Advancing transportation/logistics document exchange - the e-Impact project vision

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Elevator summary

New data interchange models based on international standards have emerged for logistics information service providers to exchange transportation-related information. These models, first proven in procurement scenarios, now are demonstrated in the European e-Impact project to be directly applicable to transportation scenarios. Today, the SMP four-corner model of access provision and the document models and syntax of UBL ISO/IEC 19845 already are providing the necessary universal access for logistics providers. They hold the potential to universally bridge numerous worldwide transportation-related data interchange projects where different syntaxes and protocols are being used. As varied and novel requirements are identified, participating in specifying the augmenting of this existing universal document model ensures more scenarios are supported for wider transportation logistics adoption.

Executive summary

Logistics information service providers streamline the transportation of goods by exchanging accurate and comprehensive documents. Replacing the long-used paper-based scenarios with electronic equivalents is in everyone's interest to make such exchange even more streamlined. Improving access opens electronic interchange to more participation. Improving data accuracy reduces re-entry and rework, and can limit mistakes that can cause delays or trigger the wasting of resources. In recent years, many electronic transportation information projects have been initiated worldwide, each independently assessing different requirements, thus ending up with different implementations of differing models.

Through advances in approaches and experiences in deployment, new generations of data interchange models have evolved. The newest data interchange models are based on international standards and have emerged as viable candidates for logistics information service providers to exchange transportation-related information in an open fashion that is inclusive of all.

These new models have already been proven in successfully-deployed production procurement scenarios. The European e-Impact project www.eimpactproject.eu [http://www.eimpactproject.eu], built from the lessons learned and best practices of previous transportation projects, actively demonstrates these new models to be directly applicable to transportation scenarios.

Few providers have any interest in changing their existing information systems in the projects where they currently participate. New participants are reluctant to modify their systems to support multiple transportation partners. But they all face compatibility challenges with the parties they need to interact with who are new from outside of their projects or are different because of the use of different software. And so legacy transportation syntax formats and protocols are being accommodated now in these new models, resulting in bridging-benefits between previously isolated transportation systems and projects.

Today, the OASIS SMP four-corner model of access provision and the document models and syntax of OASIS UBL ISO/IEC 19845 are providing the necessary universal access for logistics information service providers. Contrasted to traditional two-corner direct access and three-corner portal/single-window access models, this new model is already shown in procurement scenarios to be more inclusive of all of the community of parties involved in information interchange. No longer are candidate participants disenfranchised from being part of the data interchange network. The e-Impact project proves the same to be true for transportation.

But varied and novel information representation requirements are constantly being identified. The many different transportation projects around the world may have unique semantics that need to be conveyed beyond the project boundaries. Participating in the standardization community that is specifying the augmenting of the existing document models to eliminate the gaps in specifications ensures more scenarios are supported for wider adoption. The timing is right for joining the effort and ensuring everyone's requirements are adequately accommodated as the document standards are revised. It is important to ensure the governance of the specifications involved provides different ways for all stakeholders to participate or contribute to the work of the project.

Disclaimer

The opinions and perspectives in this essay are entirely those of Crane Softwrights Ltd. and do not in any manner necessarily represent the views or positions of the e-impact project, its participants, the OASIS Business Document Exchange (BDXR) Technical Committee, or the OASIS Universal Business Language Technical Committee.

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1. The e-Impact project vision

In April 2016 the Connecting Europe Facility of the European Union co-funded with industry the two year project named e-Impact: Implementing the e-Freight Framework and e-Delivery infrastructure [e-Impact]. This project is running real-world transportation data interchange between shippers, logistic services providers and authorities along three of the many corridors of the Trans-European Transport Network (TEN-T). The identified three are the Atlantic, the Mediterranean and the Baltic/Adriatic corridors.

Rather than being developed from scratch, this project incorporates lessons learned and best practices from other EU-funded research and development projects, notably including among others Freightwise (2006-2009), e-Freight (2010-2014) and iCargo (2011-2015).

The expressed objective of this project is the be the forerunner for wide market adoption and full-scale deployment of data interchange on both a pan-European and an international scale. These advanced capabilities have been given the simple but meaningful moniker "e-Freight". Success is expected in applying e-Freight Framework solutions producing concrete benefits from regular cargo flows and operations processes. Lessons will be learned assessing the viability of e-Freight solutions at different levels of interaction: individual participants, the corridor itself, and the impact on other corridors in the entire European network.

The project has already established collaboration with some projects in Asia, anticipating to demonstrate connectivity between European and Asian stakeholders and interoperability between independent transportation system networks. The technical coordinator of the project, Mr. Jan Tore Pedersen of Marlo a.s in Norway, sees global acceptance in the future. He summarizes in this diagram the vision of interconnecting many transportation projects found worldwide using UBL ISO/IEC 19845 as an internationally-standardized common document format:

Figure 1. The e-Impact project vision

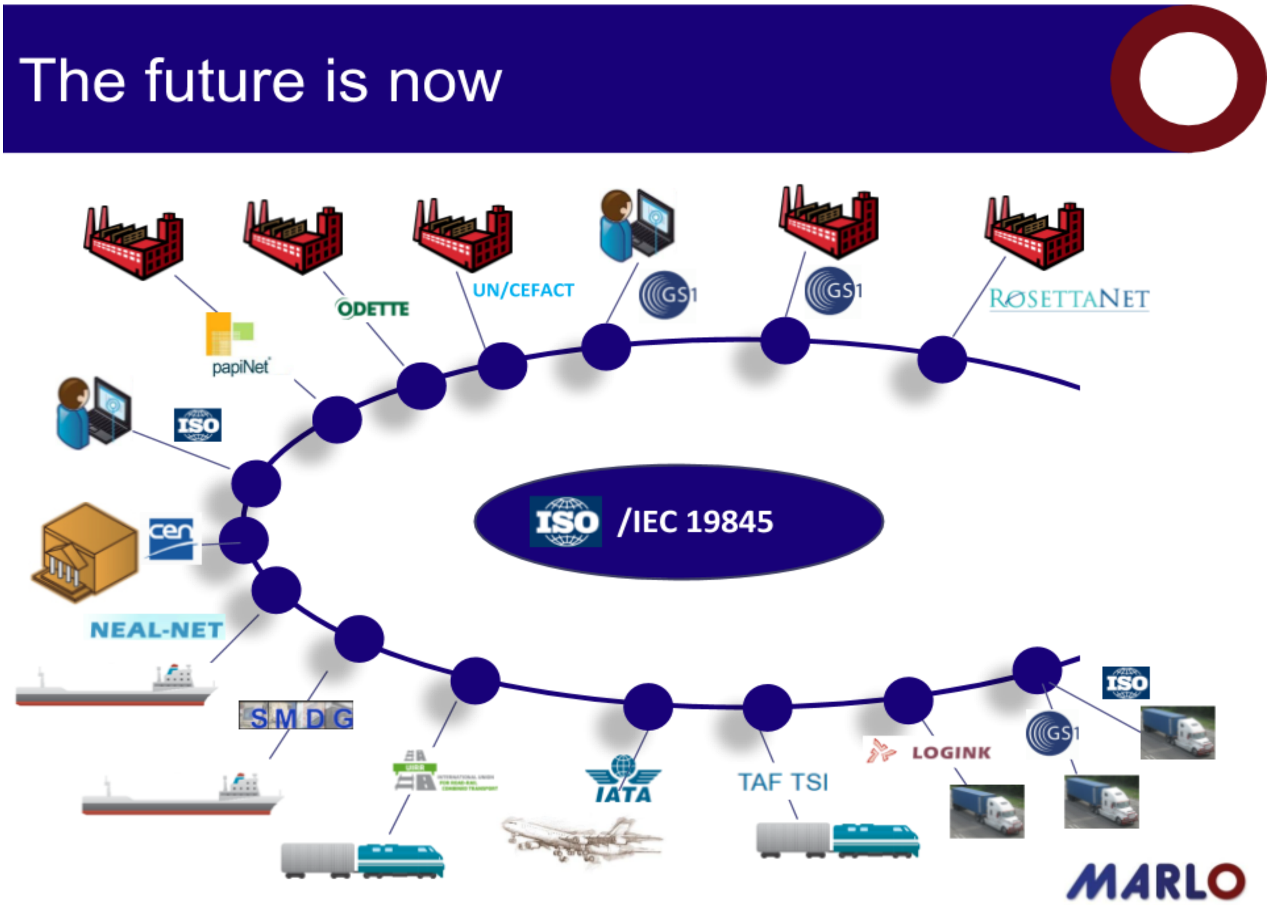


Image courtesy Jan Tore Pedersen, www.marlo.no

Industry has already jumped into this project with both feet. Around 15 organizations from Portugal, Italy, and Poland are currently directly involved in e-Impact, with examples of other projects expected to come to light in 2018. Going beyond the European transportation corridors, already the Port of Sines (the largest artificial port in Portugal) is setting up the e-Freight Framework to map transportation status messages between e-Impact and the Asian NEAL-NET collaboration of China, Korea, and Japan [NEAL-NET].

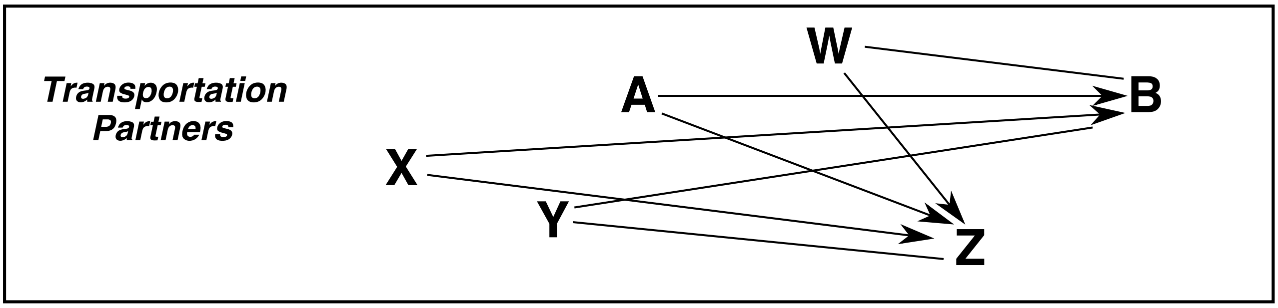
2. Contrasting data interchange models

I've described the evolution of communication models in previous essays of mine regarding procurement, but this description bears repeating as an illustration of the benefits in the transportation realm of the four-corner model over the two-corner and three-corner models traditionally used for information interchange.

The core operation of the four-corner model of service discovery and access point interaction is standardized at OASIS as Service Metadata Publishing (SMP) [SMP 1.0] maintained by the OASIS Business Document Exchange (BDXR) Technical Committee [BDXR TC]. The PEPPOL project [PEPPOL] in Europe donated its conception and initial implementation of this four-corner-model architecture for service metadata publishing to OASIS in order to be further developed into a globally-useful specification.

To better understand how such a framework differs from previously-used architectures for transportation document interchange, consider the following depiction of document transfers from some parties shown at the left of the group (A, W, X, and Y) to their transportation partners shown at the right of the group (B and Z).

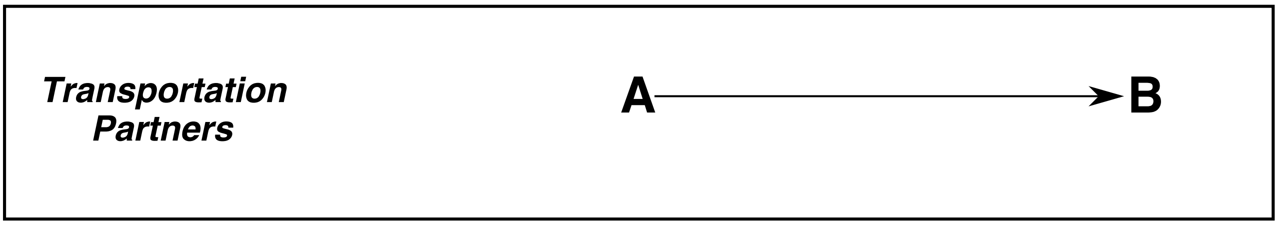
Figure 2. Transportation partners with multiple relationships



This can become a very large collection of many very different implementations of the two-corner model. Without an agreement on a common method of communicating, transportation partners B and Z must either accommodate the incoming document formats and protocols, or dictate such to the originating parties. If Z and B use different document formats and protocols, this imposes the burden on the originating parties to support multiple configurations in their systems.

Focusing on just transportation partners A and B, one can simplify the diagram to the following, where A needs to send a document to B.

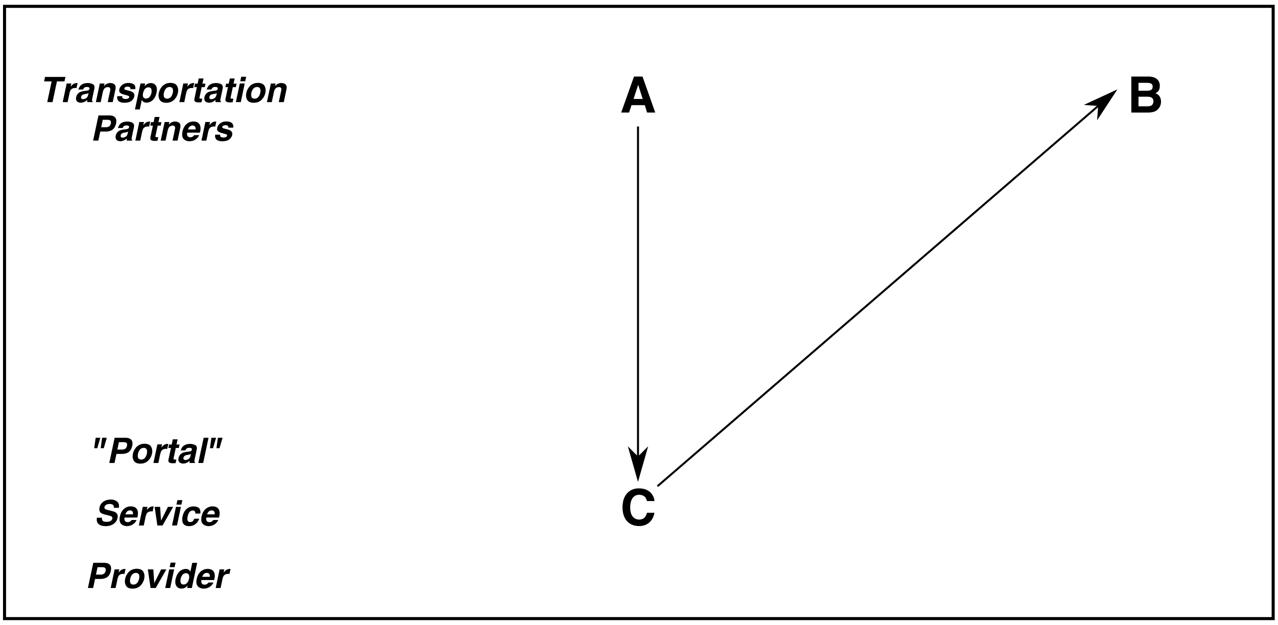
Figure 3. Focusing on two transportation partners in a two-corner model



The document transfer appears straightforward, however, there may be access restrictions or discovery issues preventing A and B from interoperating directly. Furthermore, A and B might be using different document formats or different protocols that would force one of the two to capitulate and support the other's conventions.

Traditionally, this has led to the "portal" or "single window" concept of a common service provider C with whom A and B do business. A sends the document to C and C forwards the document to B, possibly providing a document translation service as part of the process.

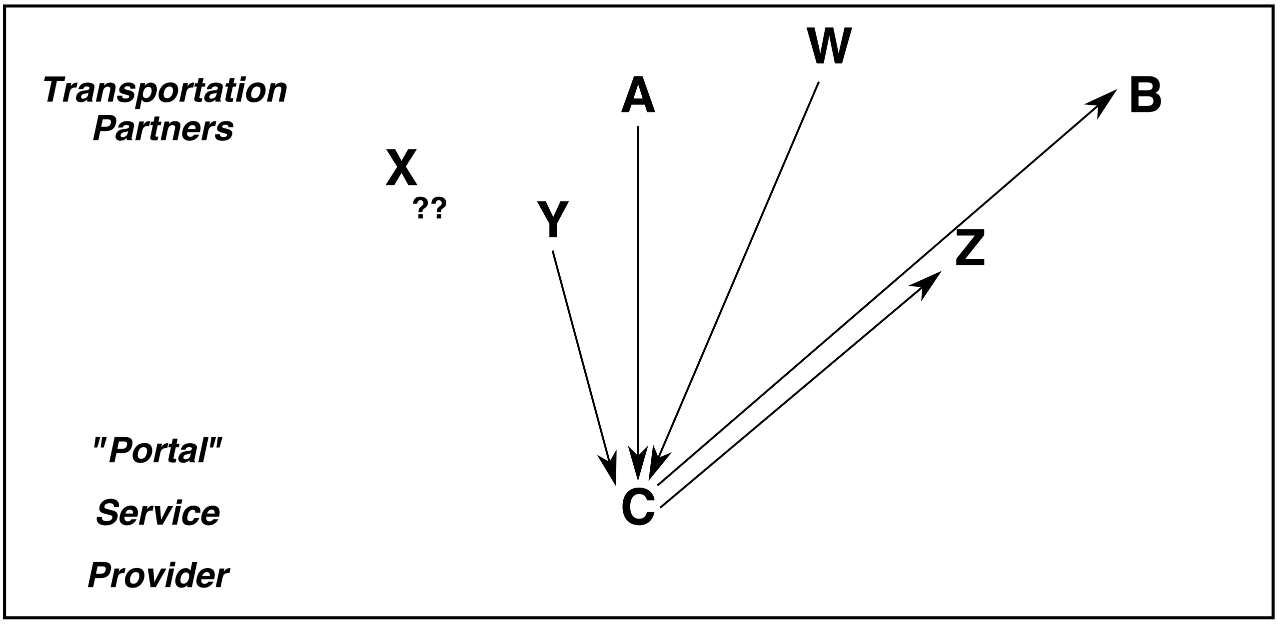
Figure 4. Two transportation partners working through a three-corner network



This readily can be seen to be a three-corner model with the service provider in the centre. But now C can be the dominant party, mandating the access from A and the access to B. And at first, this may not seem like such a problem other than A and B perhaps having to change the data format of their documents or the nature of their communications protocols if C is unwilling or unable to do so.

Moreover, there is a risk that is not immediately apparent. In the following diagram the other parties W, Y and Z may all accept the constraints imposed by the controlling C party. But what about party X who has been disenfranchised from the transportation relationship?

Figure 5. Many transportation partners working through a three-corner network



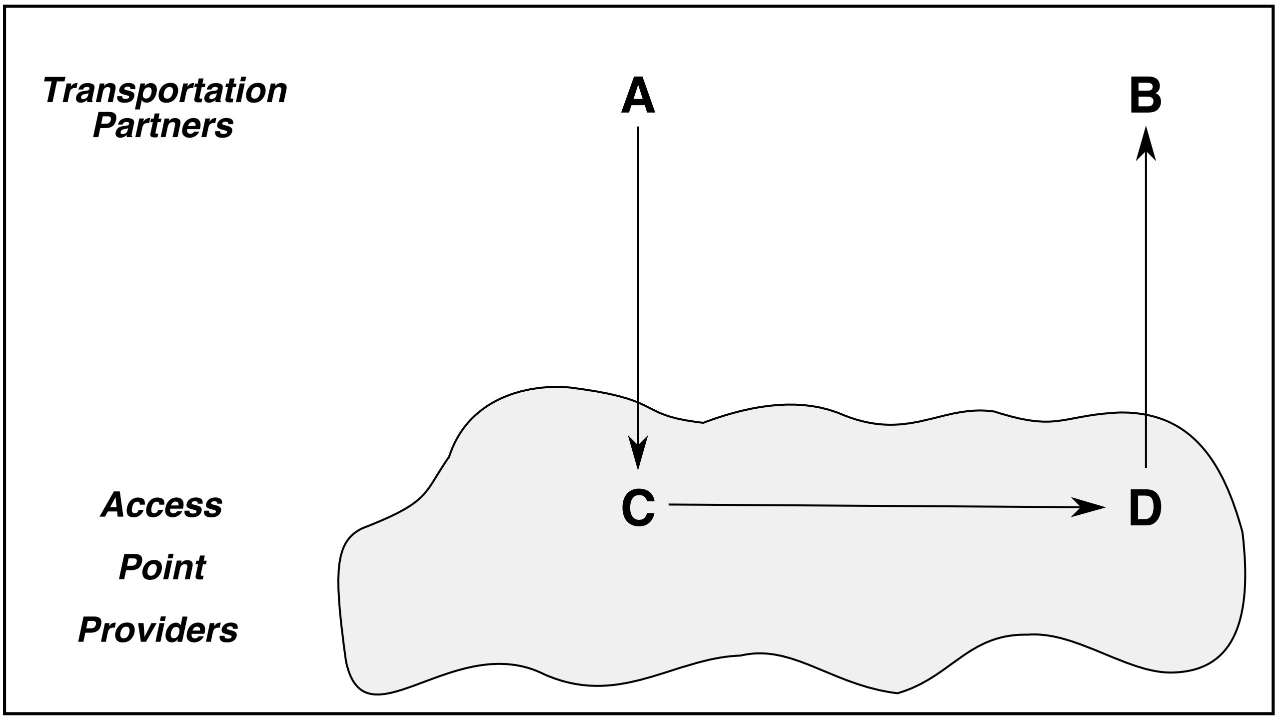
The access demanded by C might be too expensive for X to afford. Perhaps the document format demanded by C is one not supported by X. Perhaps there might a physical constraint preventing X and C from connecting. Perhaps there is a cross-border issue preventing C from providing the service to X. Even worse there simply might be bad blood between X and C and C simply refuses to let X participate.

Moreover, C represents a single point of failure for the entire community when it is the middleman of all data interchange. Perhaps C cannot scale their service to accommodate all who need to use the service.

For whatever reason or reasons, going through a single service provider can be far too constraining for some of the parties that need to be involved. Yet for many years this has appeared to be the solution that communities worked towards.

Consider, then, the following depiction of the alternative SMP four-corner-model approach first implemented for electronic invoicing conceived by the PEPPOL project and then donated to and maintained now by OASIS. Here the network is a set of connections between access point providers, each providing a network access service to their respective customers.

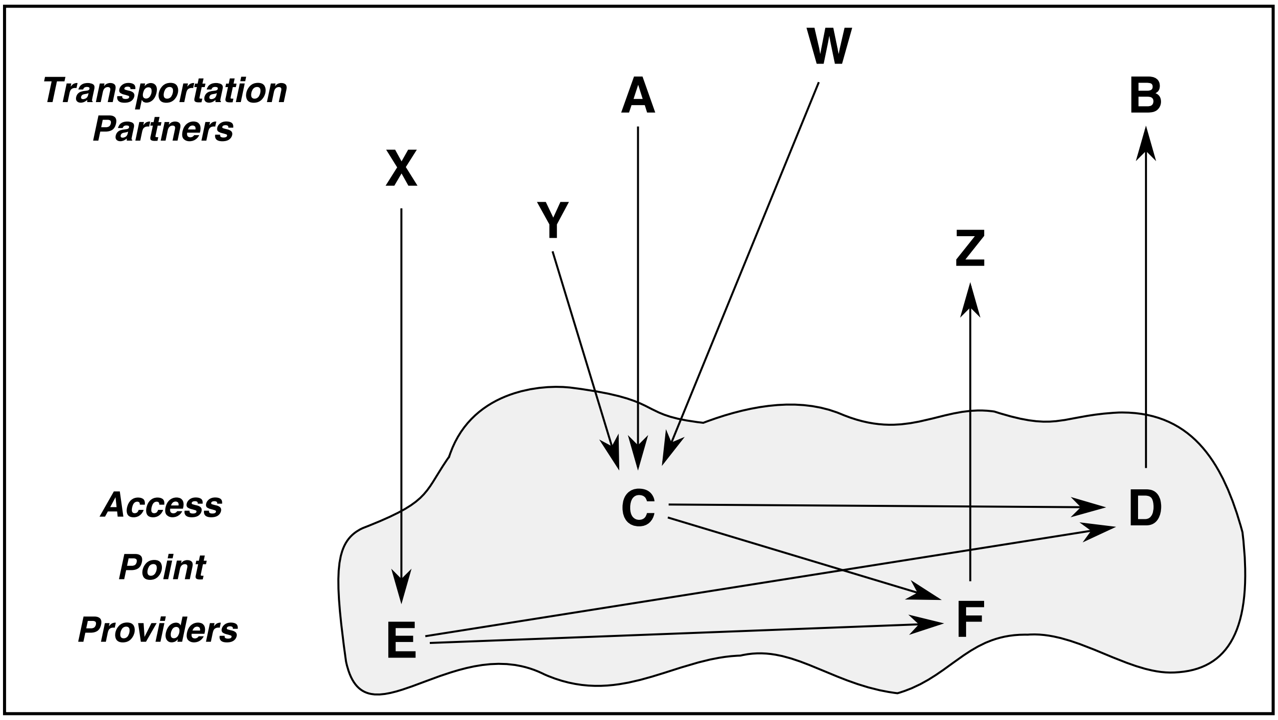
Figure 6. Two transportation partners working through a four-corner network



In the simple example of A sending a document to B, the document is not sent directly between the two parties. Rather, C is an access point providing a network access service to A, and D is an access point providing a network access service to B. The network itself is defined as a suite of service level agreements and commitments regarding standardized document formats and communications protocols, but such is imposed only on the connection between access points C and D, and not on the users A and B. The actual document format and protocol used between A and C are private to the relationship between A and C. Such is the same between B and D and could very well be very different than those between A and C. And either or both could be different than those in the network obligations between C and D.

This nurtures a marketplace for multiple access point providers delivering a common networking service to all of the transportation partners. And, again, there are no constraints on the relationship between the transportation partners and their access points. The only constraints are on the relationship between access point providers. And so one ends up with a network architecture implemented as follows.

Figure 7. All transportation partners working through a four-corner network



In this architecture, only the access point providers need communicate with each other using UBL - ISO/IEC 19845 for the document formats and whatever interchange protocol is agreed upon at the transport layer. There is no obligation for the transportation partners to use these network conventions because their relationship with the access point provider is private and can support any document format and any communication protocol. Of course they can choose to support the same network protocols, and then the access point provider's job is simplified, which may lead to cheaper services.

Moreover, larger transportation partners may choose to become their own access points. The deployment of PEPPOL has led to the creation and publishing of open-source implementations of the OASIS protocols and these implementations are being used by organizations large and small in Europe and Australia. But the bulk of users buy their access service from access point providers rather than committing themselves to the service provision obligations.

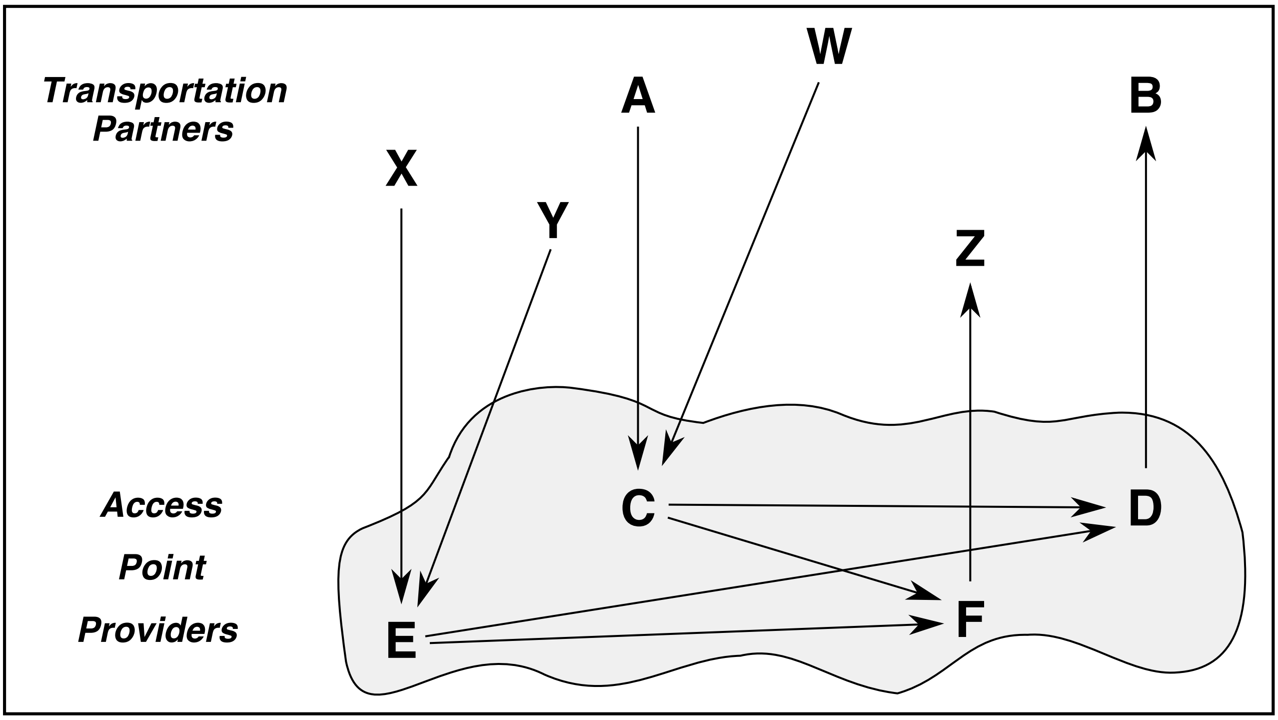
The big opportunity is for a multitude of small access point providers each creating a business to service their particular constituency of users with whom they may already have a relationship of some kind. The users come to them willing to pay for the access service for their documents to be sent and received across the network to and from their transportation partners. No-one gets disenfranchised. Those who don't like the access point providers available can nurture a new one to service them or become an access point provider for themselves.

And for all of this, there is no single point of failure. Any one access point provider failing to live up to its service commitments to its customers and to the other access points will not prevent the other access points from fulfilling their obligations because they are using other access point providers.

Surprising to some, this model is not new, until one realizes how well such a system works. There are four-corner-model implementations of other global systems that have been working for a long time. For example, when using the postal service, one sending a letter to a recipient in another country still gives that letter to their country's postal access provider. The country postal service sends the mail to the target country's postal service within the worldwide agreements and protocols for post. The target country's postal service then collects all of the letters from all countries that are addressed to a given addressee and delivers them according to the postal conventions of the target country. And the very same happens when making a long distance telephone call. Such interoperability solutions have been real-world deployments of the four-corner model and PEPPOL made the leap to recognize the same could be done for electronic invoicing.

One particular flexibility with the four-corner model applied to electronic communications systems over the Internet is the opportunity for parties to change their service provider or buy the services from multiple service providers based on the services provided. Consider in the following diagram compared to the previous diagram where party Y has had a falling out with access point provider C and chooses to use provider E instead.

Figure 8. Changing the access point provider

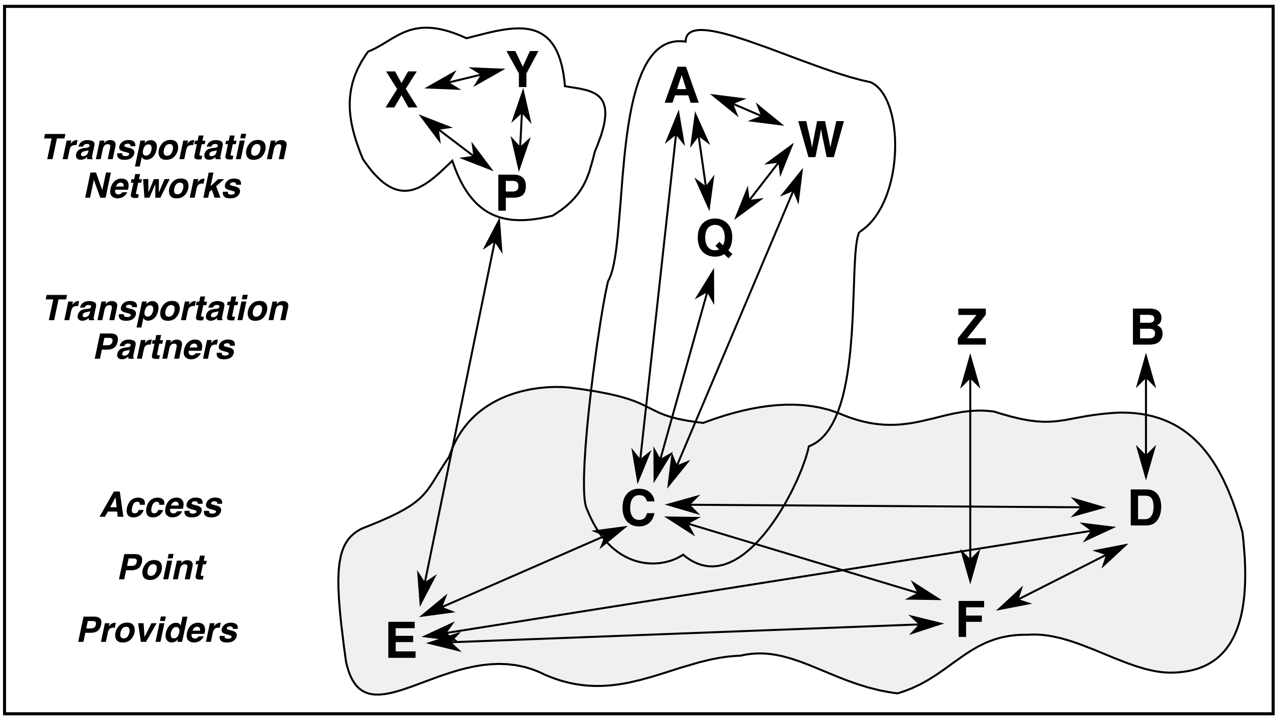


Perhaps C has raised the cost of doing business beyond what Y can afford. Perhaps C has gone out of business. Perhaps Y is using a new document format not supported by C. All Y has to do is procure the access point service from another access point provider and they are back in business sending their documents to Z and B.

Consider, finally, how other logistics information networks can interchange data with members of the e-Impact or any other UBL-based four-corner-model network.

As mentioned before, the Port of Sines in Portugal is working towards interchanging information with transportation partners in other countries using other transportation data interchange networks. In the following illustration transportation partners X, Y, and P are in a private transportation network, as partners A, W, Q and C are in another. Access point provider E is providing a service through party P as the bridge to the X-Y-P transportation network. In contrast, party C, itself, is a member of both networks and has signed the appropriate service level agreements in providing the SMP access services to the A-W-X-C network. E and C are the only parties in the e-Impact network that need to understand the syntaxes and protocols of, respectively, the foreign transportation networks.

Figure 9. Bridging entire networks and individual transportation partners



Such an open standards-based e-invoicing interoperability framework has been proven to be successful for procurement and now for transportation networks. The security and stability of this network architecture is getting the attention of health, construction and other industry sectors. Inherently, this network approach lends itself to cross-network bridges between access points of two separate networks, thus promoting international cross-border interoperability.

This is summarized by Mr. Pedersen in the following diagram illustrating how the LOGINK project in China [LOGINK], a part of NEAL-NET, would use access points to communicate with other transportation networks, and how these access points would use UBL ISO/IEC 19845 between each other. Where necessary, transformation is used to convert to and from the internationally-standardized document models and syntax:

Figure 10. The four-corner model used between transportation networks

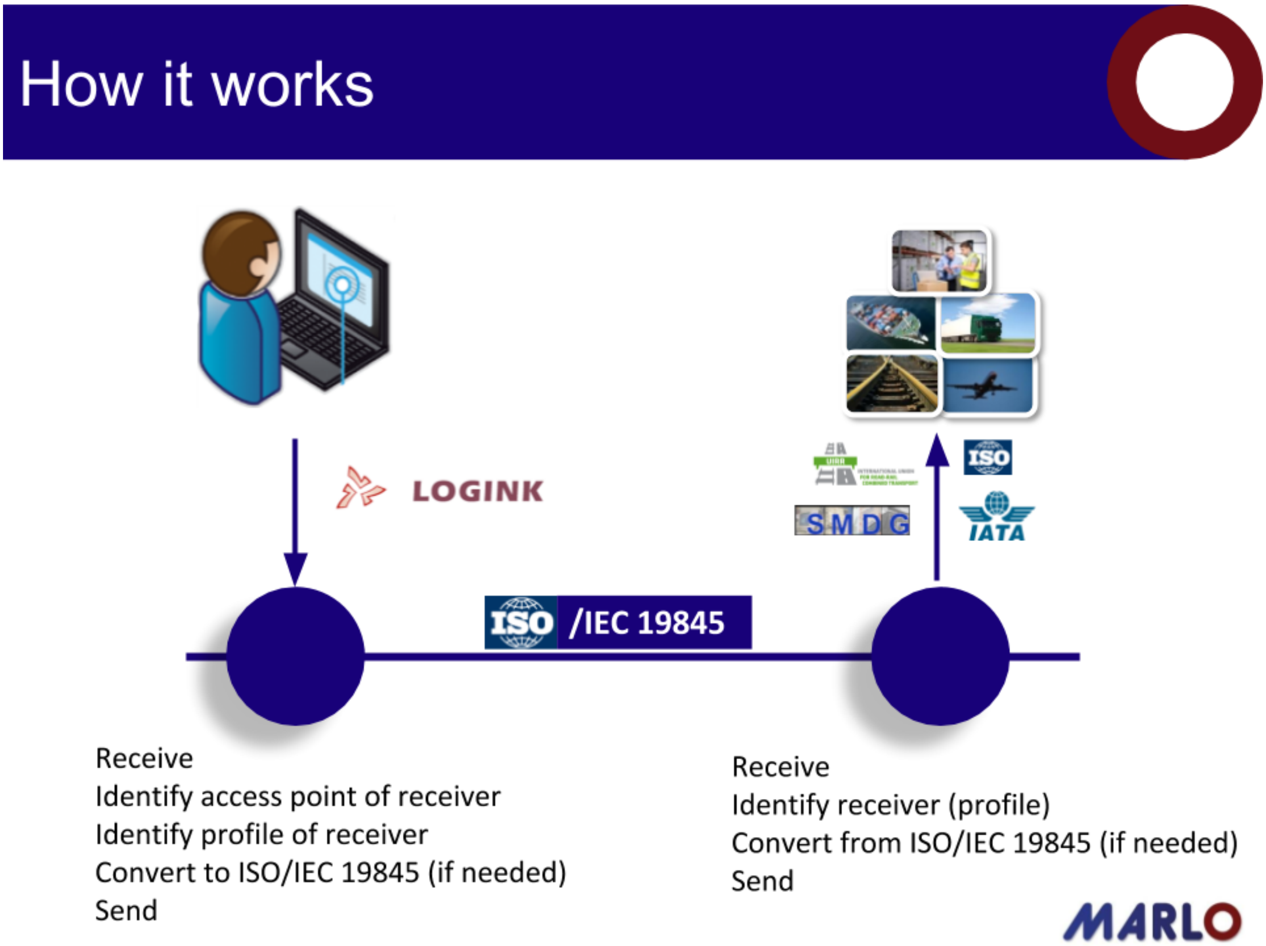


Image courtesy Jan Tore Pedersen, www.marlo.no

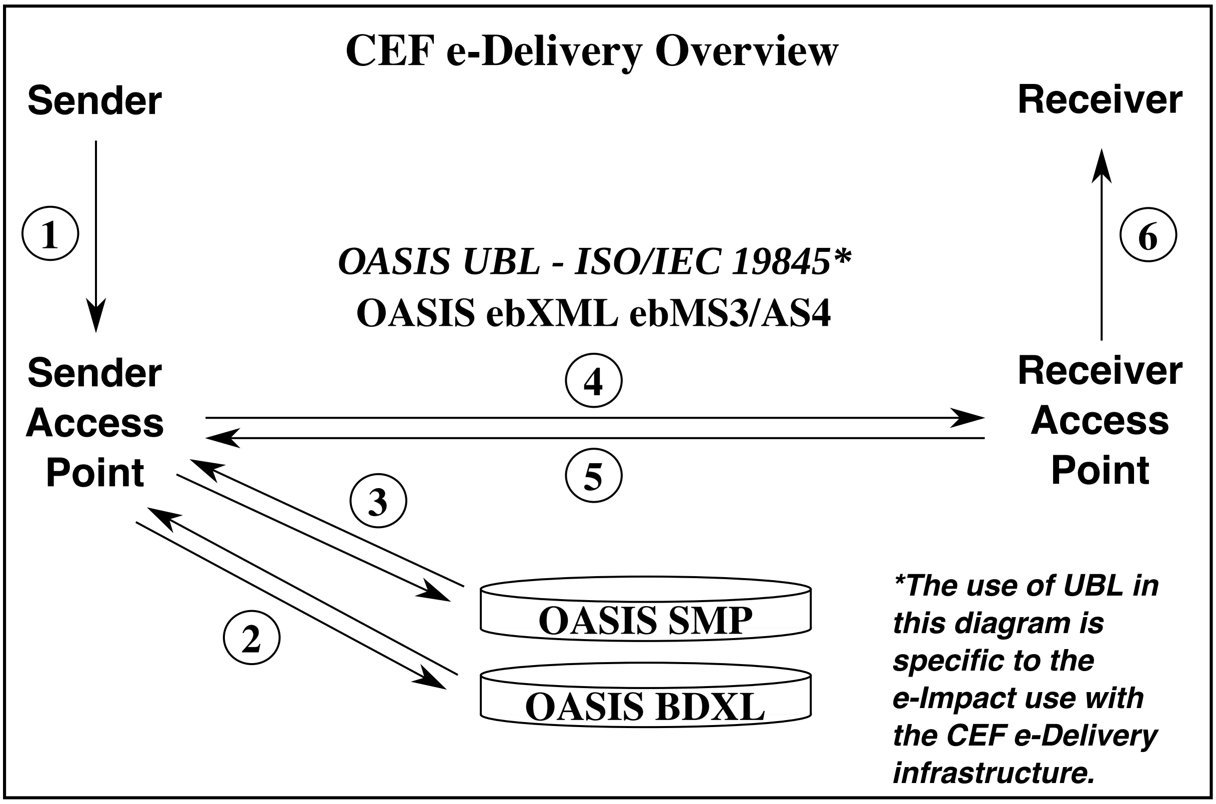
The use of SMP is more than simply serendipitous in Europe. The European Commission funded the original PEPPOL project that developed the SMP four-corner-model infrastructure. While the SMP specification itself was donated to OASIS, the real-world active support of a running infrastructure using this specification has been taken on by the European Commission Directorate-General for Informatics (DG DIGIT) and is operated under the name “e-Delivery Infrastructure”. The e-Impact project, therefore, has ready access to this running and supported implementation of this open and inclusive data interchange model.

3. The CEF e-Delivery implementation of the four-corner model

The CEF e-Delivery infrastructure is available today for European projects to use for their open communications infrastructure implementation of the four-corner model. The e-Impact project uses this infrastructure to interchange document instances of the OASIS UBL - ISO/IEC 19845 vocabulary according to the choreographed workflow between parties.

In the following diagram, one can see use of three OASIS specifications in the implementation of the four-corner model, with OASIS UBL - ISO/IEC 19845 being used within the implementation for data representation:

Figure 11. A single four-corner transmission of a document



There are six steps in the transmission of a document from the sender to the receiver:

1. The sender sends his original message to his own access point. This relationship between the sender and the sender access point is private. As such, any protocol may be used for transmission and any data format may be used for information representation, as agreed upon in the private relationship.

2. The sender access point now needs to learn about the receiver. Querying the metadata location DNS service implementing the OASIS Business Document Metadata Location Version 1.0 specification [BDXL 1.0], the sender access point finds the URL of the receiver's access point metadata information.

3. The sender access point accesses the URL for information about the location and services of the receiver access point representing the receiver, expressed using OASIS Service Metadata Publishing (SMP) Version 1.0 specification [SMP 1.0]. This gives the sender access point what it needs to know to talk to the appropriate receiver access point representing the receiver (who may use more than one access point).

4. The sender access point may have to translate the original message into the format agreed upon by all access points committing to the network service agreements. In the e-Impact project, if the original message data format is not UBL, the sender access point translates the message into schema-valid UBL. The sender access point then accumulatively validates the message, compresses it, digitally signs it, encrypts it, and then sends the result to the receiver access point. CEF e-Delivery specifies the use of the AS4 profile of the OASIS ebXML ebMS3 specification [ebMS3/AS4] for the electronic message interchange.

5. The receiver access point receives the message from the sender access point and must decrypt it, verify the sender's signature on it, decompress it, validate it, and then send a confirmation back to the sender access point. The sender access point now has the reassurance the message has been received by the receiver access point.

6. If the receiver does not understand the document format, in this case the e-Impact project use of UBL, the receiver access point must translate the received message into a format that has been agreed upon with the receiver and forward it. This relationship between the receiver access point and the receiver is private. As such, any data format may be used for information representation and any protocol may be used for transmission, as agreed upon in the private relationship.

All of the workflows implementing the choreographies of business transaction scenarios are built on top of this model for sending a single document from the sending party to the receiving party.

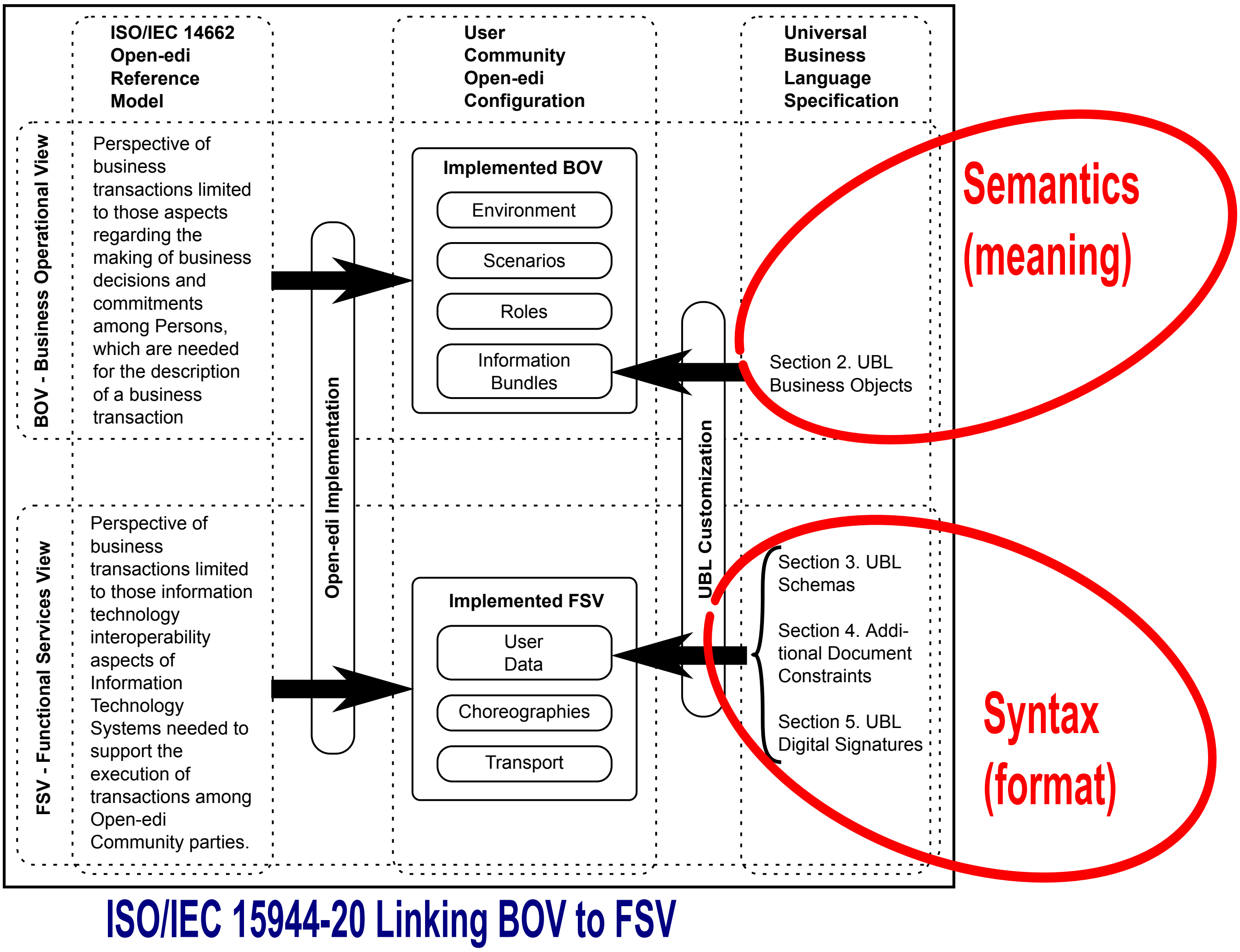
4. The universal document model and syntax

Key to the four-corner model is the committed use between access points of a single syntax in which the logistics and transportation information is expressed. Each access point is responsible for translating (if necessary) between UBL and whatever syntax their customers are using.

Importantly, the development of UBL was not done in a vacuum.

For 25 years the ISO/IEC 14662 Open-edi Reference Model has been refined to specify the components of all electronic business transaction solutions, thus including the business of transportation data interchange. Basic to this reference model is the distinction between those aspects regarding the making of business decisions and commitments for business transactions (the Business Operational View - BOV) and those aspects regarding the information technology supporting the execution of business transactions (the Functional Services View - FSV). More recently, ISO/IEC 15944-20 Linking the BOV to the FSV, illustrates in finer granularity the major facets of the two components.

Figure 12. The ISO/IEC 15944-20 linking of BOV to FSV of ISO/IEC 14662



In particular at the BOV level the concepts are abstract. Information bundles describe at a semantic level the information components, their meaning, and their structure used for data interchange. This data is interchanged between the abstract roles of the parties involved in the business transaction. These roles are formally described in scenarios that define how the business transaction is realized. This business transaction exists to satisfy a task within the business environment.

In particular at the FSV level the implementations are concrete. The user data are the concrete manifestations of the abstract information bundles in a given syntax. This syntax is interchanged between the entities representing party roles that satisfy the workflow choreography implementing the business transaction scenario. This interchange operates at a data transport level between the two entities representing the two parties of the business transaction.

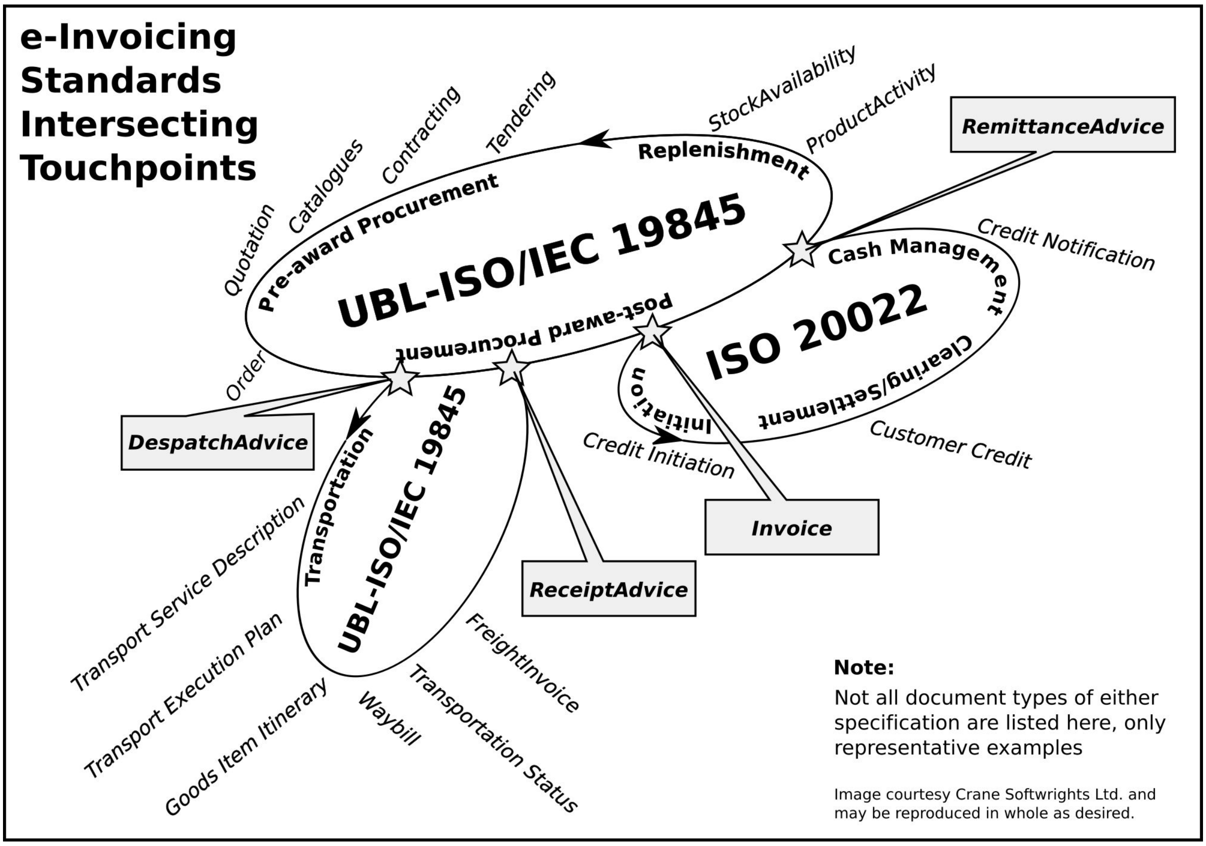
UBL version 2.1 is the revision of UBL currently internationally standardized as ISO/IEC 19845 [UBL 2.1 - ISO/IEC 19845]. The four normative sections of the specification can be grouped in two distinct areas: the semantics of the business objects (what each information item represents) and the syntax of the business objects (how is each information item expressed in data). These four sections are readily mapped to the information bundles and user data components of ISO/IEC 15944-20.

So far, the e-Impact project has been successfully deployed using the UBL ISO/IEC 19845 documents centred around the Transport Execution Plan, Transportation Status and the Transport Progress Status. The Transport Service Description documents are being tested for the commercial development of a logistics services catalogue. These standardized documents were modeled based on the real-world requirements brought forward by the predecessor projects to e-Impact cited earlier, they were not simply chosen on a whim.

Moreover, the UBL transportation documents were not developed in isolation from other important business documents. All UBL documents are modeled as an onion-skin-thin layer of a document-level aggregate business information entity. All these entities share the one set of common UBL business objects as library-level aggregate business information entities comprised of basic and associated business information entities.

Accordingly, those business objects used in transportation documents are the very same business objects used in procurement documents. Translating member business objects between two documents is not required, they may only need to be reassembled as needed. The following diagram shows how the suite of transportation documents in UBL intersects with the suite of procurement documents in UBL.

Figure 13. Intersecting touchpoints within and between international standards



Again, the use of UBL is more than simply serendipitous in Europe. The European Commission has already standardized on the use of UBL ISO/IEC 19845 objects and syntax for procurement documents. Participants in the e-Impact project are poised to leverage a single investment in learning and implementing the business objects and syntax of a single international standard in multiple disciplines within their organizations.

5. How to move forward on this

Today the use of SMP and UBL is available and already has been proven useful as the foundation of an open, inclusive, and effective data interchange model. The maintenance agency for each of these specifications are their respective OASIS technical committee.

Mr. Kenneth Bengtsson of Efact in Peru is the chair of the BDXR Technical Committee [BDXR TC] and he is leading the effort to define SMP 2.0, the next major revision of the four-corner model service metadata publishing.

Mr. Peter Borresen of Clearview Trade in Denmark is the chair of the UBL Transportation Subcommittee [UBL Transportation] and he is leading the effort to define which transportation document additions are to be incorporated into the upcoming UBL 2.3. Already UBL 2.2 has incorporated the new weight statement logistics document designed to satisfy recent European regulations for the reporting of the gross mass of containers as a condition for transport. New requirements for UBL 2.2 are no longer being accepted while this version of the specification is being finalized, so new requirements are being directed to the UBL 2.3 design effort. It is important to note that UBL document models are engineered to be fully backward compatible. For example, every schema-valid instance of UBL 2.1 is also a schema-valid instance of UBL 2.2. Stakeholders adopting any given version of UBL can rest assured that all their UBL documents will remain schema-valid with the schemas of all future minor revisions of the specification. As UBL changes, users are never obliged to change the way they use UBL.

Already the e-Impact e-Freight Toolkit is in its final draft. It will be tried and tested before the final version is released in early 2018. Moreover, as this network interconnects with other networks there may be international requirements not envisioned when the UBL transportation documents were conceived. Any issues identified by the project regarding missing information items will be taken by the e-Impact project into the UBL Technical Committee[UBL TC] following the published governance [UBL Governance].

Get involved in e-Impact and connect your own transportation world to the rest of the transportation world!

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[BDXR TC] OASIS Business Document Exchange (BDXR) Technical Committee http://www.oasis-open.org/committees/bdxr/

[ebMS3/AS4] OASIS ebXML Messaging Services Version 3.0 AS4 Conformance Profile https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=ebxml-msg#technical

[e-Impact] Implementing the e-Freight Framework and e-Delivery Infrastructure https://www.eimpactproject.eu

[LOGINK] National Public Information Platform for Transportation & Logistics https://english.logink.org

[NEAL-NET] Strategies for Improving the U.S. Payment System: Federal Reserve Next Steps in the Payments Improvement Journey (Next Steps) https://english.nealnet.org

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[UBL Transportation] OASIS Universal Business Language (UBL) Transportation Subcommittee https://www.oasis-open.org/committees/sc_home.php?wg_abbrev=ubl-tsc