Good Practice Case

eInvoicing in Denmark

Case Study

31 January 2007

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1. eInvoicing in Denmark

1.1 Case Summary

As of 1 February 2005, all public institutions in Denmark were required only to accept invoices from suppliers in electronic format. By definition, an electronic invoice is a bill converted to a particular format, which can be read directly by the public sector's accounting systems. This particular format is called an "OIOXML electronic invoice" and is based on the OASIS (Organization for the Advancement of Structured Information Standards - see http://www.oasis-open.org) standard Universal Business Language (UBL).

Thus, all public-sector entities have been required to convert all systems and administrative processes from physical to digital handling of invoices, credit notes and other transactions. This reform affects approximately 15 million invoices a year and applies to the entire public sector from government ministries to nursery schools. It is expected to save the public some EUR 120 million annually, in addition to savings in internal administrative processes. Invoices in business to business relations have not been in the focus in the development of OIOXML electronic invoice in the first run but in the meantime became more and more relevant for the overall acceptance among businesses. Further improvements of the standard in cooperation with the private sector are currently underway.

At present, the processes employed in the electronic invoicing project are those concerned with the creation of invoices by suppliers and the reception by public authorities; the earlier ordering or the following matching processes of the invoice with the order will be mapped in next development steps of the project. Electronic invoicing requires a transportation system – which in the Danish case is based on an existing VANS network (Value Added Network Services). Routing of messages from the originator to the receiver requires an electronic postal address. Different identifiers of the address can be used i.e. tax registration number or as in the Danish case an EAN (Electronic Article Number) locations number (EAN location numbers are also referred to as Global Location Numbers or GLN's - see http://www.gs1.org). This number makes possible the unique and unambiguous identification of physical locations and legal entities. Suppliers who cannot or do not wish to submit electronic invoices can still send them in paper format, with the EAN location number, to a so-called "Read-In" bureau, which converts them to digital format and forwards them to the correct public institution in question.

The project is based on proven market solutions, including the VANS infrastructure and the systems that can receive and process electronic invoices.

The compulsory transition ensures a modernisation of the entire payment infrastructure so the old-fashion "paper channel" is closed for good. It provides security and convenience for the supplier, because all invoices to public-sector customers can be sent in a single, standard format, and it enables the individual public institution to immediately begin the digitalisation of all internal work processes and systems.

The initiative for electronic invoicing in Denmark came from the Danish Ministry of Finance. In cooperation with Local Government Denmark and Danish Regions, they developed the ideas, and parliament passed the necessary legislation behind eInvoicing in Denmark. Concerned by the implementation are all 270 municipalities (respectively all 98 municipalities after the Danish Municipal Reform in 2007) and about 440,000 private companies. eInvoicing supports the Danish national strategy for eGovernment which aims to create a more effective and coherent public sector. The Agency of Governmental Management, under the Ministry of Finance handles the implementation and ongoing administration of eInvoicing.

In terms of interoperability, the specific requirement was to achieve interoperability (IOP) between private companies doing business with public institutions and its customers from the public sector, i.e. all public entities. I.e. if we think of a workflow existent between them IOP between different stages of the supply chain in terms of invoicing procedures had to be achieved independently of the kind of service or product sold. The solution chosen to meet this requirement has been to standardise the format of the electronic invoice as an OIOXML electronic invoice and to securely transport and distribute them via a central infrastructure (VANS network). The adoption of the international EAN location numbering systems ensures the routing of the messages from sender to receiver. Besides, centralised units offer clearing functions that guarantee that each company may convert and send electronic invoices independently of their technical equipment ("Read-In" bureaus, Invoicing portal). The legalisation of the standard (obligatory use) is to be seen as a main driver and supporter of the high benefits already gained on both sides, within the pubic administration as well as in the private sector.

1.2 Problem addressed

1.2.1 Specific Problem

Paper based invoicing is an expensive process, so it is a prime candidate for digitalisation. Paper requires manual processing by employees in the public sector and private companies. It incurs a number of costs including paper, printing and postage, and a considerable risk of errors.

The eInvoicing project covers invoices for all kinds of goods based on service contracts also including suppliers of water, energy, transportation, and others. (Latter examples have exceptional status of the European Procurement Directive 2004/18/EC; i.e. enjoy different regulations as conventional goods. For the conversion to the electronic invoicing to be complete, it must be compulsory. Otherwise, both public and private entities will be left with two overlapping systems – one manual and one digital.

This requires:

- That all public institutions are able to receive electronic invoices.

- The establishment of an electronic distribution and "postal service".

- A link that can convert paper invoices to electronic ones from companies who do not have the volume to justify the investment in electronic invoicing systems.

- A distinction between central infrastructure (distribution and postal service) and de-central use (internal accounting systems, etc.). In order to reap the efficiency benefits as quickly as possible, the eInvoicing project establishes the overall infrastructure, while the individual public entity must implement an efficient electronic workflow system to handle the approval of electronic invoices in alignment with its internal administration and systems.

- That the solution is based on proven market technology and private vendors, to reduce cost and uncertainty.

- That the savings earned by increased efficiency are not retained by the individual public entity, but passed back to the public treasury.

From a rather functional view, this in addition requires:

- The creation of a unique identification system for public entities compulsorily to be used in invoicing proceedings where public entities are involved. This identification system shall allow the unique and unambiguous identification of physical locations and legal entities by an already established system in the business sector; the EAN location number.

General problems addressed:

- *Replacement of a high volume clerical process between public administration and companies by an electronic one*
- *Make sure that all public institutions are able to receive electronic invoices*
- *Offer alternative solutions for companies who do not have possibilities for electronic invoices itself*
- *Make the electronic use of invoicing procedures compulsory*
- *Make sure that savings earned are passed back to the public treasury*

Specific problems addressed:

- *Implementation of a unique identification system for all public entities in Denmark*
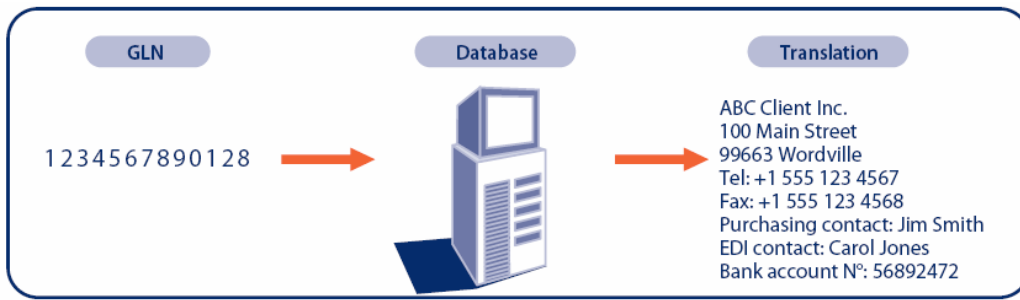- *Implementation of a secure transportation network for eInvoices*

Figure 1: Example of an EAN location number (GLN); Source: GS1

According to the Global Location Number (GLN) the EAN location number has a 13-digit numeric data structure and is composed of:

- GS1 Company Prefix (hence: Public Authority Prefix) – assigned by the GS1 Member Organisation (7 digits)
- Location Reference –allocated by the company (public authority) to a specific location (5 digits)
- Check Digit – calculated according to the standard algorithm (1 digit)

Figure 2: Systematic of EAN Location Numbers (GLN); Source: GS1

– The provision of a secure network where eInvoices are transmitted between customers and suppliers. (A Value Added Services Network infrastructure was used in Denmark, but an Internet based infrastructure may also be used).

Thus, the specific requirement concerning interoperability (IOP) was to achieve IOP between all public entities and the private companies who do business with them in terms of invoicing procedures independent of the kind of service or product sold. I.e. if we think of a workflow existent between them - IOP between different stages of a supply chain had to be achieved with thousands of organizations on each side. The eInvoicing currently encompasses "only" the invoicing process (6. to 7.), other process flows such as "match invoice with order" (step 8.) or pay invoice (9., 10., 11.) are currently in the development.

: electronic Invoice
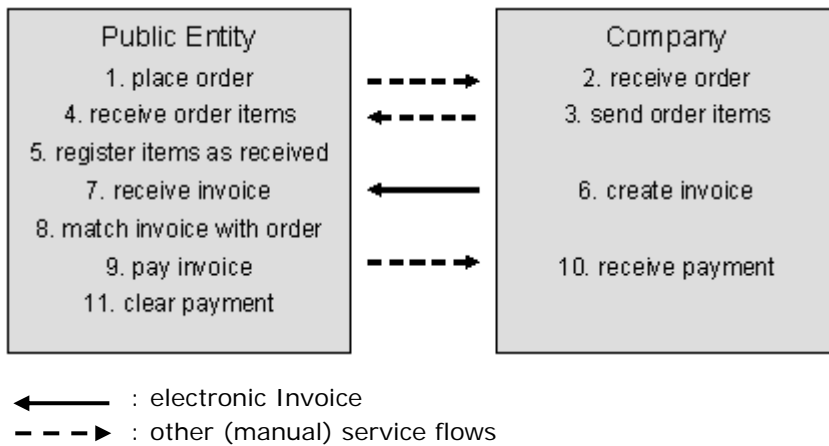
: other (manual) service flows

Fig. 3: eInvoicing process in supply chain

A specific challenge to meet this interoperability requirement is that electronic invoices generally are to be sent by the Value-Added Network Services – which is a sort of electronic postal service. This network collects and distributes all electronic invoices to the right customers at their electronic postal address (the EAN location number). I.e. transportation via VANS centralises the transport of invoices and requires a unique identification system of the public entities in order to electronically address and route the invoice to the respective public authority.
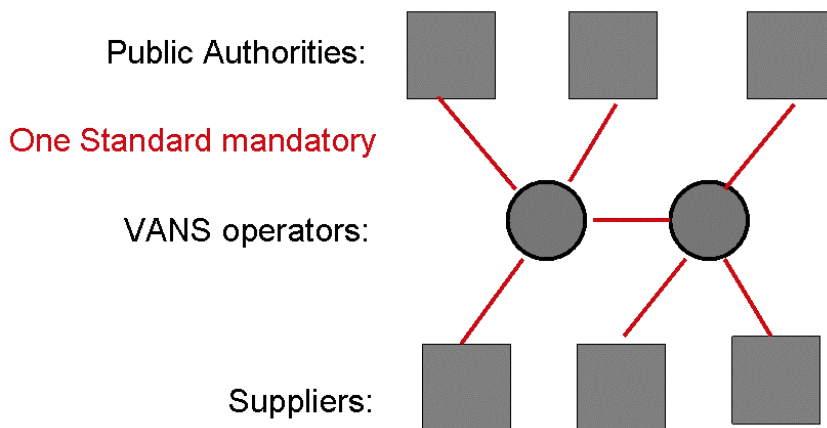
Fig. 4: Interoperability Requirement of eInvoicing

In Denmark, the public sector is only required to receive invoices in a format called "OIOXML Electronic Invoice". OIOXML is a brand which denotes the Danish use of XML with OIO (Open public Information Online), which has been standardized to ensure smooth information exchange across the public authorities and towards citizens and private businesses. "OIOXML Electronic Invoice" is a localization of OASIS Universal Business Language (UBL), which has been adopted as an OIOXML standard. Many different OIOXML standards exist for interchange of data in the public sector. The OIOXML electronic invoice format is just one among many. The underlying vision is that the public sector must act as one enterprise

with coordinated service development and re-use. I.e. a communication model using standardised workflows between pubic entities on different government levels and companies have been employed. These workflows have been standardised by the eInvoicing project as a specific XML workflow that is routed by a central postal service (VANS) via a specific identifier (the EAN number which corresponds to an electronic postal address). In addition, the "Read-In" bureaus and the Invoicing portal serve as clearing units for those companies who are not able to communicate via their electronic accounting system directly with those of the public entity in question. I.e. these units centralise the conversion of paper invoices respectively provide an entry for electronic invoices on a central level. In addition an Easy Account System enables the automatic payment of invoices and other benefits. The Easy Account System is basically a registry of bank account information for all companies and citizens in Denmark and has been in operation since ultimo 2005.

The eInvoicing project aims at making invoicing procedures more efficient for both, the public and the private sector. This is done by providing an infrastructure enabling electronic handling and routing as well as the integration of invoices. This in addition also enables the processing of invoices in the public accounting systems. I.e. the efforts of implementation are in the mid-office, between the front-office of the public entities and its back-offices.

Service provision model:
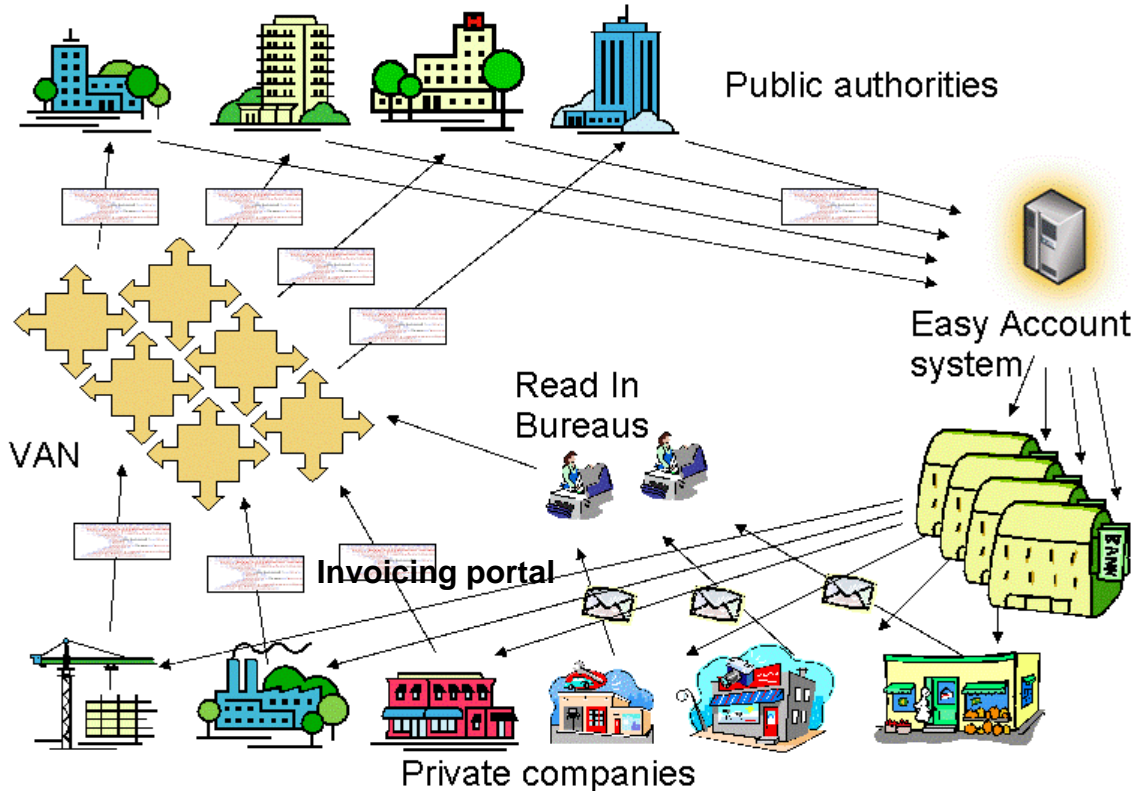*IOP between front-office and back-office*

Figure 5: Organisational Model (rough)

1.2.2 General Background

Before February 2005, public institutions would receive a paper invoice by mail and this then had to be handled by several employees for approval of entry and filing. Only one person at the time had access to the invoice and for future reference it was filed in the archives. Invoicing based on EDIFACT (as it has been usual between companies) did not exist in any big extend between public institutions and private sector. Only small projects existed but without any significant numbers. Today, the invoice arrives directly in the electronic accounting systems and is subsequently approved online by employees; a process that involves no paper and takes only a few minutes. Furthermore, the invoice can later be retrieved in a matter of seconds. This process considerably reduces the processing time for the private companies (about 440,000 in Denmark) and all Danish public institutions.

The electronic invoice is a bill converted into a particular format, which can be read directly by the public sector accounting system. This particular format is called an "OIO-XML electronic invoice".

All invoices to public sector customers in Denmark must include the following information:

1. EAN number	Must always be included in the invoice. This info must be received at the latest when the customer places the order.
2. Order or requisition number	
3. Personal or other reference	
4. Internal accounting number	Must be included in the invoice if the customer gives this number when placing the order.

The business case for adopting an international standard for electronic invoicing was published as part of a 270-page report by KPMG on behalf of the Danish Ministry of Finance in October 2003 (KPMG 2003). The business case for electronic invoicing is part of a larger business case. The overall business case aims at optimizing public sector payment processes to citizens and private companies in general. It is estimated that the public sector makes 38 million payment transactions to citizens and companies. Approximately 15 million of these transactions relate to invoices sent to public authorities.

Service:
Electronic invoices in all proceedings where companies do business with public sector customers (eProcurement)

Framework condition:
- *Report on optimizing payment processes in the public sector*

Invoices sent to the public sector	No. of invoices	Percent
Municipalities	11.1 mio	74%
Regions	2.1 mio	14%
State	1.8 mio	12%
Total	15.0 mio	100%

It is estimated that each minute saved in invoice handling of 15 million invoices equals 12 million Euros saved. A conservative estimate is that 10 minutes can be saved in the handling of each invoice once invoices are received electronically. This adds up to a total saving of 120 million Euros and is equivalent to a potential savings of more than 2,000 man-years of work per year.

The business case analysis further states that on average an additional 7 minutes can be saved if an automatic match between an electronic order and an electronic invoice can be made. Thus a conservative estimate is that the total savings potential is approximately 200 million Euros per year with a fully implemented ordering and invoicing process. The exact figures can be disputed and has been disputed (see Deloitte, April 2004), but the fact remains that the initiative has boosted the exchange of electronic business documents. Private companies as well as public institutions are now pushing for the introduction of more business documents to support an extended procurement process.

Receiving structured payment information with the invoices sent to the public sector is therefore important.

Structure of public administration in Denmark
Denmark has a population of about 5 million people and is divided into 13 counties (amter), and, as of 1 January 2006, 270 municipalities (kommuner). Three municipalities have county privileges—Copenhagen, Frederiksberg, and Bornholm. The coming Danish Municipal Reform will be implemented on 1 January 2007 and will replace the counties with five new autonomous regions and reduce the number of municipalities to 98. The new municipalities will take over most of the responsibilities of the former counties with their own local government and administration. Most of the new municipalities will have a population of at least 20,000 people.

Beside the 270 municipalities and 16 counties involved in the implementation of eInvoice are the public Agency for Governmental Management under the Ministry of Finance who handles the implementation and ongoing administration of eInvoicing and the Ministry of Science, Technology and Innovation as developer of the standards and supporting tools. Besides, two "Read-In" bureaus for scanning of invoices, several providers of internet invoicing portals, and five VANS operators (electronic post offices) for transportation

Types and level of agencies involved:
- *Public Agency for Governmental Management under the Ministry of Finance*
- *Ministry of Science, Technology and Innovation*
- *16 counties*
- *270 municipalities*
- *440,000 private companies*

and routing of the invoices are partners of the project. About 440,000 private companies (250,000 SMEs) - most of them do business with the public sector -are directly concerned by the implementation.

Even if Denmark is a relative small country, it faces same challenges as big countries as there is no central enterprise architecture or coordination and no consolidated IT-procurement. In a very complex public sector with rather bureaucratic processes there is a fragmented use of IT-standards, SOA and general infrastructure.

1.2.3   Policy context and strategy

The Danish government has the declared goal of propagating digital administration to realise the great potential for increased efficiency through digital technology and hence creating a more effective and coherent public sector (national strategy for eGovernment). Following this goal, Denmark has harvested the fruits of the seeds sown by the OASIS Universal Business Language Technical Committee (UBL TC). The Danish eBusiness working group based its work on an early draft of the UBL specification (UBL 0,7). The Danish localised version of the UBL specification has since February 2005 been the mandatory data exchange format for companies wishing to sell goods to public institutions. UN/CEFACT and OASIS has in a memorandum of mutual understanding stated that the two organizations will converge the work taking place in UN/CEFACT on standards for e-invoicing and e-ordering and the work taking place in OASIS UBL. There are currently no published standards from UN/CEFACT on these two areas, but the data model and the underlying core components have been under development for several years. Together with UK, Sweden, Norway, and Finland, Denmark form the 'North European localization initiative' aiming at building a common subset to be used in cross border scenarios for standard electronic business documents.

Framework conditions:
- *National strategy for eGovernment*
- *Constructive contribution in the OASIS UBL TC to the development of UBL*
- *Adherence to UBL in the development and implementation of eInvoicing*

The legislative process in Denmark started in 2003 and a law on "Public sector payments" (2003) was enacted by the parliament on December 27th 2003 (Law 1203 on public payments). The law briefly states that the Ministry of Finance is given the authority to publish further statutes detailing the implementation of the law. The law does not mention, "electronic invoicing" per se and the text focuses on the payment processes in the public sector.

The initiative on electronic invoicing was detailed in a statute published by the Ministry of Finance on October 7th 2004 (FM Statute 2004). The statute formalizes the requirement that public sector institutions must be able to send and receive electronic invoices by February 1st 2005. The authority to publish statutes on the invoice

Legal framework:
- *Law on Public Sector Payments, 2003*
- *Statute on electronic invoicing to public authorities, 2004*
- *Statute on information in the OIOXML Electronic Invoice for use with invoicing of public sector organisations, 2004*

format was at the same time assigned to the Ministry of Science, Technology and Innovation. The final statute specifying the Danish localized version of UBL was published by the Ministry of Science, Technology and Innovation on November 11th 2004 (VTU Statute 2004).

The Danish invoice format is a localized version of the UBL invoice and it is based on an early release (version 0.7) from the UBL TC. The decision to use UBL 0.7 was due to time constraints in the legislative process. There was not enough time between UBL 1.0 was approved as an OASIS standard on November 8th 2004 and the time when the Danish legislation had to be ready on November 11th (see above).

Denmark is not the only adopter of UBL in Europe. For instance, Spain and Sweden are also using UBL and the European Commission has also indirectly played an active role via its IDABC (http://europa.eu.int/idabc/en/home) program in providing input to the next version of UBL 2.0 which is to become an OASIS standard by December 2006.

Interoperability Framework:
- *UBL as internationally spread standard providing interoperability*
- *Coherence with the European Interoperability Framework (EIF) since IDABC (developer of EIF) also provided input to the development of UBL*

1.3 Solution

1.3.1 Specific Objectives

The public sector in Denmark aims to improve efficiency, and digitalisation – including eInvoicing – supports this. The strategy behind digitalisation is that investments must pay off, which means that digitalisation projects must either increase the quality of public services (better products, faster case-processing times, fewer errors etc.) and/or supply the same service using fewer resources. With regard to eInvoicing, all public institutions and private companies should be encouraged to go over to electronic invoicing. This carries some specific objectives:

1. As of 1 February 2005, all public entities should be able to read invoices electronically into their accounting systems.

2. The cost-efficiency benefits should be collected by the state from the very outset.

3. The IT solutions should be market-driven, vendor-neutral, standardised, simple and robust.

4. Royalty-free international standards for electronic business documents should be used (OASIS) that also provide the basis for future cross-border exchange.

5. To do so, European eBusiness standards with shared goals and milestones must be formulated and the development of infrastructures that provide the electronic exchange of business documents over the internet should be forced. Also a European infrastructure to support the addressing of pan-European eBusinesses services should be strained.

6. eDocuments should be based on XML and recognised international standards in order to archive them in that way that they can be read and rendered forever.

7. The proof of origin and integrity should be documented with digital signatures.

8. All companies should be able to send an electronic invoice. Special "Read-In" (scanning) services have been provided for companies who wish to continue submitting paper invoices and hence should free companies and public institutions from bilateral exchange agreements.

9. The solution should feature a centralised infrastructure consisting of an electronic distribution system and electronic postal service.

10. Common use of the central infrastructure. This should be established as quickly as possible, then individual public institutions and private companies can make local adaptations.

General objectives:
- *Improvement of efficiency of public sector*
- *Efficiency by digitalisation of suitable services*

Specific objectives:
- *All public institutions and private companies should be encouraged to go over to electronic invoicing*
- *Enabling integration of eInvoices in public accounting systems*
- *Cost-benefits should be collected by the state*
- *Selection of a market driven, vendor-neutral standardised solution*
- *Use of royalty-free international standards*
- *Formulation of European eBusiness standards and infrastructures*
- *eDocuments should be based on XML and should be archived that way that they can be read and rendered forever*
- *Proof of origin and integrity should be documented with digital signatures*
- *The solution should feature centralised infrastructures for distribution*

1.3.2 Implementation

The implementation of eInvoicing has proceeded according to plan. Following is a brief description of the main activities in terms of Infrastructure, Public Institutions, Suppliers, Public Bank Account Registry, and Scanning Agencies:

Infrastructure

The overall concept for the infrastructure is based on an existing concept, namely the VANS network which, since the early 1980s, has been used for sending EDIFACT messages among commercial partners. VANS (Value Added Network Service) is a digital postal service, which comprises five private VANS providers, who receive electronic invoices and forward them to the correct public institution. All public institutions are required by law to be connected to one of the five VANS operators. Private companies wishing to send invoices to the public sector are likewise required to be connected to VANS-network. The main advantage of the network is a single point of contact, namely the VANS provider. Each provider is certified according to DS-484 which is a Danish security standard.

Invoices are "read" by the VANS network and by local accounting systems. Thus, there is a fixed format using the OIOXML standard.

The electronic mailbox to the individual public entity is defined by a unique, international number – the EAN location number. Each public institution is assigned its own EAN number, and is connected to the VANS network via that number. The VANS operators share this database of EAN location numbers (about 500,000 EAN numbers). In addition to the EAN-location number, an order-reference number should also be registered with the invoice. This number aids in the matching of orders and invoices, which has a big potential in the next development steps of the eInvoicing project.

Transport of the eInvoices is based on an ebMS (ebXML Message Service) enveloping mechanism built on SOAP (ISO 15000-2). This means that the addressing information, mainly the EAN number, is part of the ebMS header. In contrast to a first solution, where there was no specific envelope format and the VANS providers had to retrieve the EAN location number from within each message, this highly improved the reliability of the system. I.e. messages are now securely sent in an electronic envelop containing the electronic address of the addressee (EAN location number) and in addition, receipts of positive or negative acknowledgements.

Two central, private scanning-in bureaus and several invoicing portals have been established to ensure that all private companies can do business with the public sector, regardless of their IT sophistication or digital preparedness.

Instead of the secure VANS infrastructure (which does not use digital signatures) in a next round the Internet based infrastructure will be implemented, then heavily relying on digital signatures.

Supporting infrastructure employed:
- *VANS network, the digital postal service infrastructure (5 providers) based on existing EDIFACT infrastructure*
- *International system of EAN location number as electronic address of the public institutions*
- *2 central private scanning-in bureaus for scanning of paper invoices*
- *Several invoicing portals for web based invoicing*
- *Centralised Information and concrete guidelines*
- *Public Bank Account Registry??*
- *Online – Validation tools (see below in this chapter)*

Awareness and Marketing:
Public Institutions
- *Regular meetings were established to discuss status and experience among local government organisations and national authorities*
- *Telephone and mail support were established so all parties could seek answers to questions about legality, technology, systems, etc.*
- *Standard information was sent to all public authorities*

Public institutions

The requirement for electronic invoicing and relevant guidelines were announced in mid-October 2004.

- All public-sector entities should implement a solution for receiving electronic invoices. This was presented as a standard solution by the national and local governments' operators. Each institution is free to choose its own, internal invoice processing system based on existing market solutions, which are linked to the "receiving system".

- Regular meetings were established to discuss status and experience among local government organisations and national authorities, up to and after the implementation date of 1st February 2005.

- Telephone and mail support were established so all parties could seek answers to questions about legality, technology, systems, etc.

Suppliers

- Information and concrete guidelines were prepared for all private companies to tell them what they should do to be ready for 1st February (e.g. the Electronic Invoicing Handbook). This was centralised, but primarily between the individual institutions and their relevant suppliers. Letters were sent to all private Danish companies (about 440,000) to inform them of the transition, what they should do and where to get information. Standard information was sent to all public authorities.

- Telephone support was established for private companies.

- An information campaign was launched with regular consultations among branch and professional organisations. Besides the items mentioned above this further includes websites, newsletters, TV-spots and adds in newspapers, as well as an information package for public institutions.

- It is possible for suppliers to the public sector to use the same invoicing standard in b2b scenarios. B2B electronic invoicing in a larger scale is currently limited to retail dominated by larger players, which has been able to promote EDI. It is however expected that the public standard will be used more extensively in b2b scenarios in the future.

Public sector bank account registry

The most central element in implementing effective payment processes in the public sector in Denmark is a shared bank account registry. All public authorities have since September 2005 shared such a registry of bank account information for all companies and citizens in Denmark. All companies and citizens were required to report which bank account they wished payments from the public sector to be transferred to. The banks have, on behalf of the

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companies and citizens, done the actual reporting to the registry. Citizens without existing bank accounts were supplied with an account by the government. The advantage of this approach is that public authorities are not required to maintain payment specific information themselves. All payment advices to the banks will go though the registry and the registry will add the correct bank account information. I.e. with the bank account registry a clearinghouse has been established providing payment data centrally and enabling routing the private bank of the supplier in question. Existing practices with cash payments, the use of cheques and manual bank transfers from different authorities will be stopped or the practice will at least be limited to a very few institutions.

The keys to the success of this transformation are two well-established registries of citizens and companies. All citizens and legal aliens in Denmark are supplied with a social security number

"CPR-nummer" in Danish. CPR = Central Person Registry.

This number is used as the primary identifier for citizens in the public sector and in some parts of the private sector (namely banks and insurance companies). All companies paying VAT and TAX in Denmark are likewise supplied with a company registration number

"CVR-nummer" in Danish. CVR = Central Company Registry.

Scanning of paper invoices by scanning companies
The potential for saving money on a more effective invoice handling process has several preconditions. First of all – if the business process is reengineered from a traditional manual handling of invoices to the electronic counterpart – it is essential that all invoices are made electronic such that two business processes are not maintained in parallel.

It is evident that all private companies selling products and services to the public sector are not capable of sending electronic invoices. "The baker" at the corner delivering bread to a kindergarten is unlikely to be capable of sending electronic invoices. This problem was tackled by establishing two so called "scanning agencies" or "Read-In bureaus. All paper-based invoices are sent to one of the two "scanning agencies" where a subset of the invoice is scanned automatically and an electronic invoice is generated. A scanned image of the original invoice is embedded in the electronic invoice in a base64 encoded element. This service of no costs for SMEs having less turnover than €2 Mio. All certified companies may act as scanning agency. A maximum of five days processing time is guaranteed. The "scanning agency" is connected to a VANS-operator like any other supplier to the public sector.

Workflow description

The objective of ordering, invoicing and payment process is that all parts of the business process from ordering to invoicing must be digitized in order to optimize the payment process to its fullest potential. The workflow below is described based on the existence of a purchase agreement between the public authority and a supplier. I.e. tendering proceedings and/or service contracts have been done earlier.

The ordering, invoicing and payment process is as follows:

- A person from the buyers organization (rekvirent) identifies the need for a product or a service
- This person sends an electronic order to an authorized person in the buyers organization
- The authorized person accepts the electronic order
- The authorized person sends the order to the seller's organization.
- The product or service is delivered to the buyer
- The seller sends an electronic invoice to the buyer's organization

    a) Via an electronic invoicing system. Companies can send an OIOXML digital invoice directly to its public-sector customer via the VANS network. To do so, a company must have a digital accounting or invoicing system. An electronic invoicing system reads invoice files from the company's accounting system. The invoicing system can either be part of the accounting system, or a supplementary module or separate invoicing system.

    b) Via a digital invoice portal. This resembles an Internet bank where you compose your invoice with a user name and password, then send it electronically. This solution was very limited in early 2004 but today, there are at least five such services who, for a very modest fee, ensure that electronic invoices are received and accepted by the relevant public entity.

    c) Via traditional paper post to a Read-In bureau. The traditional invoice is furnished with an EAN number and sent as a letter to a Read-In bureau, which scans it and converts it to an electronic invoice. This solution ensures that foreign companies, and companies who are not IT-prepared, can still do business with the public sector. Smaller companies can use the Read-In bureaus free of charge, while larger ones are required to pay a modest fee to the bureaus.

- The VANS-operator looks up the EAN-location number in a database

- The invoice is perhaps sent to another VANS-operator. (There are several VANS-operators connected to each other. The VANS-operators have different customers and when a message is sent from one customer belonging to one VANS-operator to another customer belonging to a second VANS-operator – routing between the VANS-operators must be done.)

- The invoice is sent to a public authority; most often its Financial Department. Each public sector institution must themselves contact a VANS provider and buy a VANS box (mail box). Different authorities have different practices. Some authorities have many VANS boxes and some only have one. There is no best practice. In many cases – the incoming invoices will arrive at the Financial Department's VANS box

- The invoice is forwarded to an authorized person for approval. The approved invoice is then sent to a person or a department responsible for payments. Sending the electronic invoice to an authorized person may be avoided if the electronic invoice matches the electronic order and the electronic registration of what has been received. The prerequisite is that there is a match between what has been ordered and what has been received. Not only in numbers but also in quality. Hence, this is exactly why it is so important that the original order is sent electronically to the supplier. The supplier can convert the order to an electronic invoice, which is easy to match. They share common identifiers like order-no and article numbers. In case there is a divergence in the expected and the actual prize, the invoice can still be approved automatically given that the divergence is within a defined tolerance.

- Payment is performed automatically once the invoice has been approved and the book keeping account is cleared.

The VANS network will in near future be supplemented by an Internet based infrastructure for exchanging a wide range of business documents to support a procurement process (starting July 2007). The workflow below is the ideal workflow – not the currently realized workflow in the VANS-based infrastructure. Messages will flow to and from the VANS-infrastructure (incl. query of the EAN database) to an internet based infrastructure through a gateway. The red circle in the workflow diagram shows the currently realized exchange of business documents.
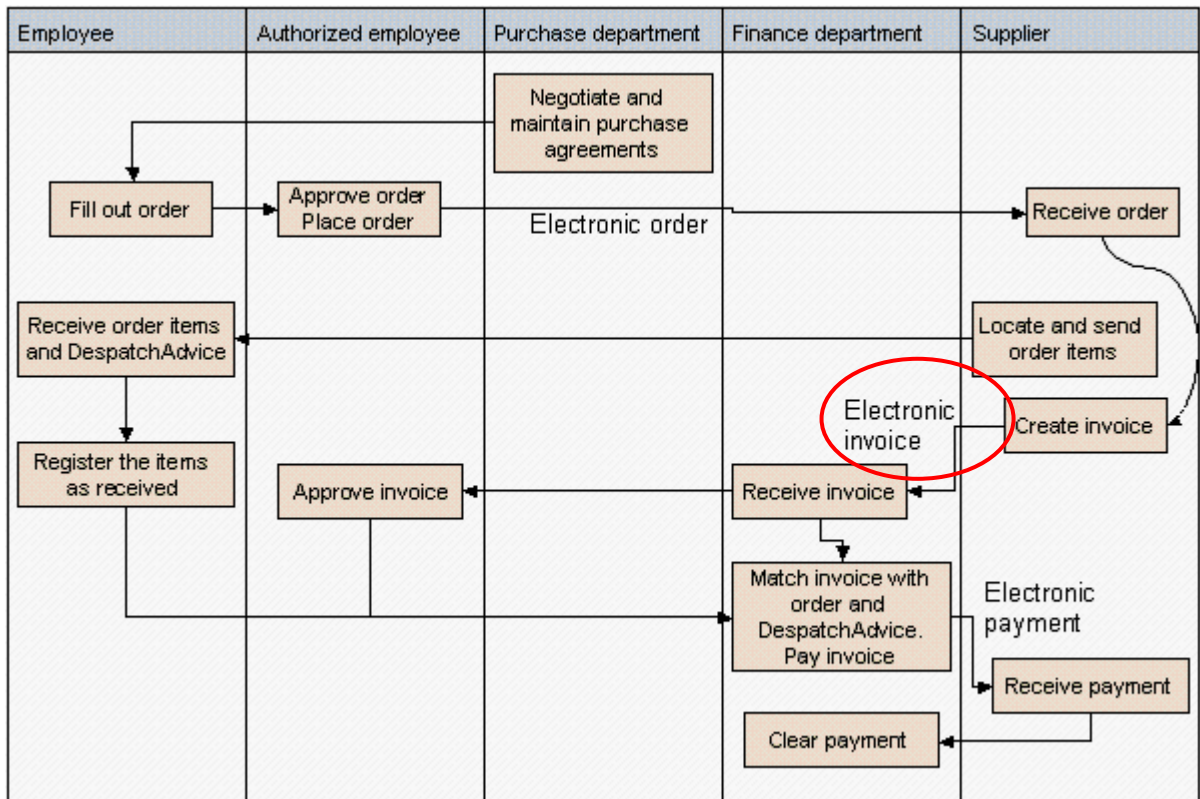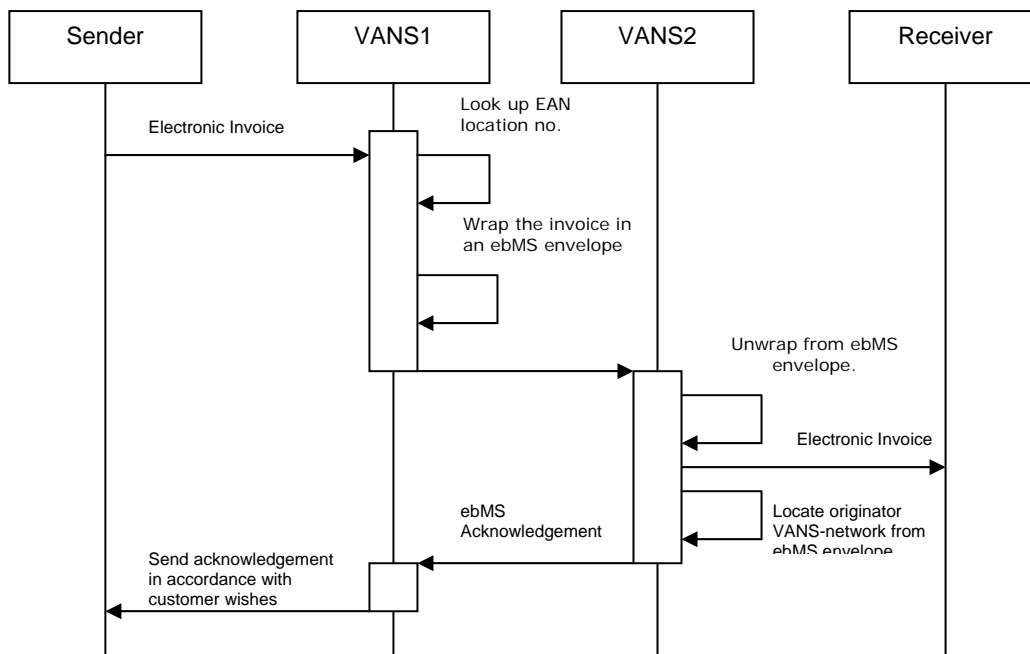
Fig. 6: Ideal Workflow of eInvoicing

Figure 7: Electronic invoicing via the VANS network:

UBL and XML Schemas

One inherent issue that one has to deal with when using international standards like UBL is the fact that most data types are relatively weak in their validation. For instance – the format of a zip code varies a lot between different countries. A zip code in Denmark consists of 4 digits. In XML Schema it is relatively easy to create a data type that will do a "strict" validation making sure that the content of a ZipCode element consists of exactly 4 digits. Alternately, the data type could be an enumeration containing all legal zip codes in Denmark. None of these solutions would have any value outside Denmark and thus the need for "weak data types" in the UBL vocabulary.

Having the normative UBL schemas is important in order to make sure messages can be exchanged between business partners in different countries. In a scenario like that in Denmark invoices are only exchanged within the country. The legislation has spelled out the use of various Identifiers. For instance, a seller must be identified through an 8-digit company registration number in the CompanyTaxIdentifier element.

In other words – the XML schemas supplied by the UBL TC (Technical Committee) cannot take advantage of the ability to do a strict validation in XML schema. As a consequence of this, two different version of the Danish localized schemas were developed: One set of schemas based on the "weak" UBL schemas (called "lax" schemas) and one set of schemas where the data types have been further restricted to perform stricter validation (called "strict" schemas).

The legislation only refers to the "lax" schemas and the "strict" schemas are only provided as "tools" which the National IT and Telecom Agency has made available for developers to test that the messages generated by their systems conform to the legislation. The tools allow developers to post an instance to a central server using an html form, and the server will reply any detected errors or warnings. The validation tool has been extremely valuable to the developers community, in particular to those who are not so familiar working with XML and XML Schema. The need for support dropped drastically once it was made a requirement for developers to test their instances prior contacting the helpdesk with questions. The online validation tool is now the de facto reference implementation on validation.

XML schemas can go a long way in regards of validation, but the technology cannot express all the rules of integrity that the legislation contains. Thus XML schemas cannot replace the checking of integrity rules that a programmer can code. However, other schema languages like Schematron can go even further that XML schema.

Case capitalises mainly on following layers of IOP:
- *Technical IOP: secure transport via VANS network based on eBMS (ebXML Message Service) and Internet protocol*
- *Syntactic IOP: Transfer of eInvoices as OIO-XML electronic invoice format; Syntax Wall (validation of XML Schemas)*
- *Semantic IOP for same data elements: Routing of messages based on EAN location numbers; Semantic validation within the Syntax Wall; Open regarding the codes for the goods delivered (articles, services)*

In order to check as many integrity rules as possible, a third validation tool was developed using Schematron (for further information see: ISO/IEC FDIS 19757-3 - http://www.schematron.com/iso/dsdl-3-fdis.pdf). This tool allows contingent validation. Integrity rules regarding internal contextual dependencies between elements and/or attributes that cannot be expressed in XML Schema are expressed in Schematron.

Invoice schemas provided:
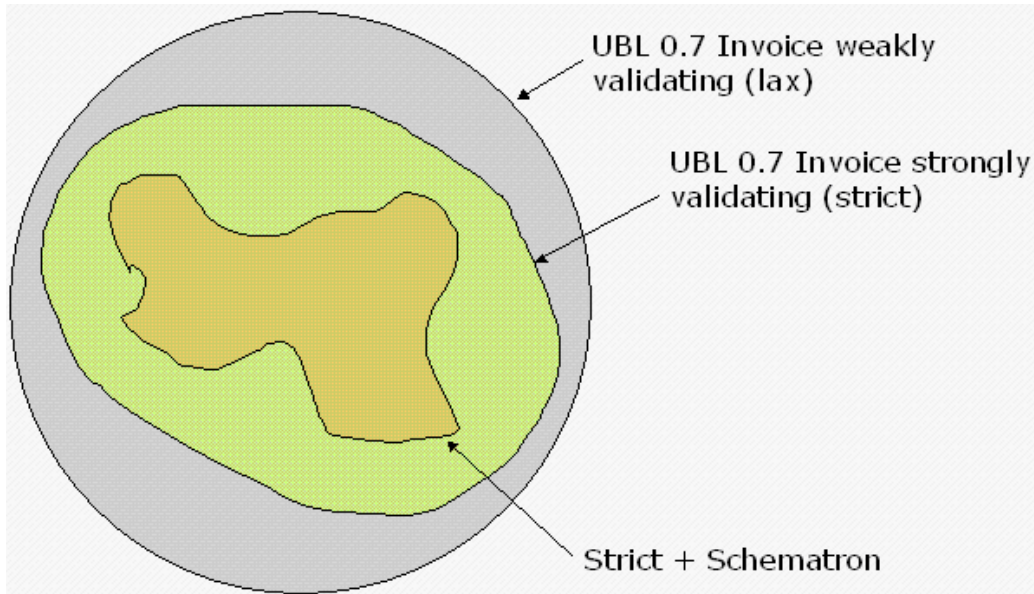
Figure 8: Invoice Schemas

Warrantee of security and privacy

The VANS network provides secure exchange of data and guarantees its delivery, once data is received by a VANS operator. Transport to the VANS network should also be secure and reliable, but this may not always be the case. There is no solution to this problem in the VANS infrastructure.

Warrantee of Security and Privacy:
A VANS infrastructure delivers a high degree of security and reliability. Alternative Internet based infrastructures can also be established

1.4 Features making it a candidate for good practice exchange

1.4.1 Impact

The Danish public sector's transition to electronic invoicing might be a good candidate under the slogan, "Just do it".

<u>Public-sector entities receive electronic invoices</u>
The basic infrastructure of the VANS network and Read-In bureaus works according to plan, and the utilisation level is relatively high, even though some institutions still accept paper invoices from certain suppliers. There are less and less problems. Very few invoices run into problems in the routing between the sender and the receiver. Many authorities have now implemented electronic workflows. Public authorities receive an estimated 1.25 million invoices per month. With this, the development of the numbers of invoices exchanged have to a large extend met expectations, even if the number of invoices received by Scanning Agencies is still relatively high one and a half year after launch (see diagram):

Outreach:
All public administration's offices, i.e. from the 270 municipalities, 16 counties and the state have to use and use eInvoicing. By September 2006 98% of invoices are received electronically. I.e. almost full national roll-out
Performance:
About 1.3 million invoices per month are dealt with electronically

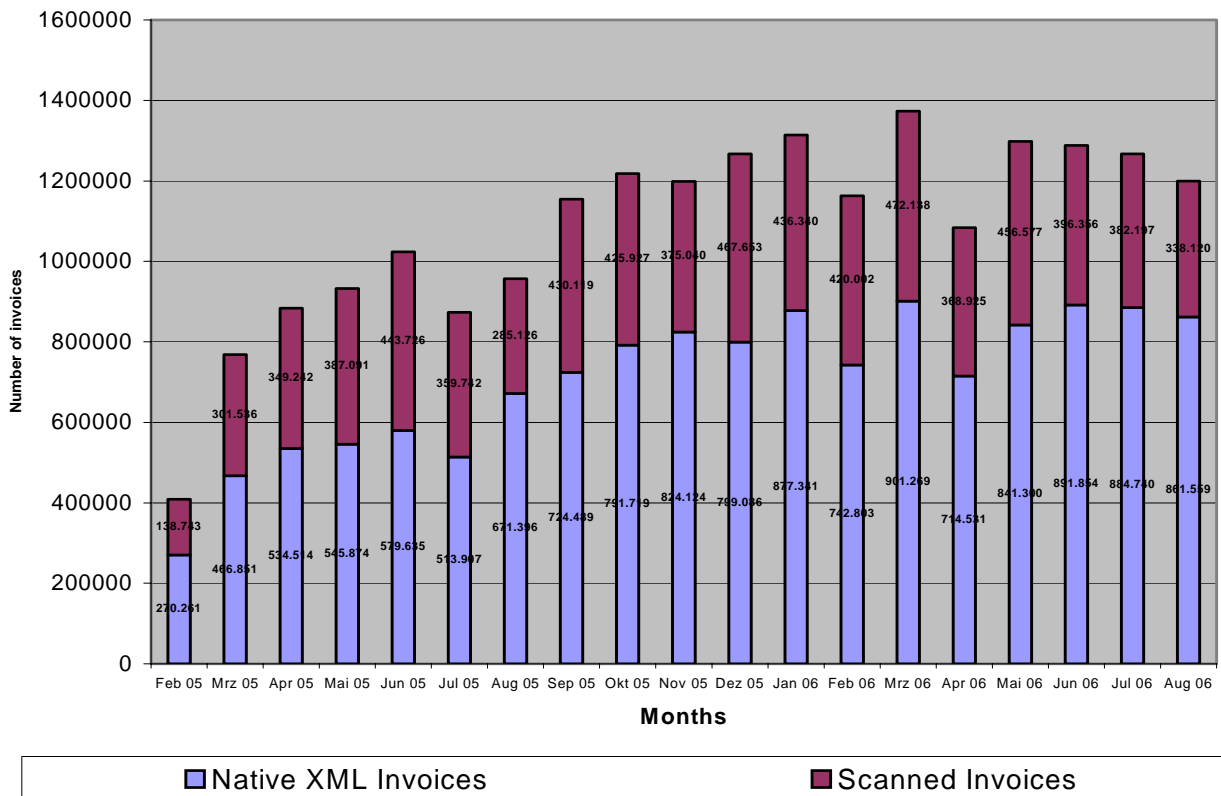**Electronic invoices to the public sector**

Figure 9: Electronic Invoices to the public sector

A number of barriers to full electronic invoicing have been identified in particular in relationship with small and medium sized enterprises (SMEs). As not all, particularly the smaller SMEs in Denmark were able to change to an eInvoicing system for B2G relations on an ad hoc basis, as alternative the Scanning Agencies needed to be implemented. However, as public sector pays for the scanning of paper based invoices originating from the smallest SMEs (with turnover of less than 2 million Euros) these companies are not stimulated to change their accounting systems to support electronic invoicing. On contrary it provides a comfortable situation for them; with the result of ongoing public subsidising this service instead of transforming invoicing to eInvoicing.

The eInvoicing infrastructure was developed primarily for B2G use. The standards were developed in collaboration with the private sector building on previous experience from EDIFACT. Some sector will continue to rely on EDIFACT for years to come but new sectors are expected to adopt the new public sector standards. Companies which already use EDIFACT based standard for B2B eInvoicing naturally are rather reluctant to implement another eInvoicing standard for B2B. The benefit for a private company to invest in software that supports only the sending of electronic invoices to the public sector is of course lower than if it also supports the sending of invoices to other private companies. However, invoices sent in B2B relations in particular among SMEs are the huge majority. 191 million paper based orders and invoices still flow between private companies. Of all invoices sent only about 17% are invoices between private sector and public sector.
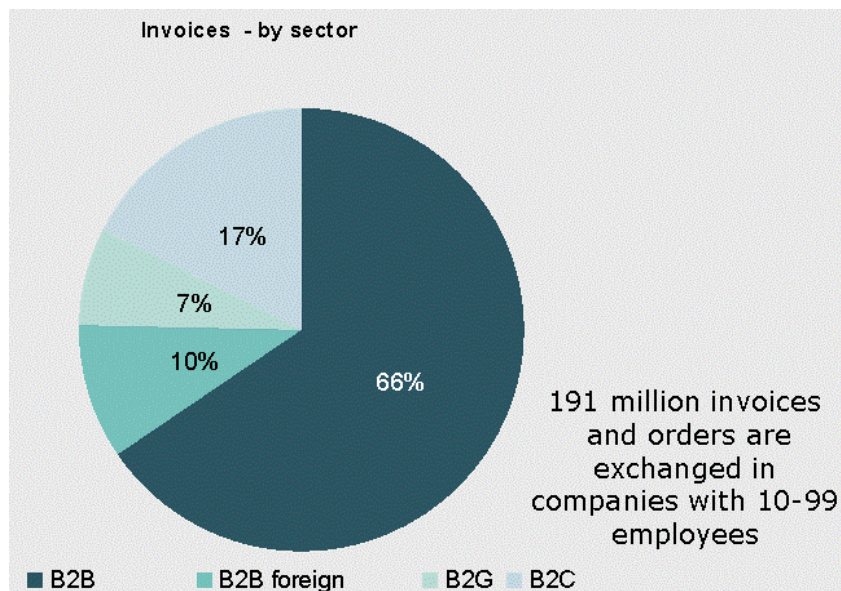
Figure 10: Invoices by sector

Source: "Analyse af besparelses- og innovationspotentiale ved digitalisering af forretningsprocesser" udarbejdet af KPMG, december 2005

Impact:
- *Scanning Agencies which convert traditional invoices in electronic invoices on behalf of companies (but on the costs of the public administration) provide a comfortable situation for these companies and are a barrier for the transition to actual electronic invoicing between B2G*
- *Based on this experience, an improved solution is in development passing this problem*
- *B2B invoicing standards have not been considered from the beginning which affected the acceptance of the B2G standard. In order to become the public standard wider accepted, cooperation with the private sector on standard improvements have been started*
- *UBL has proven to be an advantage in the development of OIOXML electronic invoicing as it is a business standard that is also the basis for electronic invoicing in B2B relations*
- *Even if not all companies employed eInvoicing in B2G but use the Scanning Agencies, all Danish companies are now aware on the possibilities of eInvoicing and already had the possibility to experience its benefits*

There is no good business case for a private company to send fully electronic invoices to the public sector if they only send 50 invoices a year. The threshold is around 200 invoices. The provision of a standard dealing invoices among B2B as well as B2G is therefore paramount. Without reaching the majority of SMEs the critical mass becoming the eInvoicing standard a positive business case also for the public administration is critical to be achieved.

Based on these experiences Denmark already started improving the system by the development of an online platform aiming at replacing the Scanning Agencies. It is envisaged to phase out public subsidies to the scanning of invoices. As the public authorities' eInvoicing standard builds on the business standard UBL, commonalities to the B2B standards already exist. This is currently used as the basis for a common approach where the private sector will be supported to get a full scale new infrastructure mainly based on open source software. A pilot on this idea will start in November 2006. The infrastructure will be free of charge; money will be taken from expenses used for scanning invoices right now.

Altogether, the purpose of the eInvoicing project is to establish the central infrastructure. Afterwards, it is up to the individual public institution to choose the solution and timing of its own adaptation to internal processes and systems. This local freedom has helped make the system durable, but its contribution to higher efficiency for the individual institution will be realised gradually.

System development

eInvoicing has worked like an engine for technological development. IT vendors have developed new solutions from simple printer drivers to advanced eCommerce systems – and made the transition for companies both manageable and not very expensive.

Moreover, since the Danish localised version of the UBL specification has been the mandatory data exchange format for companies wishing to sell goods to public institutions this has boosted the usage and knowledge of UBL in general in Denmark.

Impact:
- *eInvoicing has worked like an engine for technical development in general in Denmark*
- *Mandatory eInvoice standard and procedure has boosted the usage and knowledge of UBL in Denmark*

1.4.2 Relevance of the case for other administrations that could learn from the experience

eInvoicing is a good example of how the public sector can implement a swift, overall upgrade in technology, with significant improvements in efficiency, when there is sufficient political will and the technology to support it. The main innovative features are:

Need for regulation
Legislation is a good instrument for digitalisation. It provides security in volume for the private suppliers, and enables a swift conversion of all administrative processes for the parties involved.

Expansion to other parts of the public sector's payment systems.
If payment by the public sector to its private suppliers can be accomplished electronically, then payments by the public sector to private citizens can also be converted to bank-to-bank transactions. The recent legislation pertaining to public payments also takes this into account, and from December 2005 all payments from the public sector to citizens and companies has been directed to a selected bank account.

Need for standardisation
Common standards are a condition for digitalisation. eInvoicing employs international standards for EAN location numbers and OIOXML electronic Invoice.

Need for market solutions
Proven market solutions in technology are highly preferable if a system like eInvoicing is to provide the necessary economic incentives and to dictate standards.

Need for communication and marketing
eInvoicing affects all public institutions and private companies who supply them. This calls for some untraditional and massive marketing. A broad spectrum of communication channels have been employed, from telephone support to the individual institution and supplier, to info programmes on TV, and some 440,000 letters to Danish companies. Today, the entire concept of electronic invoicing is familiar to the parties involved, as it is them who will actually realise this project. This is crucial for implementing such a large project in so short a time.

Think big, start small
Too many IT projects have founded in grand, ambitious goals and master plans. eInvoicing shows the importance of starting with something simple and manageable.

Innovativeness:
- *Make the standard a mandatory standard to be used by law*
- *Expand the solution to as much beneficiaries as possible*
- *Use of international standards like EAN numbers for addressing and routing and OIOXML for transport*
- *Proven market solutions have been used as guarantors for success*
- *Massive marketing has been done that enabled awareness of the project and a smooth transformation*
- *eInvoicing started with something simple and manageable and grow big instead of doing it the other way around*

1.4.3   Transferability

Decision-making in the digitalisation of the public sector

The experience with legislative regulation has led to further consideration of establishing a more general legislative foundation and clearer responsibility for IT strategy by the public sector. This can set framework for further large, public digitalisation projects.

eInvoicing has also underlined the need for thinking across the public sector in relation to digitalisation. It gives a more cohesive system and a better, overall IT architecture. This mindset has aided a number of projects by creating good, constructive collaboration with local governments.

Ministries, public institutions and private companies

It is important to show how "easy" it is to digitalise administration, in order to inspire other beneficial ideas and projects. Public digitalisation initiatives must be clear to the relevant users and to society as a whole. Digitalisation does not come by itself, but by willing helpers. Thus, those authorities responsible for digitalisation must be more aggressive in their communication to the media and the parties involved – despite the risk of criticism.

Abroad

A number of countries are currently considering similar digitalisation initiatives, and the Danish case should inspire many of them to get started. The most obvious features are the technical solution, regulatory framework and distribution system. The Danish Agency for Governmental Management has already received a number of queries from other countries, including Sweden and the UK. The Swedish review of how eInvoicing could be established in the Swedish public sector recommends the Danish mandatory model.

Even if Denmark is relative to other countries a small one, it is nonetheless large enough to create a critical mass in an international development like eInvoicing. With the Danish law concerning Electronic Invoicing to the Government there has been set a number of requirements for both Danish and International suppliers of ERP-Systems to support the UBL-based invoice format.

With the next version of the UBL standard - Denmark's usage will secure widespread support of the standard among the largest ERP Solutions Providers, which potentially can function as the catalyst for a global spread and usage of the format.

Standardisation

To enable connectivity among different public authorities and private companies, data and message types have been standardized on the semantic level and a specific invoice format developed. Doing so, there is no dependency on special vendors or products, providing the "one and only" technology. Data models based on SOAP, XML and

Transferability:
- *Legislation of the standard to be used*
- *Demonstrate publicly the will for and easy way of digitalisation and its benefits*
- *Continued support for legacy structured syntaxes such as EDIFACT, UBL, OIOXML, and XML Schemas*
- *Transfer of the project methodology already under way to other countries*

Transferability:
- ***Syntactic IOP**: OIOXML formats and interfaces using SOAP and associated XML Schemas and standards are key enabler of **semantic IOP** which allows integration of OIOXML electronic Invoices in the accounting systems of the municipalities, counties, state authorities and private companies. The use of the system of (international used) EAN numbers for addressing and hence routing of messages in addition provides syntactic IOP and is highly transferable to other systems and countries*

XML-Schemas serve for the structured representation of the invoices and the automated subsequent processing.

The OIOXML standardization framework provides the standardized basis and commonly used data objects (like CompanyTaxIdentifier) defining the variables necessary for interoperable data exchange. Single services like ApplicationForSicknesBenefit are build on this OIOXML standardization framework. The e-invoicing standards are however adopted from OASIS such that only specific standard extensions were defined by the project, e.g. OrderReferenceNumber.

1.5   Results

The efficiency benefit of the conversion to eInvoicing itself was estimated at about EUR 120-150 million a year, with approximately ¼ coming from national government and ¾ coming from local government. This saving is over the long run earmarked for the national treasury. Part of this was accomplished through a reduction of allocations for 2005. For local and municipal government, this was accomplished through reduction of state government subsidies.

Overall, the cost of implementing eInvoicing in the public sector is estimated to take about 1/10 of the expected savings. This includes the acquisition of new systems and their interfacing with existing systems, plus expenses related to the free scanning-in services offered to most small companies. No costs have been incurred in establishing the VANS network or the Read-In bureaus.

A crucial element of eInvoicing is the use of legislation to create the right conditions for enabling the public sector and private companies to reap the benefits of digital administration. Regulation and the use of proven market solutions, based on existing technology, created the groundwork for the swift establishment of a viable and flexible system for electronic public payment. Regulation has enabled all public entities to quickly accommodate electronic invoices in a particular form and particular format. Accordingly, savings from increased efficiency have been realised quickly (e.g. elimination of re-keying of data in existing fax- and paper-based supply chains), and just as quickly been transferred back to the public treasury. Further initiatives are now under consideration for a general legislative framework for future digitalisation projects.

Regular contacts with business organisations indicate that especially large companies view eInvoicing as a service improvement. In the long run, eInvoicing is expected to help companies prepare themselves for other public digitalisation initiatives, and for increased digitalisation among companies themselves as the private sector also goes over to eInvoicing.

Benefits:
- *Estimated benefits are 120-150 million per year (¼ from national government, ¾ from local government)*
- *Costs are 1/10 of the benefits*
- *Savings are earmarked for public treasury*
- *Reduced workload on both sides by, at the same time, more qualitative work (e.g. elimination of re-keying of data)*
- *Faster processing of service*
- *eInvoicing helps companies prepare themselves for other public digitalisation initiatives and among companies*

The next step of development, hence, is an OIO Service Oriented Infrastructure where it should be just as easy to exchange a business document electronically as it is to send an email. The goal would be

- to build an open, secure, reliable and service oriented internet based infrastructure,

- to encompass the business requirements of both the private as well as the public sector and hence bridging the gap between the different networks,

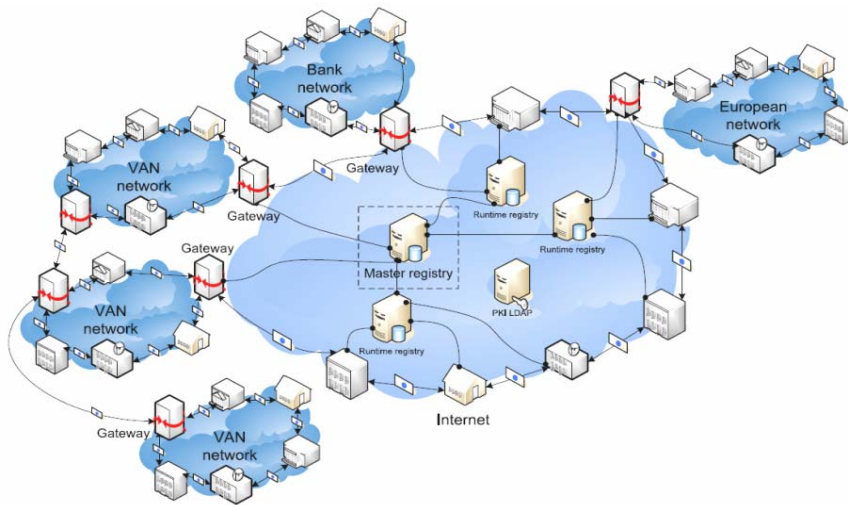- a scalable infrastructure with the ability to handle up to 200+ million transactions per year.

Figure 11: Bridging the gap between networks

1.6   Learning points and conclusions

The most important learning points and conclusions, which can inspire others to work more efficiently and effectively through eGovernment in particular in terms of eInvoicing are:

Provide a clear vision and market it to make the goal obvious to all partners

For projects involving many players, all of whom must do something for the project to succeed, it is important not to just force the change, but to formulate a clear vision and market it. This reduces resistance by giving the various players, who temporarily must carry a heavier burden, an understanding of why the digital conversion is a good idea.

- *Formulation and marketing of a clear vision to all partners*

Provide strong political support to speed up transition and reduce resistance

The success of this project was reliant on the political steer to embrace electronic initiatives, thus creating the right environment to successfully re-engineer a high volume clerical process. With the proper political support, a common transition reduced resistance to change and speed up the transition phase. I.e. regulation by law contributed to a swift conversion of all administrative processes for the parties involved and consistency in the technical infrastructure. Also, legislation has provided security in volume of orders for the private suppliers.

- *Strong political support for creating the right environment*

- *Regulation by law and backing by parliament is crucial*

There should be a strong partner in the back with the authority and capacity to manage projects

eInvoicing was the initiative of the Danish Ministry of Finance, which has both the authority and capacity to implement comprehensive IT projects across institutions.

- *Provide a responsible partner with the authority and capacity for comprehensive projects*

Projects of this size require clear role allocation incl. detailed communication plan

In a partnership with the private sector, it is important to manage clearly and decisively. This requires a clear role allocation and the assurance that system suppliers can live up to the demands placed upon them. This includes a considerable, professional communication effort. It has been learned that a project of this size requires a detailed communication plan as early as possible. Communication itself should be a structural element of the project, and it should be aggressive and differentiated in relation to all the various interests to be served. eInvoicing has led to an increased priority of resources for communication.

- *Co-ordination and integration of the different suppliers in order to maintain good communications and comprehensive understanding requires a detailed communication plan*

Good public-/private-sector relationships are preconditioned for success

Good communications were essential throughout, bearing in mind the number of parties that had to come together to deliver the project objectives. This type of digitalisation project requires a strong, experience-based collaboration and a positive public-/private-sector relationship. The public-sector partner must think in terms of alternative organisation models, which is difficult but a prudent, forward-thinking task.

- *Take care for mutual benefits and reliable partner*
- *Winning "hearts and minds" matters more than technical issues*
- *Good communications even in a dispersed partner-structure*

Calculate the estimated benefits (business case)

A clear business case like Denmark's should precede a large IT project. An estimate of the benefits of increased efficiency can be realised up-front.

- *Base your project on a business case*

Make sure that there is a benefit to be harvested - not only in the public sector

Do not forget that electronic invoicing can also be valuable internally in the private sector. E.g. manual registration and re-keying of invoices is a considerable and unnecessary cost in the public sector as well as in the private sector. UBL lowers the barriers to small and medium sized enterprises (SMEs). The potential for rationalization is enormous in both sectors.

- *Benefits not only for the public institutions but also for private companies are important*

There is a substantial investment to be made before the crops can be harvested

Do not underestimate the help needed by organizations in order to implement internal electronic workflow.

- *Substantial investments are necessary before benefits can be achieved*

Leave it to the market

Private companies have provided the infrastructure and the local systems to support eInvoicing. Thus there is a market and competition but no new major inventions, thereby ensuring that the risk is relatively limited.

- *Don't make major inventions yourself but leave them to the market in order to avoid risks*

There is no one solution, multiple channels are required

As the different IT equipment and/or internet familiarity of the companies show, there is no one single way to go, offering the one and only solution, multiple channels like the invoicing portal and scanning bureaus are required to follow in order to meet their needs.

- *There is no one solution, multiple channels are required*

Don't forget the people side of digitalisation

Introducing eInvoicing has mainly focused on getting the technology in place. The people who have to change their work processes are an equally important success factor.

- *Take also care on people not only on technology*

Instant critical mass through legislation

Denmark will be among the first countries – if not the first – to implement the requirement for electronic invoicing in the public sector in its legislation. On one hand this approach may seem forceful but on the other hand this may be just what is needed in order to achieve critical mass in electronic invoicing in society as a whole. The private sector has a huge incentive to implement electronic invoicing now that the whole public sector is able to receive electronic invoices. The government has provided an infrastructure, an addressing mechanism, a standard has been chosen (UBL) and critical mass is ensured.

- *A critical mass of customers may be ensured by making it a standard by law*

Benefits through using same identifiers across the sectors

The keys to the success of this transaction are two well-established registries of citizens and companies, the CPR = Central Person Registry (social security number) and the company registration number (CVR = Central Company Registry). Both are used as the primary identifiers for citizens and companies in the public sector and in some parts of the private sector. Denmark is fortunate in comparison with other countries, that the same identifiers are used across different public authorities. This makes data interchange between authorities much simpler compared to countries where these key identifiers are not shared.

- *Use same, probably already existing, identifiers throughout the different sectors*

Be aware that international standards need to be adapted and developed for your individual use

One inherent issue that one has to deal with when using international standards like UBL is the fact that most data types are relatively weak in their validation. Having the normative UBL schemas is important in order to make sure messages can be exchanged between business partners in different countries. But solutions within a single country or sector etc. require rather detailed assignments fitted to the individual conditions (see the ZipCode example in the implementation chapter). Thus, several validations steps expressed by the weak ("lax") and strong ("strict") validation schemes are necessary and have to be developed in addition to the existing standard. XML schemas can go a long way in regards of validation, but the technology cannot express all the rules of integrity that the legislation contains. Thus XML schemas cannot replace the checking of integrity rules that a programmer can code.

- *XML, EDIFACT or UBL etc. provide a foundation not a panacea. Standards have to adapted and developed for the individual use*

Plan for enough time to implement, test and deploy

Implementers were basically only given two and a half months to develop, test and deploy the necessary software to the public institutions and the private institutions invoicing them. The Ministry of Finance was well aware that this schedule was very "optimistic" as it was expressed in public statements. When launching a standard

- *Allow implementers 6 months to implement, test and deploy*

like UBL in the public sector with thousands of institutions and thousands of suppliers, all the legislation work and the necessary localization of international standards and specifications should be "frozen" at least 6 months prior to launch. A detailed plan for how implementations can be tested should be ready. Furthermore, it would have been advantageous to have had a six month gap between the requirement for public institutions to receive electronic invoices and the requirement that they only receive electronic invoices. This would have given developers responsible for producing invoicing systems the chance to test compatibility with the reception systems that would already have been established. An example of confusion at the developers caused by time pressure is illustrated by this:

The schemas referenced in the Danish legislation were based on the original 0.7 UBL schemas. An extra set of strongly validating schemas was also supplied, but the use of these schemas was not required (see the "lax" and "strict" XML schemas in the Learning Point above). They were supplied as tools to aide the developers in their development. Strictly speaking you could not claim to be in conformance with the requirements of the law without your instance being able to validate with these supplementary schemas. But even with the strict schemas it was possible to produce instances that were not in accordance with the legislation. The reason for this being that the XML Schema could not express all the business rules and integrity constraints needed for an invoice used in our scenario. But such technicalities were very often lost in the communication. Many developers blindly trusted the "lax" schemas validate instances as being conformant to the law. Ideally there would only have been one set of schemas and less confusion. But the speed in which the legislation was rolled out did not allow going through an official standardization process with the strongly validating schemas.

Be aware that there are developers with little or no prior exposure to XML and XML Schema

It may be that XML has conquered the world and that XML is everywhere, but that does not imply that all developers has worked with XML or even understands the most fundamental aspects of XML and validation.

In the first weeks after February 1st - invoices were sent that were not even well formed. The invoices had been generated with tools that did not support XML, and the developers had obviously not even tried to validate the messages. This caused enormous problems in the VANS-network because the VANS-operator could not determine whom an invoice was meant to be sent to.

Other developers blindly trusted the parser. They believed that their instances were in conformance with the law when they got an "ok" from the parser. But this was most often not the case. The XML Schema can of course only validate the syntax, and with the UBL Schemas to a lesser extend the data types.

Critical success factors for IOP:

- *Legislation must be ready 12 months prior to launch*

- *Standards must be ready at least 6 (better 9) months prior to launch*

- *Not everybody in particular developers must already be familiar with XML. Plan for problem-solving and support*

All weaknesses in the schemas that could be abused were abused. For instance obligatory elements that have string or tokenized string data types were not constrained to be non-empty

Example:

```
<com:ReferencedOrder>
  <com:BuyersOrderID/>
  <com:SellersOrderID/>
  <com:IssueDate>0001-01-01</com:IssueDate>
</com:ReferencedOrder>
```

Like in the example, developers will often just leave obligatory elements as empty or use default values like a useless date, and the XML Schema will accept this.

Make reference implementations and validation tools available

The problem with the developer community's inability to work with XML and XML Schema (see Learning Point above) was addressed by developing online validation tools. The tools allow developers to post an instance to a central server using an html form, and the server will reply any detected errors or warnings. The tools have been extremely valuable to the developer community and the need for support dropped drastically once it was made a requirement that developers had tested their instances prior to contacting them with questions.

Schemas can not validate everything

Almost any large XML standard is bound to define connections between elements and attributes that cannot be modelled in XML Schema. In UBL the most common occurrence of this kind of connection is that an attribute on an element containing a textnode will be used to define the type of the textnode's content. In order to check as many integrity rules as possible, a third validation tool was developed using Schematron. This tool allows contingent validation and has also been extremely valuable. The contractors had the ability to gradually improve the Schematron validation, and give developers better feedback on their instances. Schematron validation is a promising candidate for being mandated in the next roll out of procurement messages based on UBL.

The introduction of the various online validation tools as a "syntax wall" with XML schemas in the heart of the network infrastructure was crucial to the success of the project. The "syntax wall" allowed tightening the performed validation and thus the quality of invoices exchanged. To this day the contractors would have had enormous problems with bilateral discussions with developers about the quality of their invoices without this mechanism.

Critical success factors for IOP:

- *Provide online validation tools*
- *Provide reference implementations of services*
- *Provide testing services*
- *Provide stylesheets and visualisation tools*

- *Provide sophisticated validation tools for eliminating illegal instances as much as possible*
- *Make sure that your XML Schema does a good job with strong validation*
- *Provide many examples of different kinds of invoices*

Adoption of old EDI technology (the VANS network) is not necessarily the best solution

Do not assume that old EDI-technology reduces complexity. As the VANS network shows, this could also be a barrier to SME's since the VANS network is expensive and provides limited value. The pure VANS network was not sufficient for transport eInvoices, you must also take responsibility over protocol and enveloping issues.

Consider basing your technical infrastructure on Internet technologies

As shown above, the VANS network is not the ultimate solution, consider basing your technical infrastructure on Internet technologies like digital signature, SSL, ebMS, UDDI, http(s), SMTP to be more independent and connective. Be aware that the choice of infrastructure is hard to change. Denmark will by July 2007 offer an Internet based infrastructure for exchanging electronic invoices and other busines documents

(see http://www.oio.dk/arkitektur/soa/infrastruktur/english).

The use of UBL could be much cheaper for all than other eBusiness standards (like e.g.EDIFACT)

"The biggest companies have during several years been able to exchange electronic business documents based on EDIFACT. Some of these interfaces have later been replaced by XML-based sector specific standards. The challenge to the smaller companies has been, that EDIFACT-based exchange of business documents has been expensive to establish. Small companies and large companies alike can both harvest the potential in doing electronic business with a "universal" common denominator standard like UBL.

The philosophy of UBL is that the choice of which elements goes into a particular message must fulfil the 80/20 rule: That all elements must be usable in 80 percent of the usage scenarios. Other eBusiness standards that have been developed in specific sectors are typically trying to cover most of the known requirements in that sector. This approach makes it costly to support all the aspects of a standard by ERP-suppliers. They may have to support a feature that is only needed by a fraction of the users. UBL is an extensible language, where sectors can localize (change) UBL following strict rules ensuring that basic data can still be read by vendors, which do not understand the sector specific extensions. This means that for instance an invoice can be localized regionally, nationally or even in a particular sector (i.e. a European version, a Danish version or a utility sector version) can still be exchanged with customers in other parts of the world" (Bosak 2005).

- *Adoption of old technology (e.g. EDI) is not necessarily the best solution*

- *Consider basing your technical infrastructure on Internet technologies*
- *Be aware that the choice of infrastructure is critical to change*

- *Generally spoken, the use of UBL could be much cheaper than other eBusiness standards*

The addressing mechanism must be under public control

The addressing mechanism of a public infrastructure is a critical piece of infrastructure. Dependence on private companies in such a mechanism leaves the public sector vulnerable to a costly lock in. Central shared services like addressing mechanisms and Federated Identity and Access Management mechanisms should be established and be under control by the public sector in order to avoid digitalization projects which are not interoperable.

Security of sensitive invoice data

Electronic invoices may or may not contain sensitive data. In Denmark it was decided that all invoices should be sent in confidentiality without risk of the invoices being compromised. Security and privacy issues are very high on the agenda in most European countries and the forthcoming internet based infrastructure which will be established in Denmark will provide a very high level of security based on a PKI infrastructure.

Critical success factors for IOP:

- *The addressing mechanism is a critical piece of infrastructure and must be under public control in order to avoid digitalization projects which are not interoperable*

- *Security of sensitive invoice data is crucial and should be based on a PKI infrastructure*

1.7   References and links

Agency for Governmental Management 2005: E-Invoicing in Denmark – higher efficiency in the public sector, 2005. Leaflet of the Agency for Governmental Management (Økonomistyrelsen).

Agency for Governmental Management 2005: Electronic Invoicing Handbook of the Agency for Governmental Management 2005 (http://www.oes.dk/graphics/Filbibliotek_OES/OFFENTLIG/Betaling/Elektronisk_fakturering/Electronic_invoicing.pdf). Last visited on 14 September 2006.

Bosak, Jon 2005: Denmark Leads the Way With Electronic Billing. Published in Børsen, August 23, 2005. By Jon Bosak, Sun Microsystems (http://xml.coverpages.org/BosakDenmark2005.html). Last visited on 14 September 2006.

Deloitte 2004: Undersøgelse af tidsforbrug og transaktionsantal i udvalgte kommuner og amter. (http://www.oio.dk/files/deloitte_pricewaterhousecoopers.doc) Last visited on 14 September 2006.

GS1: Global Location Numbers (GLN). Leaflet obtained from http://www.gs1.org/docs/idkeys/GS1_Global_Location_Numbers.pdf. Last visited on 7.11.2006.

Hippe Brun, Mikkel; Nielsen, Brian; Lanng, Christian; Rasmussen, Bryan 2005: Large scale validation of millions of UBL Invoices with XML Schema and Schematron, November 2005 (http://www.idealliance.org/proceedings/xml05/ship/73/Large_scale_validation.HTML) by Mikkel Hippe Brun, Brian Nielsen, both from Danish National IT and Telecom Agency, Christian Lanng,

Bryan Rasmussen, both from Ministry of Science, Technology and Innovation. Last visited on 14 September 2006.

Hippe Brun, Mikkel; Brown, Jan; Løhde, René 2005: Adoption of UBL in Denmark - business cases and experiences, Proceedings of XTech 2005: XML, the Web and beyond, May 2005 (http://www.idealliance.org/proceedings/xtech05/papers/03-05-02/) by Mikkel Hippe Brun, Jan Brown, René Løhde, all from Danish National IT and Telecom Agency. Last visited on 14 September 2006.

Hippe Brun, Mikkel 2006: eInvoicing in Denmark – lessons learned with eDocuments, Interoperability and Archiving. Presentation at the International High Level Seminar "eGovernment for all Europeans" on 10 February 2006, Mumok, Vienna, Austria (http://www.egov2006.gv.at/Presentations/Panel%20C%20-%20Mikkel%20Hippe%20Brun.pdf#search=%22eInvoicing%20in%20Denmark%20%E2%80%93%20lessons%20learned%20with%20eDocuments%2C%20Interoperability%20and%20Archiving%22) . Last visited on 14 September 2006.

ISO/IEC 2004: Schematron: ISO/IEC FDIS 19757-3 (http://www.schematron.com/iso/dsdl-3-fdis.pdf). Last visited on 26 October 2006.

KPMG 2003: [Danish] Optimizing payment processes in the public sector. (http://purl.oclc.org/net/oioxml/ubl/einvoice/BusinessCaseDocumentation) Danish title: Optimal betalingsformidling i den offentlige sektor. October 2003. Last visited on 14 September 2006.

Law on Public Sector Payments 2003: [Danish] Law on public payments. (http://purl.oclc.org/net/oioxml/ubl/einvoice/LawPublicPayments) Danish title: Lov om offentlige betalinger m.v. (Lov nr. 1203 af 27/12 2003) December 27th 2003. Last visited on 26 October 2006.

FM Statute: [Danish] Ministry of Finance: Statute on electronic invoicing to public authorities. (http://purl.oclc.org/net/oioxml/ubl/einvoice/FinanceStatute) Danish title: Bekendtgørelse om elektronisk afregning med offentlige myndigheder (Bekendtgørelse nr. 991 af 7. oktober 2004). October 7th 2004. Last visited on 14 September 2006.

VTU Statute: [English] Ministry of Science, Technology and Innovation: Statute on information in the OIOXML Electronic Invoice for use with invoicing of public sector organisations (Statue no 1075 of November 11th 2004). (http://purl.oclc.org/net/oioxml/ubl/einvoice/VTUstatuteEN) / [Danish] Bekendtgørelse om information i OIOXML elektronisk regnig til brug for elektronisk afregning med offentlige myndigheder (http://purl.oclc.org/net/oioxml/ubl/einvoice/VTUstatuteDK) November 11th 2004. Both last visited on 26 October 2006.

Links: (all links worked out on 26 October 2006)
Danish Agency for Governmental Management under the Ministry of Finance (Økonomistyrelsen): http://www.oes.dk, www.oio.dk, and www.e.gov.dk

Danish National IT and Telecom Agency: http://www.itst.dk

Global Location Numbers or GLN's: http://www.gs1.org

Ministry of Science, Technology and Innovation: http://www.itst.dk

OASIS - Organization for the Advancement of Structured Information Standards: http://www.oasis-open.org

Annex 1: Assessment Questionnaire for the MODINIS Case Descriptions

In order to ensure that the case descriptions meet the information needs of stakeholders in interoperability at the local and regional level, we ask you to complete this short assessment questionnaire. Your feedback will be used to improve the next version of the present case and will also be taken into consideration when writing up more cases to be described in the course of the project.

Case being reviewed: ....

1.) Information content

a) Completeness of description

```
1                               5
|-----------|-----------|-----------|-----------|
only few                        all
relevant                        relevant
aspects                         aspects
```

b) Detail of description

```
1          3          5          3          1
|-----------|-----------|-----------|-----------|
too                   right                  too many
general               level                  details
```

2.) Length of description

```
1          3          5          3          1
|-----------|-----------|-----------|-----------|
too                    right                 too
short                  length                long
```

3.) Structure / headings

```
1                               5
|-----------|-----------|-----------|-----------|
unclear                         clear
```

4.) Margins

```
1                    3                 5
|--------------------|------------------- --|
misleading      not necessary      good
                                   orientation
```

5.) Learning potential

```
1                                       5
|----------|-----------|-----------|-----------|
none at all                        many new insights
```

6.) Usefulness for your own work

```
1                                       5
|----------|-----------|-----------|-----------|
not at all                         very much
```

7.) Transferability of case to your country

```
1                                       5
|----------|-----------|-----------|-----------|
not at all                         very high
```

8.) Will you get into contact with the contact person?

```
1                                       5
|----------|-----------|-----------|-----------|
certainly                          for sure
not
```

Comments

_____

_____

Your affiliation

☐   ☐   ☐   ☐
local/regional   national   IT   academia
government   government   business

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