A methodology to introduce exchange maritime information among cross border ports

Stefanos Petsios[1] and Chrysostomos Stylios[1,2]

[1]Computer Technology Institute & Press 'Diophantus'N. Kazantzakis str, University Campus, GR-26504, Patras, Greece
petsios@westgate.gr

[2]Department of Computer Engineering,
Technological Educational Institute (T.E.I.) of Epirus,
47100 Kostakioi Arta, Greece
stylios@teiep.gr & stylios@westgate.gr

Abstract. Maritime ports emerge to create close area IT networks suitable to model and represent the interconnected business processes. Actually, there are already such strongly connected collaborative networks mainly serving national purposes. Here, we present the experience of designing and developing a pilot IT maritime information exchange network that was built to serve in Adriatic Sea among three heterogeneous and autonomous port community systems (PCS). Their integration was based on a cross border platform that dealt with several challenges and met all the key requirements set by the stakeholders. In this paper we present the proposed exchange methodology and protocol, based on web services, and the details of the interconnection as part of this innovative platform. Finally we will conclude by describing the advantages and disadvantages of the proposed approach and possible future extension.

Keywords: Port Community Systems, data exchange, web services, cross border IT, port stakeholders, EDI exchange, EC Directive **2010/65.**

1 Introduction

The last decades there is an emerging need on cross border exchange between port authorities. Almost all modern ports montitoe their port processes based on Information Technology port community systems and so they provide better passenger and maritime services. Within a EU funded project, the Adriatic Port Community (APC), there was explored the approach to exchange port related data so that to expand and enrich the available port services [1]. There was analysed all the port procedures and processes of the three participating Adriatic port (from three different countries) and created a prototype platform. The design of the platform, revealed a series of important restrictions and possible feature expansions towards a real cross border application to serve maritime, security and environmental purposes.
Port Community Systems play a major role in facilitating and increasing the efficiency in movement of goods and passengers while allowing all the interesting

government departments such as Customs to organize effective inspections. This study revealed a great variety of existing port community systems in terms of features and implementations. While the needs of different ports vary, also PCSs usually differ quite a lot from each other. There is no golden rule or guidelines between them except the wide use of EDI for the paperwork that correspond to the IMO FAL forms.

There was enabled the identification of the IT mission in this cross border application so that to assure the management and control of the whole maritime port network, promoting the co-operation and interoperability between the involved stakeholders. The proposed implementation solution was based on a thorough review in the domains of maritime port logistics, EDI/ EDIFACT [2] and Web services [3]. Among the new technologies, the Web Services are emerging as the core methodology to support the integration of applications and systems of different companies and organizations using open Internet standards. Web Services is a promising approach to the problem of "communicating on the Internet" among enterprise information systems that several previous technologies, such as CORBA, do not solve [4].

In this paper, we present the scientific output regarding the exchange protocol used at the Global Single Window (GSW) platform and useful conclusions for similar feature applications that emerged from the prototype and pilot cases. Key points of the paper refer to the complete Web Service Definition Language (WSDL) [5] of the cross-platform communication protocol. Moreover there are presented the exploitation of these results on the implementation of EU Directive 2010/65.

2. Cross border data exchange layer for three different ports in three different countries

Maritime innovation in world wide scale leads towards high quality services. The existing port services of the three Adriatic ports examined and a theoretical approach took place in order to compare and evaluate the cross border value of the data stored in the port community systems (PCS) of the three different port authorities. Three different countries with different laws and completely different approach on paperwork and in port administrative procedures raised the necessity of success of the APC project. The APC project revealed a series of functional requirements regarding the GSW platform that could act as key asset to the existing port community systems. On the other hand a set of non-functional requirements were identified regarding the: platform requirements, organizational requirements and ethical requirements. [6]

Here it is presented an evaluation regarding the cross border user moderation and administration and how to meet the port authority's requirements. The existing users of the port community systems are promoted to cross border users and with an intuitive moderated mechanism we can control the availability of the shared data based on the location and the role of each user.

The Global Single window platform implements a set of business models. Most of the traditional modelling would take advantage of up to date web based platforms capable to create reliable, fast and user friendly environments. The implemented

platform enabled intelligent and secure exchange of information between port stakeholders and APC system. There was introduced a new cross border data exchange and reduced the organizational gap between equivalent stakeholders on different – but ship related – ports.

The figure 1 depicts the main information flow, components and modules of the implement platform. The arrows on the figures represent the data flow of a use case between a shipping agent participating on the Port community system of port A and the IT port community system of port B. The proposed implemented communication layer resides on the Web Service modules depicted with a rectangular named "Web Service".

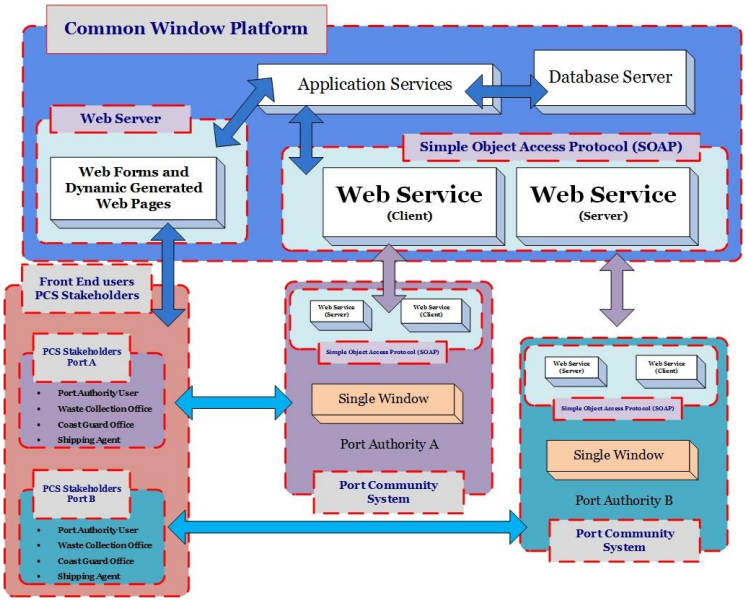

Figure 1: The Common Window Platform acts as an interconnection layer between the various port community systems.

The communication between the three cross border port community systems was achieved with the help of a bespoke Web Service protocol. A complete APC WSDL description [5] of a web service was designed and developed in order to have a machine-readable description of how the service can be called, what parameters it expects, and what data structures it returns. The cross border maritime needs and in port traffic needs of the three ports led to the following list of exchanged data based on IMO FAL and port oriented requirements:

1. General Declaration (IMO FAL 1)
2. Cargo Declaration (IMO FAL 2)
3. Ship's stores declaration (IMO FAL 3)
4. Crew's effects declaration (IMO FAL 4)
5. Crew list (IMO FAL 5)
6. Passenger list (IMO FAL 6)

7. Dangerous goods manifest (IMO FAL 7)
8. Truck list
9. Container list
10. Vehicle list

A proper WSDL description was presented and implemented for the ports to be deployed as a server and handle request from authorized clients. The Web Services Description Language (WSDL) is an XML-based interface description language that is used for describing the functionality offered by a web service. A WSDL description of a web service (also referred to as a WSDL file) provides a machine-readable description of how the service can be called, what parameters it expects, and what data structures it returns. It serves a roughly similar purpose as a method signature in a programming language.

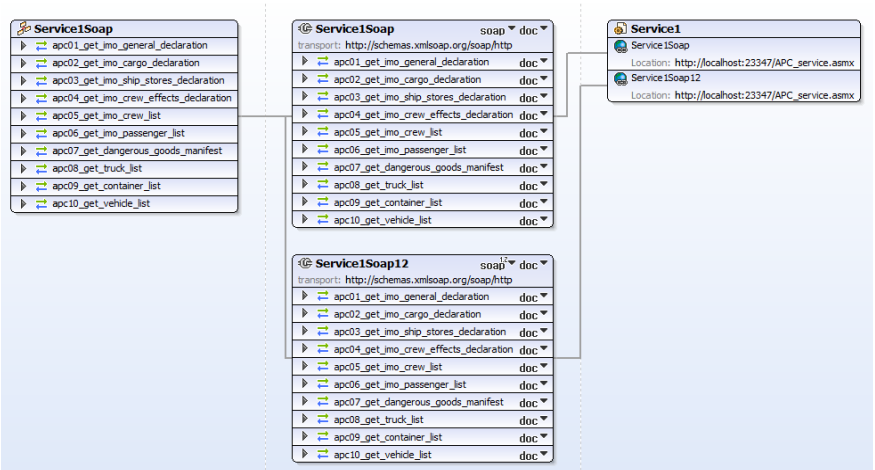

Figure 2: The PortTypes, the bindings and the services of the proposed WSDL.

Figure 2 presents the bindings that provide the bridge between the logical messages used by the services to create a concrete data format that an endpoint uses in the physical world. It describes how the logical messages are mapped into a formal format that is used on the wire by an endpoint. It is within the bindings that details such as parameter order, data types and return values are specified. For example the "apc_01_get_imo_general_declaration" declares more than 40 return variables. The data types are ordinary types like: string, Boolean, dateTime, int, base64Binary and complex types like in this case a type named "ArrayOfAttachedDocuments" which permits to return an Array of objects that describe attached files.

The queries for data through the bindings follow a similar format. For example the "apc10_get_vehicle_list" is a binding that incorporates the operation to get detailed data from a Port Community System regarding the Vehicles that are onboard of a Ro-Ro ship. Table 1 presents the parameters of the operation. This example presents the parameters that narrows the return list of vehicles based on: the plate number (in_1_1_PlateNumber), the name of the driver (in_6_0_VehicleDriver), the

nationality of the vehicle (in_7_0_Nationality), the identification number of the ship's voyage (in_14_0_VoyageID), the name of the ship (in_15_0_NameOfShip), the arrival (in_19_0_GateArrivalDate) and departure dates (in_17_0_VesselDepartureDate). Finally there is a set of parameters which serve as input to the authentication mechanisms of the platform: in_apc_UserId, in_apc_UserPw, in_apc_LdapTicket, in_apc_UserGroup and in_apc_UserRole.

Table 1: The available parameters to operate with the binding "apc10_get_vehicle_list" to seek for a vehicle list from a Port Community System.

minOccurs	maxOccurs	Name	type
0	1	in_1_1_PlateNumber	s:string
0	1	in_6_0_VehicleDriver	s:string
0	1	in_7_0_Nationality	s:string
0	1	in_14_0_VoyageID	s:string
0	1	in_15_0_NameOfShip	s:string
1	1	in_17_0_VesselDepartureDate	s:dateTime
1	1	in_19_0_GateArrivalDate	s:dateTime
0	1	in_apc_UserId	s:string
0	1	in_apc_UserPw	s:string
0	1	in_apc_LdapTicket	s:string
0	1	in_apc_UserGroup	s:string
0	1	in_apc_UserRole	s:string

The strength and the cohesion of the cross border community, both internally and with respect to external port community stakeholders (such as passengers), can take advantage of the existence of the deployed network services that can improve the communications between Port Authorities. Such services should enhance common practices and take place on communication infrastructures enabling secure and useful transactions. The proposed approach may further be expanded and used on the improvement of passenger mobility, speeding up the disembarkation process, improve custom operations, and better control the in-port parking and traffic.

3. Potential for generalization and conclusions

The success of any IT developed system influence the whole Port authority network, which is multidimensional. The proposed approach successfully identified all the necessary requirements for designing and implementing the cross border data exchange protocol. The test of the developed system proved that the data stored in a maritime port community system may be very useful to the ship's destination port. But for the implementation of this network, there were a lot of difficulties such as

different interpretation of data, national laws, added effort and requirements to the existing port community systems.
Results of testing the pilot prototype suggested several improvements that could be integrated in Port Community Systems so that to handle the complex data sharing modules and to enrich their available data and information presented to the stakeholders. Possible future implementation of the same approach could be to handle the upcoming obligations of the directive 2010/65/EC, which is expected to have similar requirements for the data exchange among the port community systems and the national IT system. In the aforementioned directive the data exchange is based on the seven IMO FAL documents exactly as it was implemented here along with a set of information related to maritime health and specific information for ships coming from a non- European port.

There is an upcoming requirement to have an integrated exchange of useful data among European ports with automated processes that are secured, controlled, moderated, flexible and mostly expandable that increase the value of the presented approach . It presented in depth all the in port-processes and the available infrastructure of three Adriatic ports. This was a step forward to close the huge gap between the approaches of port authorities and share real data in three different countries. Nonetheless the existence of a prototype Global Single Window acted as a trigger for future extensions and expansions that can lead to a real time platform with more European ports and with an expanded set of data sharing and features.

Acknowledgement

This work was co-supported by ARGES project implemented within the framework of the European Territorial Cooperation Programme Greece-Italy 2007-2013, co-funded by the European Union (ERDF) and by National Funds of Greece and Italy and by the project “Adriatic Port Community System APC” (code 111) funded by IPA Adriatic Cross-border Cooperation Programme 2007-2013 co-financed by European Union, Instrument for Pre-Accession Assistance.

References

1. Adriatic Port Community, http://www.apcwindow.eu

2. Garstone S. Electronic data interchange (EDI) in port operations. Logistics Information Management 8.2 (1995): 30-33.
3. Isaías, P. T., & Macedo, F. M. D. (2007). Web services as a solution for maritime port information interoperability. In Human Interface and the Management of Information. Interacting in Information Environments (pp. 1029-1038). Springer Berlin Heidelberg.
4. Mougin, P., & Barriolade, C. (2001). Web Services, Business Objects and Component Models. Orchestra Networks, Jul.
5. apcwindow.eu/sites/default/files/documents/WP4-CrossBorder_User_requirements.pdf
6. Petsios, S. and Stylios C. (2014). A collaborative IT network for three Adriatic maritime ports. Proceedings of PRO-VE 2014 15th IFIP Working Conference on Virtual Enterprises