invoice and a supply of goods or services". The two previously imposed methods for ensuring authenticity and integrity: Advanced Electronic Signature and Electronic Data Interchange (EDI) are stated only as examples. Another important provision is that the online invoice store of a taxable person should be accessible both by the competent authorities of the host country and the country in which tax is due, for control purposes. All Member States should align their laws and regulations according to the Directive 2010/45/EU by 31 December 2012 at the latest.

In Republic of Macedonia, invoicing is mainly regulated in the VAT Law [8] and the Regulation on implementation [9]. Article 53(2) of the law defines the term invoice as "every document issued by the taxable person or other authorized person for a completed trade". The words "paper" or "electronic" invoice or document are not mentioned anywhere in the Law. But, one could easily draw a conclusion that it is all about paper invoices. For example, Article 53(10) says that every invoice must contain signature and stamp. On the other hand, there is a Law on electronic data and electronic signature [10] which states that one electronic data cannot be refused or not accepted only because it is in electronic format. Therefore, changes have to be done in order that this law becomes compliant with EU Directives and that paper and electronic invoices are equally treated. This is a basic precondition so that the system being proposed in this paper can be deployed.

B. Data Formats

At the present there is a variety of invoice formats used by the companies across Europe, many of them accepted by invoice service providers. One popular format in big multinational companies is EDI, which is used for bilateral transfer using agreed format and can be very hard to implement at SMEs. Respectable number of electronically exchanged invoices is still in non-structured format, such as PDFs, image scans, where automatic processing is very difficult to be achieved. Another clear reason to introduce standardized data format is to enable interoperability between different service providers, both for internal and cross-border communication.

EC Communication [2] addresses promotion of a standard data model as one of the key priorities for faster development and adoption of e-invoicing. Expert Group in [1] recommends UN/CEFACT Cross-Industry Invoice (CII) v.2[1] as a basis for European standard data model. UN/CEFACT is a subsidiary body of the UNECE (United Nations Economic Commission for Europe) Committee on Trade, which develops electronic standards for international trade. CII is xml-based standard that meets the requirements from different industry branches. Furthermore, the European Committee for Standardization (CEN) started a project to develop European Core Invoice and implementation guidelines for the UN/CEFACT CII syntax, expecting final deliverables by the middle of 2011. European core invoice shall contain minimum information that fulfils requirements of majority of trading partners.

Our model will use minimum necessary set from CII v.2 data format, so that it fulfils conditions in Article 53 of Macedonian VAT Law for the data that must be contained in every invoice. Once European core invoice is defined, it would be essential to check what changes are needed both in the data format and the national law, so that it conforms to European standards.

III. MACEDONIAN E-INVOICING MODEL

A. Model Requirements

On the grounds of previously discussed suggestions, standards and practices, the following non-functional requirements emerge:
- to align with the EU recommendations and norms;
- to adapt to our national legislative, proposing minimal required changes;
- to be trusted by users, offering high level of protection and security;
- to use HTTP protocol over Internet;
- to be accepted by the companies, offering them the necessary applications and libraries to minimize changes in their internal software solutions;
- to be acknowledged by the tax authority and open for audit and inspection;

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[1] http://www.unece.org/uncefact/data/standard/CrossIndustryInvoice_2p0.xsd

The proposed system should also satisfy these functional requirements:

- to use CII v.2 XML format with minimal set of elements;
- to use digital certificates both for access control and for electronic signature of e-invoice data (more of this is discussed in Section IV - long-term signatures);
- to send notification of delivery for every received electronic invoice;
- to provide ready-to-use application for companies with full automation of e-invoicing process, taking all duties about signing, transferring and receiving of data;
- to provide ready-to-use application for companies that do not have full automation process, in order that they can perform all necessary operations via web interface;
- to guarantee authentication and integrity of e-invoices over the storage period specified by the law;
- to provide dispute mechanism;
- to provide functionalities for registration of companies;
- to enable administration of users, access control and system supervision;
- to provide access point for tax auditing controls;

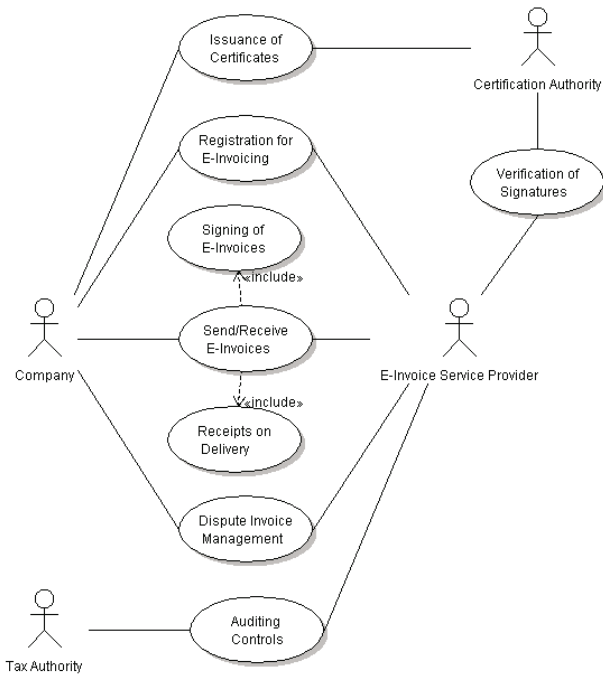The required functionalities of the model can be presented by the following use case diagram:

Figure 3: The Use Case Diagram of the System

B. Overall Architecture

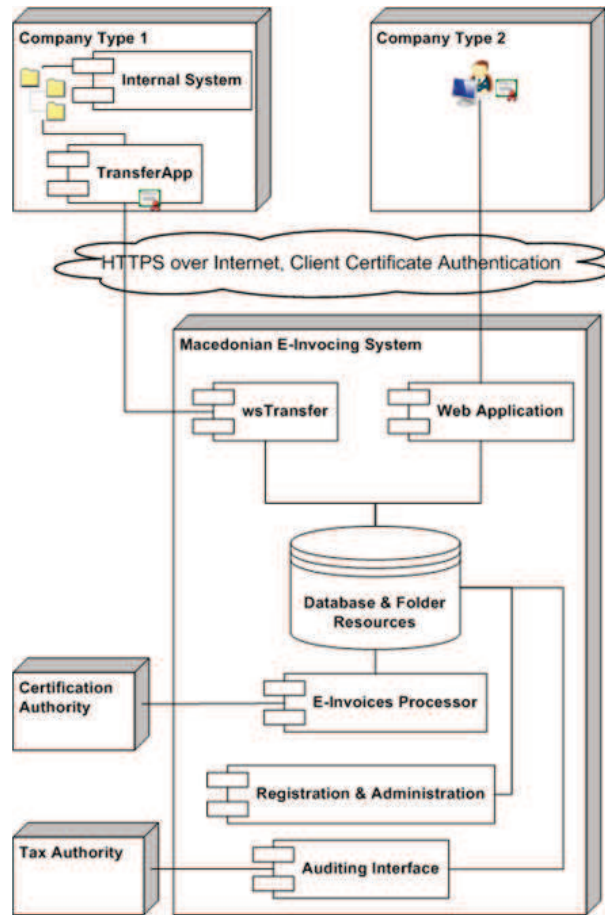The general deployment diagram of the model is shown in Fig. 4:

Figure 4: Overall Deployment Diagram

It consists of the following main components:

a) TransferApp – application provided to the companies (of type 1) for archiving, sending and receiving files, signing and verifying files, and generating transfer acknowledgements. Files contain data about invoices or disputes;

b) wsTransfer – web service that enables TransferApp to perform all necessary operations between the clients and the e-invoicing system;

c) Web Application – certificate secured application for companies (of type 2) that manually enter invoices. It contains client-side module for signature and verification, send/receive functionality, and appropriate reports;

d) E-Invoices Processor - application for receiving, distribution and validation of incoming files, and time-stamping for long term archive purposes;

e) Registration & Administration – module for maintaining register of companies, administration and authorization of users. Parts of the register, such as the list of companies using e-invoices, are available for public access;

f) Auditing Interface – module that provides access to the archived invoices for authorized tax authorities;

This model requires only Internet connection at the companies to communicate with the system. They need to have one qualified digital certificate that is used for two purposes. One purpose is for authentication to the sites of the server provider, since they are allowed to be accessed only by clients whose digital certificate is authorized by the web server. Another purpose is to create signed e-invoice file (by the TransferApp), so that the content of the e-invoice is assured in terms of integrity and authenticity. The system also has its own electronic certificate to sign every response file back to the clients. All communication traffic between two parties is encrypted by setting SSL (Secure Sockets Layer) protocol.

IV. LONG-TERM SIGNATURES

A. Problem statement

Article 233 of the Council Directive [7] states that "the authenticity of the origin, the integrity of the content and the legibility of an invoice, whether on paper or in electronic form, shall be ensured from the point in time of issue until the end of the period for storage of the invoice". Authenticity means that the identity of the issuer must be certain, while integrity means that the invoice content has not been altered.

EDI guarantees authenticity and integrity by using certain procedures in an agreement between trading partners, such as use of secure networks, access control to networks, syntax checking of data and summary file control reporting.

The system proposed in this paper uses Advanced Electronic Signature (AdES), that, as defined in EU Directive 1999/93/EC [11], "meets the following requirements:
 a) it is uniquely linked to the signatory;
 b) it is capable of identifying the signatory;
 c) it is created using means that the signatory can maintain under his sole control;
 d) it is linked to the data to which it relates in such a manner that any subsequent change of the data is detectable;"

According to the European standards [12] [13], Basic Electronic Signature (BES), also known as ES (Fig. 5), fulfils the necessary requirements of AdES. It contains the document (invoice) itself, signed attributes including reference to the signer certificate, and the digital signature value computed on the user data and the signed attributes.
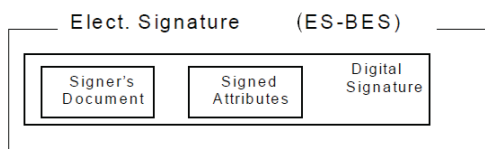

Figure 5: Basic Electronic Signature
(Adapted from ETSI TS 101 733, 2011)

Given that in the moment of signing the certificate of the invoice issuer is valid, BES is enough to prove the origin and non-alteration of the e-invoice at that moment, having in consideration the so-called "Grace period". As specified in [12], grace period is a "time period which permits the

certificate revocation information to propagate through the revocation process to relying parties". In fact, that is the period from the moment of certificate revocation request until the moment when CA publishes that information. All signatures made in that interval are invalid.

However, the bigger problem arises from the requirement that authenticity and integrity must be ensured throughout the entire storage period. That period in the Member States legislative is specified from 5 to 11 years, and even longer in some countries for the purposes of tax inspection. According to the Macedonian VAT Law, invoices "must be kept at least five years after the year for which they refer".

Knowing that the expiration period of digital certificates varies from one to three years, it is clear that the archive of signed e-invoices should be kept long after the moment of signing. In that case, despite the cryptographic correctness, there is a problem of proper verification of the signed data, because of two main reasons:
 • The certificate has expired, therefore its public key, which is used for verification of the signed content, can no longer be trusted; and
 • After the expiration date it is no longer clear whether the certificate was not revoked at the moment of signing, because Certification Authority might have removed it from the Certificate Revocation List (CRL list);

Additional complications may arise if meanwhile some of the CA's intermediate or root certificate has expired.

In order to overcome these possible scenarios, verification has to be based on the time of signature creation, rather than the current time. In other words, it is sufficient to prove that the signature was valid at that given point of time in the past, when it was actually created. To accomplish this, the following approaches are possible:
 • to include additional validation data in the signature (time-stamp, whole certificate chain, CRL);
 • to take additional organizational measures (keeping CRL history, guaranteeing validity by the trusted third party – notary role, keeping the signed content on the safe place to prevent possible attacks); or
 • to make combination of these two methods;

Standards [12] [13] expand the set of formats of electronic signature, so that the more extensive ones provide long term validity. Extended long signature (ES-X-L), shown in Fig. 6, is a format which contains the necessary elements for future verifications without checking external source: time-stamp over signature and complete set of validation data.
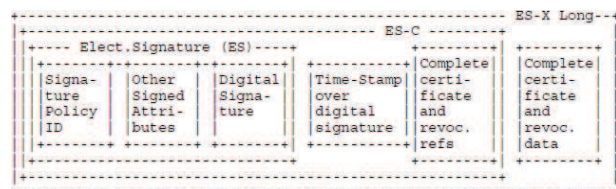

Figure 6: Extended Long Electronic Signature
(Adapted from RFC 3126, 2001)

However, it is possible that the certificate from the time-stamp server is going to expire before the storage period ends.

In that case, the time-stamp token is no longer trusted. To solve this, the digital content has to be re-time stamped from a server with a newer certificate. This procedure, as illustrated in Fig. 7, extends the signature validity period and, when necessary, should be periodically repeated.

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+------------------------ ES-A --------- ----------+
| +------------------ ES-A ---------------+        |
| | +------------ ES-X -------------+     |        |
| | |.............................| +-----+ |  +-----+ |
| | |.............................| |Time | |  |Time | |
| | |.............................| |Stamp| |  |Stamp| |
| | |.............................| +-----+ |  +-----+ |
| | +----------------------------+     |        |
| +--------------------------------------+        |
+--------------------------------------------------+
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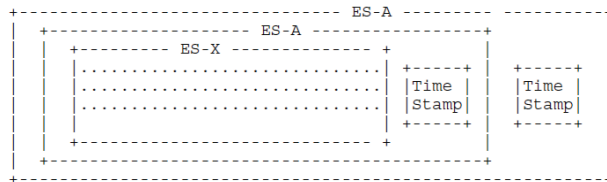
Figure 7: Archival Electronic Signature
(Source: RFC 3126, 2001)

B. The solution in the model

The model uses combined approach to solve the problem of long term signatures. The companies shall apply only basic electronic signature to their e-invoice data. This is a functionality built into the application TransferApp. The Macedonian e-invoicing system will act as a trusted party both to the clients and the tax authority. It shall take care of enhancing the received signed data to an archival format of electronic signature, by putting the time-stamps and certificate status information. According to the regulations in the law, it will also archive the e-invoices during the specified storage period.

V. CONCLUSIONS AND FURTHER WORK

European Union is making determined steps towards creating a good climate for wide acceptance of electronic invoicing. The e-invoicing model being proposed in this paper relies on many of EU recommendations, at the same time trying to be well suitable for our domestic companies. That is the reason why it produces ready-to-use software solutions that will help in minimising costs for transition from paper to electronic invoices. The model is built upon very high security requirements. But definitely, there are changes in our VAT law that have to be done, in order that two forms of invoices get equal treatment.

Some of the principles of this model may be revised or slightly changed, especially if they become the reason for low acceptance. For instance, due to its complexity, the proposed Cross-Industry Invoice data format can create potential difficulties for companies to transform their data. In that case, the system may request a simpler, adjusted standard for data format, and then, when needed, to convert the e-invoice to the agreed common format if it should be sent to another European state.

While building the prototype and the real system, it should be designed for future acceptance of payment transactions, so that it can integrate two important commercial processes – exchange and payment of invoices.

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