



Grant Agreement number: 233758

Project acronym: E-FREIGHT

Project title: European e-Freight Capabilities for Co-modal Transport

Funding Scheme: Sustainable Surface Transport, Large-scale Integrating Project



D3.2 – Reference Solutions for Next Generation National Single Windows

Due date of deliverable: 31/10/2011

Actual submission date: 20/11/2011

Start date of project: 01/01/2010

Duration: 42M

Organisation name of lead contractor for this deliverable: BMT

Version: 2

Project co-funded by the European Commission within the Seventh Framework Programme (2007-2013)		
Dissemination Level		
PU	Public	<input checked="" type="checkbox"/>
PP	Restricted to other programme participants (including the Commission Services)	<input type="checkbox"/>
RE	Restricted to a group specified by the consortium (including the Commission Services)	<input type="checkbox"/>
CO	Confidential, only for members of the consortium (including the Commission Services)	<input type="checkbox"/>

Document Title:		WP	Task:	Document number:
Reference Solutions for Next Generation National Single Windows		3	3.2	D3.2
Main authors:			Org:	
Tom Cane			BMT	
Contributing authors:			Org:	
Takis Katsoulakos			ILS	
Yannis Zoraios			K-NET	
Charalampos Doukas			UoA	
Maria Lambrou			UoA	
Ilias Maglogiannis			UoA	
Doc history:	Version:	Comments:	Date:	Authorised by:
Draft	0.1	Draft version for QC	2011-11-11	TC
Final v1.0	1.0	Final Version 1	2011-11-18	MV
			2011-11-19	JTP
Final v2.0	2.0	Final Version 2	2011-11-20	MV
Classification:		PU		
Number of pages:		89		
Number of appendices:		4		

Table of Contents

List of Abbreviations and Definitions	8
Executive Summary	9
1 Introduction.....	10
1.1 The e-Freight project	10
1.1.1 The Core e-Freight Components	10
1.1.2 e-Freight Solutions	11
1.2 Scope of this Deliverable	12
1.2.1 Objectives	12
1.2.2 Structure of the document.....	12
2 Background and Context	14
2.1 Regulatory Compliance Complexity	14
2.2 The Broad EU Policy Context.....	14
2.3 The EU e-Freight Policy Context	15
2.4 UN/CEFACT Single Windows	17
2.5 EU Single Window Initiatives.....	17
2.5.1 e-Customs Single windows.....	18
2.5.2 Maritime Transport Single Windows.....	18
2.6 The Next Generation Single Window Challenge	19
3 Review of Current Reporting Practices	21
3.1 Review of Maritime Reporting and Single Windows.....	21
3.2 Review of Cross-Border Notification Practices for Inland Transport	23
4 The e-Freight Next Generation National Single Window Concept.....	27
4.1 Scope and Initial Design Principles.....	27
4.2 Early Models and Prototypes, and Evolution of the e-Freight Concept.....	27
4.2.1 Maritime Single Window Demonstrator	29
4.2.2 Conclusions from the Feedback from the Community	30
4.3 Final Proposed Concept.....	31
4.3.1 High Level Interaction Model	31
4.3.2 Application Component Model	32
4.3.3 National Single Windows.....	33
4.3.4 Common Reporting Gateway Application	34
4.3.5 Information Exchange Application	34
4.3.6 Central EU National Single Window Support Services	35
5 The Common Reporting Schema.....	36

5.1	Definition and Concept.....	36
5.2	Design Principles and Approach	36
5.3	Data Model	39
5.4	Standardisation	43
5.5	Feedback and Validation	43
6	Deployment of the National Single Window Reference Solution in Latvia.....	44
6.1	User Requirements.....	44
6.2	Solution Development Methodology	44
6.3	Solution Architecture	45
6.4	Models.....	49
6.4.1	Use Case	49
6.4.2	Database.....	51
6.4.3	Business Objects.....	51
6.4.4	Business Processes	52
6.4.5	Application Referencing	54
6.5	Configuration and Deployment of NSW Reference Solution in Latvia.....	56
6.6	<i>Results</i>	56
6.7	<i>Feedback</i>	56
7	Feasibility of Using NSWs for Performance Indicator Statistics	57
8	Summary and Conclusions	57
8.1	Phase 2 of Task 3.2 and the Second Release of the Deliverable	58
APPENDIX I: EMSA SSN – Review, Proposals and Recommendations.....		59
Review of Current SSN Landscape		59
SSN evolution towards a single window for European maritime information exchange.....		59
Current practices and implementation examples around Europe.....		60
Current SSN architecture and proposals for the incorporation of more efficient management tools and applications		61
Enhanced SSN network and applications management toolkit		61
SafeSeaNet Integration - Issues for consideration		62
An approach to e-Freight architecture in light of Single Window, SSN evolution and e-Maritime developments.....		65
Technical Design Requirements		71
Proposed model and Conclusions		72
APPENDIX II: Latvian Authorities’ User Requirements.....		74
APPENDIX III: Architectural Patterns Used in the e-Freight National Single Window Solution		79



APPENDIX IV: Details of the Technical Solution for the e-Freight National Single Window 82

List of Tables

Table 1: Typical current regulatory information management practices	26
Table 2: Typical logical order of supply chain information generation.....	37
Table 3: Use of e-Freight solution development methodology for the NSW solution.....	45
Table 4: Hardware and software specification for the NSW reference solution in Latvia.....	56

List of Figures

Figure 1: Ship formalities and information flows	22
Figure 2: Early e-Freight NGSW concept	28
Figure 3: Revised NGSW concept, implemented as a demonstrator for maritime reporting	29
Figure 4: High Level Concept	31
Figure 5: The e-Freight Next Generation Single Window Concept	33
Figure 6: Common Reporting Gateway Configurations	34
Figure 7: Common Reporting Package and NSW interaction.....	38
Figure 8: CRS + NSW - reporting to authorities	39
Figure 9: Common Reporting Schema logical model	40
Figure 10: The WCO data model GOVCBR message structure.....	41
Figure 11: Common Reporting Schema Data Model.....	42
Figure 12: e-Freight Solution Development Methodology	44
Figure 13: e-Freight solution architecture.....	46
Figure 14: Architectural patterns used in e-Freight Solutions	47
Figure 15: e-Freight NSW technical solution.....	48
Figure 16: NSW Use Case Model	50
Figure 17: Example entity-relationship model for the Package domain entity	51
Figure 18: Example business object (IDEF1x) model for the Package domain entity	52
Figure 19: The top level e-Freight Framework "Manage Regulatory Information" activity	53
Figure 20: Decomposition of the "Manage Regulatory Information" activity	53
Figure 21: "Respond to CRG Input" activity decomposition	54
Figure 22: National Single Window application structure	55

Disclaimer

The content of the publication herein is the sole responsibility of the publishers and it does not necessarily represent the views expressed by the European Commission or its services.

While the information contained in the documents is believed to be accurate, the authors(s) or any other participant in the E-FREIGHT consortium make no warranty of any kind with regard to this material including, but not limited to the implied warranties of merchantability and fitness for a particular purpose.

Neither the E-FREIGHT Consortium nor any of its members, their officers, employees or agents shall be responsible or liable in negligence or otherwise howsoever in respect of any inaccuracy or omission herein.

Without derogating from the generality of the foregoing neither the E-FREIGHT Consortium nor any of its members, their officers, employees or agents shall be liable for any direct or indirect or consequential loss or damage caused by or arising from any information advice or inaccuracy or omission herein.

List of Abbreviations and Definitions

Abbreviation	Full name	Definition
Dow	Description of Work	The Description of Work document for the e-Freight Project
CRG	Common Reporting Gateway	One of two applications which make up the National Single Window system. This application presents a common, standardised interface for businesses to report regulatory information.
CRS	Common Reporting Schema	A single, standardised document which contains data fields for all the information which is required for reporting to Authorities across all modes and in all Member States.
IE	Information Exchange	One of two applications which make up the National Single Window system. This application is responsible for reporting information to Authorities. It also facilitates the exchange of information between Authorities within a Member State and with EU level systems.
MDA	Model-Driven Architecture	The Object Management Group's (OMG) approach to separate business and application logic from the underlying platform technology.
MDE	Model-Driven Engineering	A software engineering methodology which uses various models of a domain to guide the development process.
MSW	Maritime Single Window	See NSW
NGSW	Next Generation Single Window	The Single Window concept developed as part of the e-Freight project advances the current concepts so will form the “next generation” of solutions.
NSW	National Single Window	A system, which exists at a National level, for the reporting of certain information to Authorities for a specific purpose. For example, Maritime National Single Windows exist to receive information in the Maritime domain for the purposes of safety, security and environmental risk management.
OASIS	Organization for the Advancement of Structured Information Standards	A not-for-profit consortium that drives the development, convergence and adoption of open standards for the global information society.
PCS	Port Community System	An IT system, local to a port, which facilitates the exchange of information between stakeholders in the operation of the port.
UBL	Universal Business Language	OASIS's Universal Business Language defines a common XML library of business documents and information elements for transport and procurement.
UN/CEFACT	United Nations Centre for Trade Facilitation and Electronic Business	Provides analysis, policy advice and assistance to governments, it gives focus to the United Nations global mandates in the economic field, in cooperation with other global players and key stakeholders, notably the business community.

Executive Summary

This deliverable reports on the activities that have been carried out to date in Task 3.2 of the project. After a general introduction to the e-Freight project as a whole, the document focuses on the development of the “Next Generation” National Single Window (NSW) concept.

The report first introduces the topic of single windows with an overview of the background and context from EU and international regulatory and policy perspectives. Current single window initiatives are reviewed and the current regulatory environment and reporting practices in different modes and Member States are analysed.

A number of challenges and requirements are identified for the NSW, for which a selection of solutions is presented. Prototypes and demonstrators which were implemented throughout the task are explained and the feedback from each demonstrator is discussed. Each solution is evaluated in turn, leading to the development and refinement of the proposed “next generation” concept.

The final e-Freight Next Generation Single Window concept consists of a multimodal National Single Window (NSW) deployed in each Member State and supported by a number of central EU services. In turn, the NSW system consists of two applications:

1. the Common Reporting Gateway provides a common interface for businesses to report all regulatory information in a standardised format, regardless of mode or country
2. the Information Exchange facilitates the distribution and sharing of information between Authorities within and across Member States, and with EU level systems

Based on the developments in T3.2, the final concept has been implemented as a reference solution in Latvia as part of the project Business Case 6. This report documents the design and implementation of the Latvian NSW solution and its deployment in Latvia.

In parallel to the development of the NSW concept, T3.2 undertook the development of the Common Reporting Schema. This report introduces and explicates the Common Reporting Schema concept as a single, standardised document for reporting to Authorities across all modes and in all Member States. The development of the associated data model is also presented.

In addition to the work described above, an extensive review of the EMSA SafeSeaNet landscape was also carried out as part of T3.2. The results of this task form Appendix I of this deliverable.

1 Introduction

This chapter provides a short overview about the e-FREIGHT project, its aims, components and solutions. It also includes an overview of the objectives and methodology of this report and the underlying Task 3.2.

1.1 The e-Freight project

e-FREIGHT is a research and development project co-funded by the European Commission under the 7th Framework Programme. It started in January 2010 runs until June 2013. e-FREIGHT has 30 partners from 14 EU Member States and Norway.

In order to make European transport of goods as efficient and effective as possible, it is important that the existing transport infrastructure is utilised to its fullest potential. Combining the use of all modes – road, rail, inland waterways, coastal shipping and air – such that each one is being properly exploited is a challenge that the European Commission has been addressing through a number of research and development projects.

The objective of the e-FREIGHT project is to facilitate the use of different transport modes, on their own and in combination, to obtain an optimal and sustainable utilization of European freight transport resources.

e-FREIGHT provides interoperability of business processes across organisational boundaries and across transport modes, allowing the different organizations involved in a freight transport chain to plan, execute and control transport movements seamlessly – as if the transport movements were being carried out within a single, highly efficient “extended enterprise.”

e-FREIGHT can achieve this degree of interoperability, regardless of the number of organisations and modes of transport involved and the size of the consignment, because it is based on an understanding of the essential business processes that are required and how organisations can exchange the information required by these business processes through standardised messages. The project presents this understanding using the e-Freight Framework.

Based on the e-Freight Framework, e-FREIGHT provides IT capabilities to demonstrate that paperless information exchange, among all EU freight transport stakeholders for freight transport in the European Community and, as far as possible internationally, adhering to EU policy on co-modality, is possible in practice.

1.1.1 The Core e-Freight Components

There are four completely interdependent components that constitute the e-Freight concept:

1. **e-Freight Framework:** a reference model for Freight Transport & Logistics (i.e. a description of processes, actors, information and other domain entities) supporting paperless information exchange among stakeholders in all transport modes.
2. **e-Freight Platform:** a comprehensive software infrastructure that reflects the e-Freight Framework and facilitates the development and deployment of e-Freight Solutions. The platform has three capabilities:
 - i. it provides a repository (a storeroom) from where e-Freight Solutions and Services may be downloaded,

- ii. it acts as ‘run-time’ environment that supports operation and interaction of the e-Freight Solutions, and
 - iii. it provides a software development environment for the development of additional e-Freight Services and Solutions.
3. **e-Freight Services:** e-Freight Services are elementary pieces of software used as the building blocks of e-Freight Solutions. The e-Freight Services are totally interoperable software derived directly from the e-Freight Framework.
 4. **e-Freight Solutions (A2A & A2B applications and/or B2A & B2B applications):** Systems, consisting of software components and data feeds (e.g. on traffic, weather, cargo flows), that perform meaningful functions in the area of Freight Transport & Logistics.

1.1.2 e-Freight Solutions

The e-Freight project is developing the following generic e-Freight Solutions:

1. **Next Generation National Single Window (NGNSW):** a B2A application. A facility that will allow parties involved in trade and transport to lodge standardized information and documents on a single entry point in order to fulfil all reporting obligations both for trade and transport for all modes within an EU Country. NG National Single Window will provide interconnections with existing National systems and EU platforms such as SafeSeaNet (SSN), e-Customs, RIS, TAF/TSI, etc.
2. **Central EU National Single Windows’ Support Services:** an A2A application, a central EU level module which facilitates information exchange among Next Generation National Single Windows, holds the registry of all NGNSWs, provides for keeping regulatory requirements and policies changes updated and for other statistical and data services.
3. **Collaborative Security Risk Management:** an A2A application intended to support real time tracking of high risk trucks and vessels and security risk information exchange and sharing among authorities and administrations in different regions of a country.
4. **Setting up Co-modal Transport Networks:** a B2B application, addressing co-operation strategies, based on electronic interactions, in order to provide quality transport services while at the same time improving the environmental footprint of the entire supply chain.
5. **Co-modal Shipment Planning:** a B2B application to assist transport clients in specifying, comparing and negotiating the terms of a required co-modal transport service and
6. **Monitoring of Transport Services execution:** a B2B application to support monitoring of the status of co-modal transport services and detection of deviations from the agreed transport plan.
7. **Single Transport Document:** a B2B application consisting of a universally available Service which generates electronic transport Documents (waybills) from existing operational data, based on a common standardised Schema (data model)

The above generic e-Freight Solutions are customized in the e-Freight project Business Cases according to the needs of the stakeholders in each business case:

- **Business Case 1:** Improving port/terminal efficiency and accessibility – involving STENA, DB Schenker and DSV.
- **Business Case 2a:** Managing transport between ARA ports and Germany – led by ISL.
- **Business Case 2b:** Testing Optimisation of Transport Planning of containerised cargo transport between Spanish ports and inland Spain. – led by MJC2.

- **Business Case 3:** Road transport, with focus on planning (using historic information about traffic conditions) and execution (obtaining real-time information about traffic conditions) - led by Jan de Rijk.
- **Business Case 4:** Managing transport between Lisbon and Spain/Portugal – led by SPC.
- **Business Case 5:** Managing co-modal transport for the Ireland, Britain, Mainland Europe Corridor – led by the Port of Cork and NECL.
- **Business Case 6:** Testing and evaluating the Single Window capabilities, as defined in the White Paper 2011 by different transport related authorities – led by the Maritime Authority in Latvia.

1.2 Scope of this Deliverable

This report documents the work carried out in Task 3.2 of the e-Freight project on the development of one of the e-Freight Solutions, *The Next Generation National Single Window* (see 1 in section 1.1.2). This introductory section gives an overview of the objectives of T3.2, a high level description of the activities performed, and an outline of the structure of this deliverable.

1.2.1 Objectives

The main objective of T3.2 was to produce a reference solution for the “Next Generation National Single Window” concept. Here, the phrase “Next Generation” refers to the new design concept that has been developed in the e-Freight project.

To achieve this objective, the current and emerging Single Window environment was analysed from different regulatory, policy and stakeholder perspectives. Design concepts for a new National Single Window model were developed and presented in demonstrations. Feedback from these demonstrations and other consultations with stakeholders was used to refine the concept. This deliverable outlines the key evolution points in the design process and presents the final e-Freight “Next Generation” National Single Window model.

A so-called “Reference Solution” has been implemented in Latvia as part of T3.2. The reference solution is an implementation of the proposed e-Freight NSW model to demonstrate and evaluate the functions and capabilities of the e-Freight concept.

The next phase of the work in T3.2 is to carry out testing, evaluation and further refinement to the solution model, based on the experiences which will be gained during the pilot of the reference solution in Latvia to be carried out in *Business Case 6* of the project. This work will be presented in the second release of this deliverable, which is due in M30 of the project.

1.2.2 Structure of the document

This report is structured in five main sections. **Chapter 2: Background and Context** is adapted largely from the paper “*The e-Freight Next Generation Single Window for Trade and Transport*” (Cane, T. & Katsoulakos, T. 2011) which was prepared for the e-Freight Conference in Munich. It gives an introduction to the concept of Single Windows and an overview of the context in which e-Freight is developing its “Next Generation” solution.

Chapter 3: Review of Current Reporting Practices surveys the current reporting situation in all modes in order to provide input to the design of the “Next Generation” multimodal solutions. In **Chapter 4: The e-Freight Next Generation National Single Window Concept**, the development of the multimodal NSW solution is described, from early design concepts to the final application reference model.

Chapter 5: The Common Reporting Schema explains in more detail the concept of a standardised multimodal reporting document called the Common Reporting Schema and how it is used in conjunction with the National Single Window system.

Finally, **Chapter 6: Deployment of the National Single Window Reference Solution in Latvia** completes the picture by explaining the implementation of the reference model as a real software application in Latvia.

The **Summary and Conclusions** chapter summarises the outputs of T3.2 and draws conclusions from the document. Outstanding issues and actions for resolving them are also summarised, along with recommendations for future work. Finally, a collection of **Appendices** to this document contain additional information which is referred to in the main body of the text but has not been included to improve the readability of the document.

In particular **APPENDIX I: EMSA SSN – Review, Proposals and Recommendations**, reviews the current EU maritime reporting landscape and analyses the requirements and results of the e-Freight National Single Window concept from the perspective of the EMSA SafeSeaNet (SSN) system. Additionally, it asks what requirements must be met by the e-Freight NSW design and what impact the proposed concept will have on the evolution of the SSN system in the future.

This section was moved to the appendix because it was felt that the content and length of this section disrupted the logical flow of the description of the design and development of the NSW reference solution.

2 Background and Context

2.1 Regulatory Compliance Complexity

Traditionally, trade was regulated through bilateral treaties between nations imposing high tariffs on imported goods and restrictions on international trade. In the 19th century, the advantages of free trade became apparent among western nations. The World Trade Organization was established in 1995 to promote free trade while creating a globally regulated trade structure¹. Transport regulations are mode specific, and particularly cover safety, security and environmental protection issues.

Despite the importance of freight trade in most countries, representing a significant share of gross domestic product (GDP), regulation still poses barriers to efficient trade, particularly when combined with transport formalities.

Explosion of global trade in the last decade has resulted in increased complexity of regulation. Freight trade and transport related authorities have established an extensive range of agency-specific and country-specific regulatory requirements for international trade and transport with little coordination amongst each other, at national, European or international levels². A cross border shipment typically involves 35 documents exchanged between 25 parties. There are more than 600 laws and 500 trade agreements to be considered. Even describing commodities according to applicable standards (e.g. Harmonized Tariff Schedule) is a tedious and costly exercise.

In summary, traders and transport operators are faced with a complex set of duplicative and redundant reporting requirements and related systems (forms, data models, messages, software applications, etc.). Consequently, businesses are forced to develop and maintain interfaces with many different systems to manage compliance with different national systems³. Ship, port and logistics operators and national administrations have to develop several adaptors (often with limited useful life) to integrate with the plethora of different systems they encounter in their day to day operations. This adds significant costs to all parties, both in financial terms and in terms of problems in managing timeliness and accuracy of reporting data. SMEs are particularly affected by this situation because they need access to information systems that are often closed and different from country to country and for different authorities.

Regulatory compliance complexity has become more acute in recent years with the requirements for advance trade and transport notifications for security purposes, and business requirements for improved interoperability between stakeholders in international supply chains.

2.2 The Broad EU Policy Context

EU policy addressing regulatory information management for trade and transport spans different perspectives. In the broader context of the Lisbon Strategy, e-Freight is closely related to the European e-business initiative which was set up in response to the Lisbon objective that the EU should become the most competitive knowledge-based society in the world by 2010. Establishing an efficient trans-European transport network (TEN-T) is a key element in the re-launched Lisbon strategy for

¹ <http://www.wto.org/>

² Regulatory Framework for Maritime and Intermodal Transport – SKEMA Report - <http://www.eskema.eu/defaultinfo.aspx?areaid=26&index=1>

³ Kyeongrim Ahn, Keunyoung Youn & Sunho Park, "The Study of Interface Standard for Single Window System," ncm, pp.824-828, 2009 Fifth International Joint Conference on INC, IMS and IDC, 2009

competitiveness and employment in Europe. Importantly, the 2011 white paper⁴ includes as goal 5 an “EU wide multimodal TEN-T ‘core network’ by 2030 [...] and a corresponding set of information services”.

A special dimension of competitiveness strategy is support for SMEs, which represent 99% of businesses in the EU and are a key driver for economic growth, innovation, employment and social integration. The EU is helping SMEs to develop and promote their international activities⁵ and is facilitating access to international markets. Internationalisation also means awareness of standards and compliance certification processes. Actions are carried out to improve the participation of SMEs in the European standardisation process⁶ as well as to promote the use of standards facilitating access to the Single Market. Easy integration of SMEs into transport networks and reporting systems is therefore an important issue for Single Window developments.

EU policy for Sustainable Transport (Keep Europe Moving – Sustainable mobility for our continent, COM (2006) 314) includes *‘encouraging and increasing co-modality and decongesting transport corridors’*: development of sustainable, innovative, intermodal and interoperable regional and national transport and logistics networks, infrastructures and systems in Europe; cost internalisation; information exchange between vehicle/vessel and transport infrastructure; optimisation of infrastructure capacity; optimal use of modes individually or in combination (co-modality) to encourage energy efficient means of transport. Promotion of transparency of the environmental performance of transport solutions, particularly across different corridors, could be supported by NGSW concepts. Furthermore, initiative 26 of the new white paper 2011, *‘a regulatory framework for innovative transport’*, is likely to add new requirements for the NGSW concept.

The EU i2010 Strategic Framework stresses the critical role of ICT for productivity and innovation, and anticipates a new era of e-business solutions, based on integrated ICT systems and tools. In this context, e-Freight can be seen as an initiative to promote e-government⁷ and e-business⁸ developments in the freight logistics and transport sector.

2.3 The EU e-Freight Policy Context

The specific policies that are driving the work reported in this paper arise from the Freight Transport Logistics Action Plan COM (2007) 607, and the following specific actions:

- Work towards a standard for information flows to ensure the integration and interoperability of modes at data level and provide open, robust data architecture primarily for business-to-administration (B2A) and administration-to-administration (A2A) data flows.

⁴ *Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system* (28.03.2011)

⁵ http://ec.europa.eu/enterprise/policies/sme/market-access/internationalisation/index_en.htm

⁶ http://ec.europa.eu/enterprise/policies/sme/market-access/standardisation/index_en.htm

⁷ e-Government also known as e-gov, digital government, online government refers to the use of internet technology as a platform for Administrations to exchange information, providing services and transacting with citizens, Businesses (A2B), and other Administrations (A2A).

⁸ eBusiness (electronic business) is, in its simplest form, the conduct of business on the Internet. It is a more generic term than eCommerce because it refers to not only buying and selling but also servicing customers and collaborating with business partners (B2B) and administrations (B2A).



- Mandate work on a standard data set to describe freight, including for regulatory requirements (while taking into account the current requirements for hazardous goods, live animals, etc.) and technologies such as RFID.
- Establish a Single Window (single access point) and one stop-administrative shopping for administrative procedures in all modes.

Initiative 7 of the new 2011 white paper, *“Multimodal transport of goods: e-Freight”*, highlights the creation of the appropriate framework to allow the tracing of goods in real time, to ensure intermodal liability and to promote clean freight transport:

- Put in practice the concepts of ‘single window’ and ‘one-stop administrative shop’; by creating and deploying a Single Transport Document in electronic form (electronic waybill), and creating the appropriate framework for the deployment of tracking and tracing technologies, RFID etc.)
- Ensure that liability regimes promote rail, waterborne and intermodal transport

Related EU transport policies include:

1. The Action Plan for the Deployment of Intelligent Transport Systems (ITS) in Europe COM (2008) 886 - Identification of ITS services to be deployed in support of freight transport (e-Freight) and support for the wider deployment of an updated multimodal European ITS Framework architecture for intelligent transport systems
2. Modernisation of Customs Code Regulation (EC) No 450/2008 and the e-Customs initiative (70/2008/EC)
3. The Community ‘Vessel Traffic Monitoring and Information Systems’ Directive 2009/17/EC to guarantee that all Member States will be interconnected via the Community maritime information exchange system SafeSeaNet (SSN) in order to obtain a complete overview of the movements of ships and dangerous or polluting cargoes in European waters
4. Communication and action plan with a view to establishing a European maritime transport space without barriers COM (2009) 10/2 and related Directive 2010/65/EU (repealing Directive 2002/6/EC) on reporting formalities for ships arriving in and/or departing from ports of the Member States
5. The European Border Surveillance System (EUROSUR), SEC (2008) 151, 152 13.2.2008 and the integration of maritime surveillance: A common information sharing environment for the EU maritime domain, COM (2009) 538
6. Harmonisation of River Information Services (RIS) on inland waterways in the Community (Directive 2005/44/EC)
7. Technical specification of interoperability (TSI) relating to telematics applications for rail freight (2006/62/EC)
8. Framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport Directive 2010/40/EU

9. Action Plan on Urban Mobility and Mobility Action Plan 2009 COM (2009) 490: Optimise urban logistics efficiency, improving the links between long-distance, inter-urban and urban freight transport, aiming to ensure efficient 'last mile' delivery
10. Transport related statistics with data collections based on legislation applied by EU Member States for each mode⁹. Statistics on trade of Member States, including classifications of countries and products

In the context of developing a Next Generation Single Window concept, all the aforementioned policies create key requirements for information exchange between different stakeholders. Particularly important is ensuring that the e-Customs and Maritime Single Window developments¹⁰ (addressing policies 3-6 above) are integrated in the NGSW concept.

2.4 UN/CEFACT Single Windows

The concept of a Single Window (SW) was introduced by the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) to enhance the efficient exchange of information between trade and government¹¹. The motivation was to support Supply Chain Management by minimising trading cost and making lead times shorter and more predictable. According to UNECE (United Nations Economic Commission for Europe), a Single Window is defined as¹²:

“A facility that allows parties involved in trade and transport to lodge standardized information and documents with a single entry point to fulfil all import, export, and transit-related regulatory requirements. If information is electronic then individual data elements should only be submitted once.”

Single Windows have been developed in many countries¹³ since the beginning of the 1990s. Common features include:

1. Combining electronic import/export clearances (Customs) and port clearances
2. Use of EDI, UN/EDIFACT and UN LOCODE standards
3. For import procedures, the key benefit is reduction in cargo release time and paperwork cost, as well as improved accuracy of information
4. For port related procedures, messages are sent once resulting in reduced communication and personnel cost and improved data quality
5. The key success factor is co-operation between the parties that are responsible for cargo logistics and customs and for transportation safety, security, and environmental issues.

2.5 EU Single Window Initiatives

There are currently two initiatives, backed by EU directives, with which it is important to align the new NGSW concept. These are:

⁹ <http://epp.eurostat.ec.europa.eu/portal/page/portal/transport/legislation>

¹⁰ <http://www.eskema.eu/defaultinfo.aspx?areaid=44&index=2>

¹¹ <http://www.unece.org/cefact/>

¹² UNECE (UN/CEFACT) Recommendation No. 33, “Recommendation and Guidelines on establishing a Single Window”, ECE/TRADE/352, pp. 3 (2005)

¹³ http://www.unece.org/cefact/single_window/sw_cases

1. e-Customs Single Windows facilitating trade under the Modernised Customs Code Programme
2. Maritime Transport Single Windows mandated by the new ship formalities directive (section 2.3, policy 3) and extending the requirements of the VTM directive (section 2.3, policy 2)

2.5.1 e-Customs Single windows

In the context of the European e-Customs and the Modernised Customs Code programme (initiative coordinated by DG TAXUD¹⁴), Single Windows are foreseen to enable economic operators to *lodge electronically and once only* all information required by customs and non-customs legislation for EU cross-border movements of goods. National Single Window systems for customs are to be developed in all Member States which should be interoperable between themselves and with EU centrally-managed systems. In line with this, the Single Administrative Document (SAD) provides the documentary basis for standardised and unified customs declarations in the EU and in Switzerland, Norway and Iceland.

From 1st January 2011, an Import Control System (ICS) is mandatory in all EU Member States and is intended to help increase the security of the global supply chain. A key element to the new rules is the responsibility of carriers to give information, supplied by the forwarder/shipper, to the respective national authorities. An ICS requires that an electronic Entry Summary Declaration (ENS) is submitted to the first customs Office of Entry in the EU, prior to any cargo entering or transiting the EU. A security risk assessment must also be undertaken using agreed EC risk profiles. Also from 1st January 2011, the EMCS (Excise Movement and Control System) became compulsory for monitoring movements of excise goods under suspension of excise duty within the EU (i.e. goods for which no excise duties have yet been paid).

2.5.2 Maritime Transport Single Windows

In the maritime transport sector, in parallel to the trade related use of Single Windows, the concept of a Single Window has been used for some time now. Initially, Port Single Windows were implemented to facilitate Port State Control reporting and to provide a national maritime traffic database. More recently, National Single Window (NSW) implementations provide a single *national* interface for mandatory reporting by ships in European waters in compliance with the "VTM Directive". These National SSN applications are regarded as a kind of maritime National Single Window. Finland is a pioneer in the deployment of this kind of national infrastructure implementing the Single Window concept. The Finnish system PortNet has been operational since 1993 and provides direct input to SSN without involving any other actors. The system receives 40,000 port call notices and 70,000 cargo notices annually.

Development pathways of NSWs for maritime transport differ from country to country but invariably are linked to Port Single Windows, which in turn are increasingly linked with Port Community Systems (PCSs). The new Directive on reporting formalities for ships, which requires all Member States to provide National Single Windows for maritime transport, has created a new impetus to developments in this area, a key dimension of which is co-operation at both EU and international level. With the recent trend of establishing National Port Community Systems, such as PORTBASE in the Netherlands, the role of PCSs in the development of a NGSW becomes more important.

¹⁴ http://ec.europa.eu/taxation_customs/customs/policy_issues/e-customs_initiative/index_en.htm

2.6 The Next Generation Single Window Challenge

The Single Window is a concept for overcoming inefficiencies in mandatory reporting and associated regulatory control processes in trade and transport. The two main Single Window development streams outlined in the previous section, namely SWs for trade facilitation (e-Customs) and SWs for transport (for monitoring vehicle and cargo movements) have been developing independently over the last twenty years (with the latter being developed particularly by maritime authorities).

The current situation is therefore characterised by multiple developments at national level serving the specific interests and strategies of different countries, and at EU level serving the implementation of different EU policies. Particularly important are mode-specific interoperability standards: the TAF/TSI initiative¹⁵ provides the European Commission approved specifications for interoperability for telematic applications for freight specified by the railways and the River Information Services¹⁶ (RIS) standards are used to ensure compatibility and interoperability between current and new RIS systems at European level and to achieve effective interaction between different information services on waterways.

Recently, there is increased recognition that it is both feasible and necessary to consider ways for improving interoperability between the many Single Window-like systems that now exist or are under development at national, EU and international levels. The e-Freight challenge is to establish a coherent framework bringing order to the highly fragmented landscape in the field of regulatory information management for trade and transport.

Key influence factors are:

- Supporting the implementation of *all related* EU policies described in sections 2.2 and 2.3
- Facilitating regulatory information exchanges across modes and authorities
- Facilitating visibility of statistics for transportation CO₂ footprint and other sustainability indicators
- Managing the highly dynamic nature of changes in regulatory requirements and support applications

The high level requirements of the three key stakeholder groups in *Managing Regulatory Information*¹⁷ can be summarised as follows:

- **Businesses** (trade and transport) need to:
 - report regulatory information in a standard format irrespective of destination or mode
 - submit information electronically, ideally extracted automatically from operational systems
 - easily manage changes arising from new or updated regulations

¹⁵ International Union of Railways <http://www.uic.org/spip.php?rubrique882>

¹⁶ Directive 2005/44/EC on harmonised river information services (RIS) on inland waterways in the Community

¹⁷ *Manage Regulatory Information* is one of the key top-level activities in the e-Freight Framework (see Figure 19 and Figure 1920)



- **National Authorities** need to:
 - enforce regulations efficiently
 - co-operate with authorities in different countries
 - easily manage changes arising from new or updated regulations

- **The EU** needs to support the implementation of policy and therefore to facilitate the above requirements

A successful design for a NSW system needs to ensure that the requirements of all three stakeholder groups are met.

3 Review of Current Reporting Practices

A key feature of the e-Freight Next Generation National Single Window concept is that it will be multimodal. That is, it will not be specific to a particular mode, as the case with Maritime Single Windows, but will facilitate reporting across all modes.

3.1 Review of Maritime Reporting and Single Windows

The existing situation regarding reporting formalities for ships (administered by the Master or Ship's Agent) has arisen from a combination of Port State Control inspections, IMO FAL forms, the International Ship and Port Security (ISPS) code, the VTM Directive (SSN Notifications) and customs (import/export) declarations. Although the content of the forms is standardised there are several issues that still need to be addressed:

- The interpretation of “timing rules” – i.e. the requirements for the information which needs to be submitted at 72, 24 and 2 hours before arrival may differ from state to state (in practice, combinations of forms are often used);
- There may be additional national or local port specific requirements that should be communicated efficiently and accurately to the reporting party;
- In many countries, ship formalities are still discharged manually and on paper. In other cases, information is submitted electronically through various channels;
- Authorities responsible for processing various forms and the associated “clearances” differ from country to country and therefore the necessary flexibility must be built into interoperable solutions.

An overview of ship formalities and corresponding information flows is given in Figure 1:



Ship Formalities

72h Pre-Arrival

PCS MIOU Report

24h Pre-Arrival

Ship Pre-Arrival Security Information Form [ISPS]

IMO Cargo Declaration FAL2

IMO Crew List FAL5

IMO Passenger List FAL6

IMO Dangerous Goods Manifest FAL7

Waste Declaration

Ballast Water Report

2h Pre-Arrival

IMO General Declaration FAL1

IMO Ship's stores Declaration FAL3

IMO Crew Effects Declaration FAL 4

Health Declaration

Departure

FAL 1,2,3, 5,6, 7

Ship's Certificates

Other

Exceptions info

Incidents

Reporting Channels

Port Community Systems

Customs Systems

National SSN Applications

National Windows

SSN Notifications

Port Notification

Ship Notification

HAZMAT Notification

Alert Notification

Port Plus

Ship Call

Figure 1: Ship formalities and information flows

Currently, the *electronic* submission of information takes place in two ways:

1. Ship formalities information is submitted to Port Community Systems from which the information is passed to a National Port Authority for authorising entry or exit. The information is then passed to a National maritime application through which the SSN notifications are handled; the PCS also handles intercommunications for Custom clearance.
2. Ship formalities information is submitted to a National Maritime Single Window or National SSN application acting as a Single Window for communications to both SSN and Customs.

In both cases, customs formalities are handled through submissions to customs systems via National Maritime Single Windows or directly from Port Community Systems. Electronic submission of the information is usually realised through the transmission of some sort of "Single Call Document" (formatted as BERMAN EDIFACT or XML, for example) which is submitted by the ship or Ship Agent for

each port call the ship makes. The message can be created and sent as a file to or the information can be entered into an online web page interface, which sends the message on the user's behalf.

Single Call Documents are similar to the SSN PortPlus Notification message that combines in single modular message information related to a number of reporting requirements, namely:

- Pre-arrival notification at least 72 hours before the ship's arrival in a EU port whenever the ship is eligible for an expanded PSC inspection
- Pre-arrival notification at least 24 hours before the ship's arrival in a EU port
- Arrival notification, upon actual arrival of the ship in a EU port
- Departure notification, upon actual departure of a ship from a EU port
- Notification of dangerous and polluting goods carried on board a ship bound for an EU port

3.2 Review of Cross-Border Notification Practices for Inland Transport

An initial study was undertaken to gain an understanding of the complexity and diversity of reporting requirements that exist across different modes and in different countries. The study consolidated information from meetings, interviews and informal communications with a number of the project partners as well as external contacts. The main contributors included representatives from National Authorities in Latvia, the ports of Valencia, Cork and Barcelona, Portbase, the Finnish Transport Agency, and e-Freight business case partners such as Stena and Jan de Rijk.

The results of the study are presented in Table 1, which gives details of typical National Authorities and their current practices in regulatory information management for transport and logistics. This information formed a key input to the development of the "next generation" solution, particularly with regard to ensuring the model supported regulatory information exchange in all modes and was applicable in all Member States.

National Competent Authority	Description	Documents Used (or Regulatory Submissions ¹)	Existing Systems	Interactions with other Authorities	Technologies Used for Interaction
National Maritime Authority	Part of the Ministry of Transport; Responsible for registering ships under the National flag; registering, issuing and approving Mariners' documents; SSN in co-operation with other authorities inspect ships as required by the EU THETIS	Documents relating to registration of ships and mariners; SSN related information	National SafeSeaNet (SSN) Application; AIS; access to the Coastguard	Port Authorities Maritime security agencies / coastguard	Phone, email, regular meetings National SSN application is often used by ports also
Road Transport Authority	Part of the Ministry of Transport; responsible for licensing hauliers for national operations and the wider EU community; carry out border checks on licenses	No documents required on a journey by journey basis other than presentation of license at border	Database of Licensed Operators, National ITS Applications	Customs	Paper documents, fax, email, phone
Railway Authority	Part of the Ministry of Transport; responsible for managing railway operations within country and maintaining agreements with neighboring countries; register operators to operate within country	Submission 2h before border crossing; Order Acceptance; Consignment Note	Central databases for all Railway operations in country and neighboring countries; EU TAF/TSI Systems; Accident Management System	Customs	Paper documents, fax, email, phone web interface for access to databases
Inland Waterway Authority	Part of the Ministry of Transport; responsible for managing national waterways, flood control, and providing the national River Information Services system	Dangerous Goods Declaration	National RIS (River Information Services) systems (e.g. DoRIS in Austria) although these are predominantly information sources and navigational tools rather than regulatory information management applications	Customs	Paper documents, fax, email, VHF radio; Electronic submission systems currently under development

<p>Customs</p>	<p>Part of the Ministry of Economics / Finance, under Revenue Services. Responsible for control of goods crossing borders with EU and non-EU countries and goods in transit through the country; Provide clearances for import and export control; Liaise with related authorities to carry out special inspections (e.g. Dangerous Goods, Food, Veterinary); Responsible for registering EORI numbers; assign Movement Reference Numbers for cargo within country; register trader Guarantees</p>	<p>Export Summary Declaration; Import Summary Declaration; Transit Summary Declaration; Entry Summary Declaration; Exit Summary Declaration; IMO Ship Stores Declaration (FAL 3); IMO Crew's Effects Declaration (FAL 4)</p>	<p>Export Control System; Import Control System; Transit Control System; Customs 'Single Window' interface (web application) for traders to submit customs information for cargo; Guarantee Management System</p>	<p>Food and Veterinary Services; Road Transport Directorate; Railway Authority; Port Authorities; Agriculture Support Services</p>	<p>Notifications of special requirements to Food and Veterinary happen manually, either through phone or email. However, these happen very late, if at all. Data exchange agreement with Agriculture Support Services for checking AGRIX licenses</p>
<p>Border Control</p>	<p>Part of the Ministry of Interior; responsible for control of immigration; control and inspection of border-crossing operations; responsible for checking radiation levels of cargo</p>	<p>IMO Crew List (FAL 5); IMO Passenger List (FAL 6)</p>	<p>National SafeSeaNet (SSN) Application; National Database System; some links with European Interpol system;</p>	<p>Customs, Port Authorities, Railway Authority</p>	<p>Phone, fax, email</p>
<p>Coast Guard</p>	<p>Under the jurisdiction of the Military; part of multi-institutional response team for ship security alerts; safeguarding coastal security; Co-operating with Maritime Authority for giving approval prior to ships entering national ports;</p>	<p>Dangerous Goods Declaration; 72h Pre-Arrival Notifications; 24h Pre-Arrival Notifications</p>	<p>National SafeSeaNet (SSN) Application; AIS system is also integrated with SSN</p>	<p>Port Authorities</p>	<p>SSN system is often used by ports also</p>
<p>Food and Veterinary Services</p>	<p>Part of the Ministry of Agriculture; responsible for control of certain categories of consignment, including veterinary, phytosanitary, and animal and non-animal origin food stuffs</p>	<p>Currently no special documents submitted, but there are a number of certificates which are issued by this organization. In future, to implement a document for declaring these types of goods in advance, in line with an EU initiative</p>	<p>National Databases; TRACES (EU system for veterinary information)</p>	<p>Customs</p>	<p>Phone, fax, email</p>



Security Police	Part of the Ministry of Interior; main institution for transport security; gathers intelligence to assess possible threats and responds accordingly	No requirements for transport to report to this authority. Information is requested from different authorities if there is possibility of a security threat	Security Police Systems and Databases – many are classified or restricted access	All authorities	Information can be requested or received via any means: phone, email, etc. For classified information, special encrypted channels are also available
Health Inspectorate	Part of the Ministry of Health; responsible for inspecting ships and issuing health certificates	Certificate of Health	Database	Port Authorities	Inspections arranged with Ship Agent via phone or email; liaise also with Port Authorities to facilitate inspections
Port Authorities	Normally under the jurisdiction of the local City Council; responsible for communicating with vessels, controlling port operations, collecting ship formalities, authorizing berths and overseeing loading/unloading of cargo	72h Pre-Arrival; 24h Pre-Arrival; IMO FAL Forms 1-6; Pre-Arrival Security Notification; Waste Declaration; Declaration of Health; Dangerous Goods Declaration	Port Community System; AIS; VTS	Health Inspectorate; Coastguard; Customs	Paper documents, fax, telephone
State Emergency Medical Service	A service provided by the Ministry of Health which can deal with medical emergencies (e.g. evacuation of a sick person from a ship); service required if sick person crosses border	No documents – emergency response (incidents later logged in database)	National database	Maritime Authority, Railway Authority, Road Authority, Border Guard, Coast Guard, Security Police	Any authority may alert the service of an incident via any means possible; phone, email, radio etc.

Table 1: Typical current regulatory information management practices

4 The e-Freight Next Generation National Single Window Concept

4.1 Scope and Initial Design Principles

A National Single Window could be defined as a single system, existing at a National level, which accepts certain information as input and makes it available to various different stakeholders within that country. For example, in current parlance, a *Maritime National Single Window* is a system which accepts information from businesses in the maritime domain and presents it to administrations responsible for the regulation of that domain within that Member State, such as Port Authorities and National Maritime Authorities. Similarly, a *Customs National Single Window* is a system which acts as a single point of entry for all goods related information. As we have seen, many Member States have already developed, or are in the process of developing, these kinds of National Single Window systems.

The main problem with the current situation is that there is little or no information exchange *between* these national single¹⁸ window systems. Authorities which do not have a Single Window system for their area of jurisdiction do not have free access to other Authorities' systems and so are forced to liaise with them via telephone and email, which is inefficient and time consuming. Important information is often received very late or missed altogether. Similar problems occur between authorities in neighbouring countries.

It is e-Freight's objective to develop a multimodal Single Window concept to facilitate exchange of electronic regulatory information, and which will satisfy the requirements of stakeholders in all transport modes. However, in line with the scope of the project, the NSW concept will not cover air transport.

4.2 Early Models and Prototypes, and Evolution of the e-Freight Concept

After analysing the requirements outlined in the previous sections, two design approaches were considered, representing the classical alternatives of **centralised** versus **decentralised** solutions. Initially, the notion of having a "Next Generation EU Single Window" (as described in the DoW) led to the development focusing on the centralised model.

An early design concept is shown in Figure 2. The basic principle is that businesses submit regulatory information to a central EU system, which then disseminates the information to National Single Windows in each Member State. Similarly, the National Single Windows exchange information with mode-specific EU level systems, such as SSN and RIS, and also with a central information facility. However, it soon became clear that this model would not be a satisfactory solution.

¹⁸ Another issue being that they are not really "single" windows, by virtue of the fact that there is more than one of them per Member State

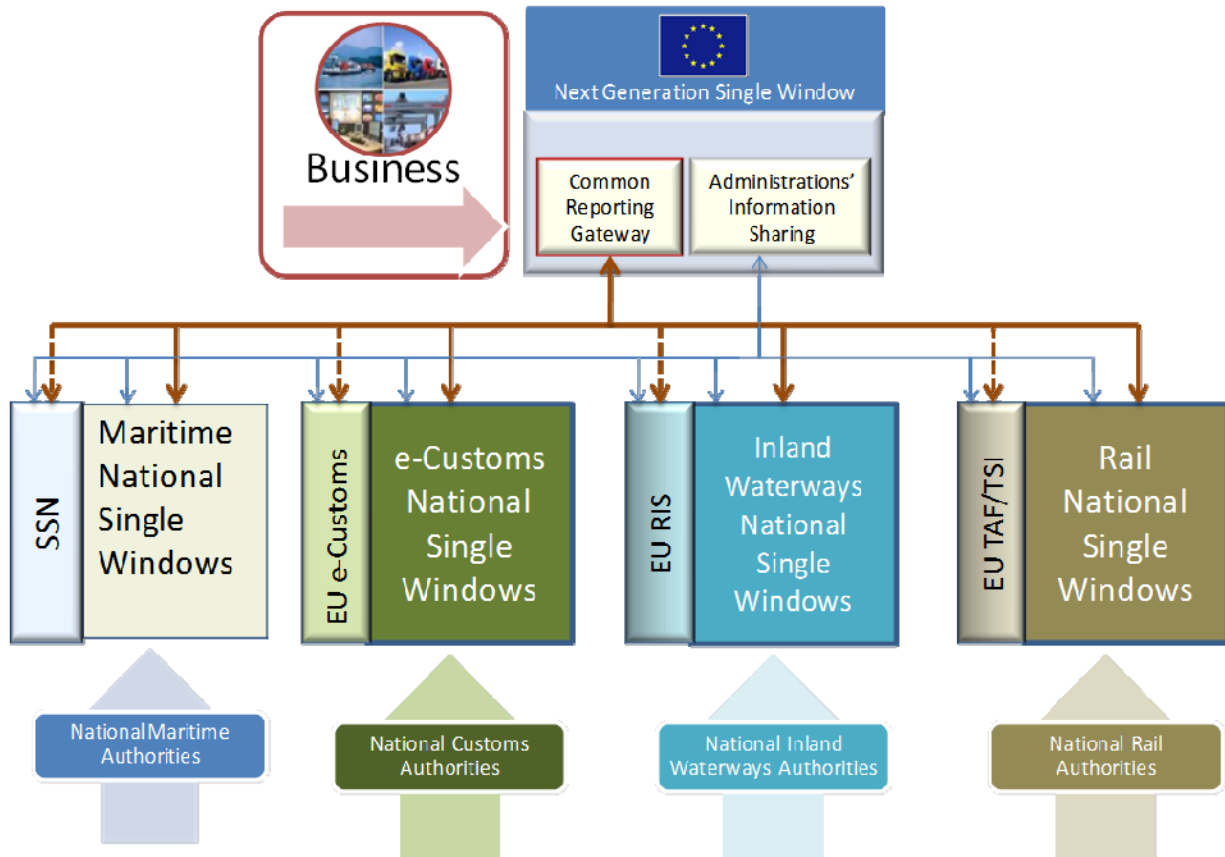


Figure 2: Early e-Freight NGSW concept

Whilst the concept in Figure 2 demonstrates integration of existing systems, it does not satisfactorily embody the spirit of a multimodal single window. Indeed, including multiple “single” windows, one for each mode, is counter-intuitive. Moreover, this model necessitates that each Member State develop single windows for each mode as well as customs. While some Member States have moved in this direction already, it seems unnecessary to require others to do so when one *multimodal* single window system would suffice. Finally, authorities which operate across all modes, such as security and immigration services, must still use multiple systems to carry out their responsibilities, thus undermining one of the fundamental principles of a single window.

The initial model was therefore revised and a second centralised model was developed, again based on a common application for reporting hosted at an EU level. In this new model, shown in Figure 3, each Member State hosts a National Single Window system which receives information from the central EU Single Window and facilitates the sharing of information between Authorities. This approach has the benefit of a true, centralised Single Window interface for reporting but also a centralised system for Authorities within the Member State.

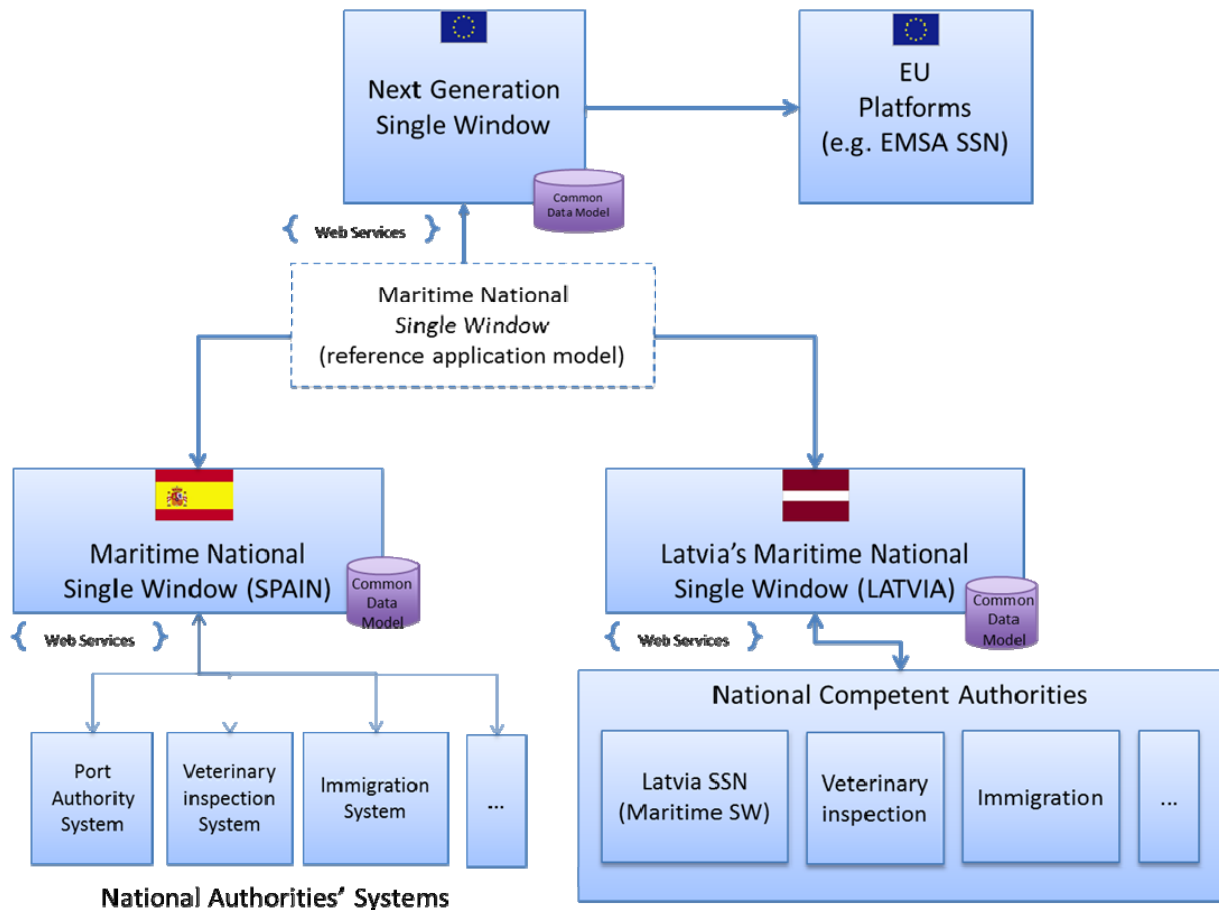


Figure 3: Revised NGSW concept, implemented as a demonstrator for maritime reporting

In this scenario, the control of the reporting application is also centralised, allowing the EU to implement policy directly. The key advantage here is easy maintenance, particularly in relation to regulatory and policy change. Additional benefits relate to managing security and quality of data but such issues involve both technical and organisational considerations which complicate the situation.

4.2.1 Maritime Single Window Demonstrator

In order to increase the understanding of the way the user community would react to the proposals, the revised model was implemented as a prototype for maritime reporting (as depicted in Figure 3). The maritime domain was chosen because it has the most complex regulatory requirements for trade and transport and because all Member States are currently working towards the development of Maritime Single Windows as part of the Ship Formalities Directive¹⁹.

At the end of its first year, the e-Freight project carried out demonstrations of the prototype, the objectives of which were to:

- demonstrate proof of concept for the initial e-Freight ideas applied to regulatory information management
- demonstrate the notion of e-Freight *Framework + Platform* for the development of e-Freight Solutions

¹⁹ Directive 2002/6/EC of the European Parliament and of the Council of 18 February 2002 on reporting formalities for ships arriving in and/or departing from ports of the Member States of the Community

- demonstrate harmonisation, rationalisation and streamlining of complex reporting requirements
- elicit feedback from users

As shown in Figure 3, the demonstrator consisted of a single EU level reporting application (“Next Generation Single Window”) and two Maritime National Single Window applications, one for Spain and one for Latvia, to highlight the differences in reporting for these two nations.

4.2.2 Conclusions from the Feedback from the Community

The most valuable outcome of the demonstrator was the feedback received, which was later used to refine the e-Freight NGSW concept. The feedback can be divided into several categories which summarise the most pressing concerns of the community:

- **Business case:** What is the business case for using EU Single Windows? What are the costs and benefits to reporting businesses?
- **Reliability and availability of infrastructure:** What will happen if the central reporting facility is compromised technically?
- **Reliability and ownership of data:** Who owns the data if it is stored centrally on an EU level? What will happen if the central reporting facility is compromised with regard to security?
- **Ownership and management:** Who will be responsible for the ownership, management and maintenance of a central EU system?

The prototype was useful for demonstrating the technical feasibility of the centralised approach which affords direct control over policy and regulation implementation. However, it soon became clear that this approach would not be acceptable to the business user community. The main reason was that the single point of failure was seen as inappropriate for the “mission critical” nature of the local systems currently controlling decisions affecting trade flow.

Based on the above feedback and comments received from other parties, workshops, conferences and events, several key conclusions were drawn which influenced the development of the NGSW:

1. There should be no centralised EU reporting application. Instead, the reporting interface should be a *distributed* application
2. The focus for reporting and information exchange has shifted from a single central EU Single Window to multi-modal National Single Windows in each Member State
3. The e-Freight Platform should not impose run-time support. Whilst the Platform has the option of providing run-time processing, the system should be designed such that Single Window applications are not dependent on it
4. To support the distributed applications, a set of centralised services must be introduced to support important functions, such as the management of changes to regulatory reporting specifications and registries of reporting interfaces

Points 1 and 2 above indicated that a *decentralised* approach was more appropriate. In the decentralised approach, the functionality of the common reporting interface was relocated from the centralised application to distributed national applications, shifting control of the application from the EU to Member States. The main advantage that this brings is that it avoids relying on a single physical computer system which could become a single point of failure.

The EU Single Window originally conceived was shown to be neither feasible nor desirable at the current time. Instead, EU Single Window will be redefined as a set of services which will support the distributed applications in Member States. These central EU National Single Window support services have been devised to provide support for the implementation of a standardised approach to regulatory information management and to facilitate information exchange between Authorities in different member states. The key advantage of this is that policy implementation is still managed centrally, but the reporting and information exchange applications are distributed, allowing Member States complete control over the implementation.

Finally, because the objective of the e-Freight project is to develop a system which can facilitate management and sharing of regulatory information across *all* modes, the maritime reporting model was extended to incorporate the other transport modes.

4.3 Final Proposed Concept

NB: From this point forward in the document, the “Next Generation” prefix will be dropped and the reader should assume that the concepts are “Next Generation” unless expressed otherwise.

4.3.1 High Level Interaction Model

Figure 4 presents a high level overview of how the e-Freight Single Window solution interacts with the three stakeholder groups as explained in section 2.6.

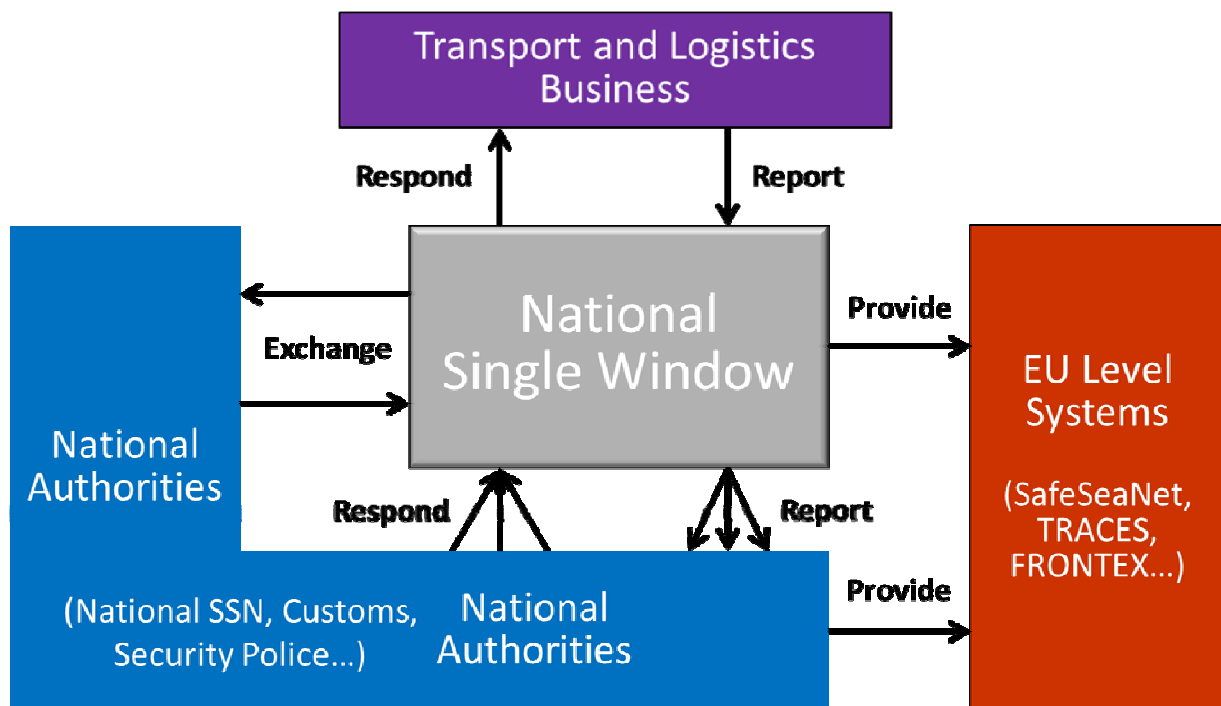


Figure 4: High Level Concept

The National Single Window application facilitates the exchange of regulatory information between the three stakeholder groups in four different interactions:

1. **REPORT** – transport and logistics businesses **report** information to national authorities
2. **RESPOND** – national authorities **respond** to businesses, giving clearances and authorisations or requesting more information
3. **PROVIDE** – information is **provided** to EU level systems, either from national authorities or directly from the NSW application
4. **EXCHANGE** – national authorities share and **exchange** information with one another

REPORT: The diagram shows a single reporting and responding arrow for businesses. This represents a single interaction with a single reporting interface for a given Member State. In addition, the interface is standardised and common to all NSW applications, so will be the same for **all** Member States.

The information submitted by business is disseminated (reported) by the NSW to the Authorities which require it and in the format specified by each respective Authority. The information received by each Authority and the format that it is presented in is determined on a country by country basis and the NSW will be configured to the specific needs of each Member State. These requirements are also not fixed, so Authorities are free to update their information needs in the future.

RESPOND: The NSW receives responses from all Authorities and consolidates them into a single response for the business party. This saves the business party from having to keep track of submissions and responses from many authorities, which can lead to confusion and errors.

PROVIDE: Currently, Member States are obliged to supply certain information to EU level systems. For example, the EMSA SafeSeaNet requires Member States to report maritime information for the purposes of safety and security management. With the model proposed in Figure 4, Authorities in Member States can continue to provide information to EU level systems through existing means and in the way they have done so in the past. However, information can also be provided directly by the NSW. This has the advantage that each Member State only needs to maintain one system to fulfil the role of reporting at the EU level.

EXCHANGE: Finally, the NSW provides facilities for exchanging information between Authorities within a Member State. Currently, there are no mechanisms for sharing arbitrary information between Authorities, other than the provision of limited, read-only access to databases. The NSW will provide services which will allow Authorities to publish and access data, raise alerts and share information with one another. Through this functionality of the NSW, the co-operation of Authorities in safety, security and environmental risk management will be greatly enhanced.

4.3.2 Application Component Model

Figure 5 presents a more detailed model of the e-Freight Single Window concept depicting its constituent application components. There are two main concepts: the **National Single Window** and the **Central EU National Single Window Support Services**. An overview of these concepts is presented below. A more detailed description of their respective components functionalities is given in the following sections.

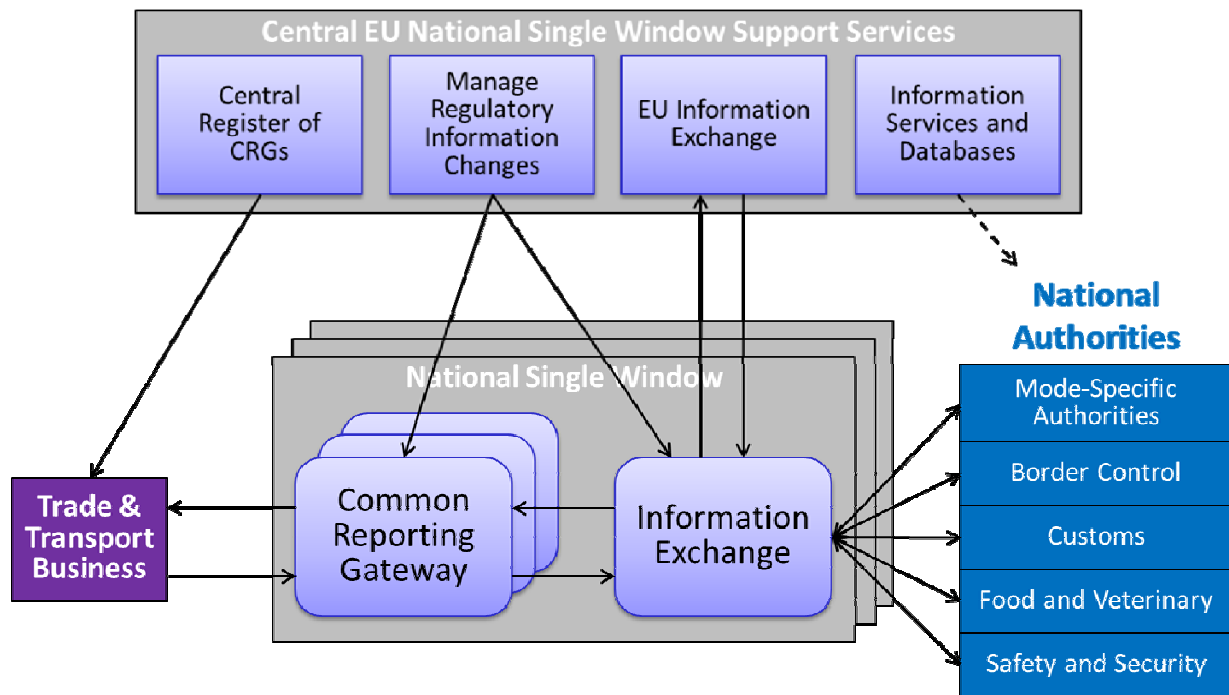


Figure 5: The e-Freight Next Generation Single Window Concept

The **Transport Logistics Business** component on the left represents the set of all parties who are obliged to submit information for the purposes of trade and transport regulation (e.g. parties such as ship agents, consignors, freight forwarders). The collection of **National Authorities** components on the right represent different categories of Authorities within a Member State who are responsible for regulation and to whom information must be reported. Note that the EU systems shown in the previous diagram are not included in this Figure for clarity.

4.3.3 National Single Windows

Each Member State has a **National Single Window** system, consisting of two types of application. Businesses in the transport logistics domain submit regulatory information using a standardised reporting application called the **Common Reporting Gateway (CRG)**; they also receive related response messages from authorities through the CRG. The CRG application accepts the information in a standardised format called the **Common Reporting Schema (CRS)**. The CRS contains fields for all the information required for reporting to all authorities and across all modes. This is explained in more detail in section 0.

The CRG relays regulatory information to another application called the **Information Exchange (IE)**. This application represents the “core” of the NSW and co-ordinates the exchange and sharing of information between Authorities within a Member State. Its main functionality is to enable the *B2A* (Business to Authority) information exchange pattern and thus implement the regulatory reporting process. In addition to this, it has the ability to exchange information with Authorities in other Member States and with EU level systems.

The e-Freight NSW concept differs from current single window implementations in two key ways. Firstly, it constitutes a single point of entry for *all* transport logistics regulatory information in a Member State, regardless of mode or transport route. Secondly, it facilitates the exchange and sharing

of information between national authorities and within the Member State and with neighbouring countries.

4.3.4 Common Reporting Gateway Application

It can be observed in Figure 5: The e-Freight Next Generation Single Window Concept Figure 5 that there are multiple CRG instances within one NSW system. This reflects the fact that the CRG can be deployed either as a single central application or distributed within a Member State. The CRG is provided as a standard component for reporting to the NSW which can be integrated with legacy systems. This flexible solution allows local entry/exit system operators (e.g. PCSs) to maintain control of the interaction with businesses, which might be important for providing value added services. At the same time, the standardised reporting interface for businesses is retained.

Figure 6 demonstrates the different possible configurations. On the left hand side, the dashed box represents a complete centralised *CRG + IE* NSW solution. On the right hand side, a distributed CRG is shown incorporated into a legacy system. In both cases, the information received by the CRG is transferred to the central Information Exchange, which then distributes it to the Authorities.

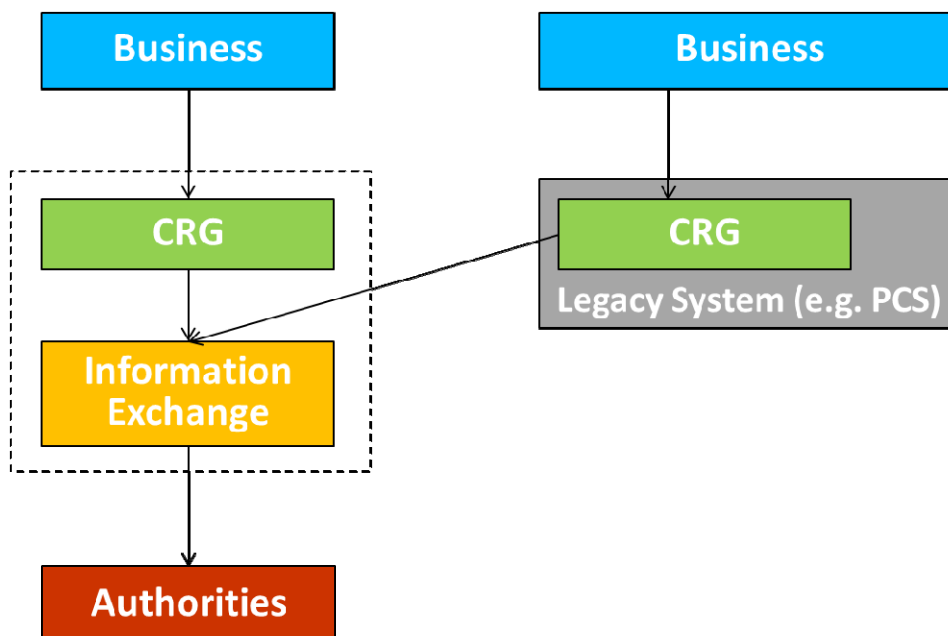


Figure 6: Common Reporting Gateway Configurations

The recommended CRG configuration is to have just one central CRG, which will be the default case where no existing local systems are in place. Equally, both configurations can be employed simultaneously. The level of distribution of the CRG can be decided by each Member State.

4.3.5 Information Exchange Application

The IE application is the core of the NSW, allowing regulatory information to be received, processed and distributed intelligently and efficiently through a variety of electronic communication means (e.g. web services, webpage interfaces, electronic messaging, email, SMS) which allow existing and future Authority systems and users to interact with the system.

At the core of the application is a database which accumulates all information submitted for transport regulation. The information is analysed and distributed to EU level systems and National Authorities,

as well as NSWs (and hence Authorities) in neighbouring countries, if appropriate agreements are reached. Access to data is controlled by access rights, which are decided and managed by the Member State.

The IE can also accept information from other sources; internal and external authorities, traffic, cargo and infrastructure monitoring systems, and EU level systems. This information is combined in the system and intelligently analysed using data fusion and semantic reasoning techniques. The results of this process can be used to trigger alerts and notifications, and to support environmental, safety and security risk management.

4.3.6 Central EU National Single Window Support Services

To fulfil the functionality envisaged in the EU Single Window concept, a number of central EU software modules have been devised which support the implementation and management of NSWs in Member States. The first of these, a **Central Register of CRGs**, acts as a directory for businesses to locate and connect to reporting interfaces. The register also manages new NSW systems and updates to contact details.

When regulatory requirements and policies change, updates to the application models can be made centrally through the **Manage Regulatory Information Changes** module. This module will hold central specifications for the CRG and IE applications defined as part of the e-Freight Framework. This means that any changes in regulations and related practices will be captured and automatically transformed into updated NSW Solutions. Section 6.4.5 explains how this will be realised.

The central **EU Information Exchange** acts in much the same way as the IE by facilitating the exchange and sharing of regulatory information on an EU level to support co-operation in safety, security and environmental risk management. The EU Information Exchange also provides the information exchange interface with the EU level systems, such as SafeSeaNet and TRACES.

Finally, through the **EU Services and Databases** module, a number of additional services and databases may be provided, such as the provision of statistical information to authorities and businesses, or a database of registered operators within the EU.

Development of the various modules which provide the central EU NSW support services will shortly commence. Prototype versions will be produced to test the interaction with the NSW solution deployed in Latvia. This work will be reported in the second release of this deliverable.

5 The Common Reporting Schema

This section explains the concept of the Common Reporting Schema in more detail. The CRS and NSW concepts are complimentary and are designed to be used in conjunction. However, the two concepts can exist and be used independently, allowing either of them to become a standard without relying on the other.

5.1 Definition and Concept

The term “Common Reporting Schema” is still a working title and needs careful explanation to avoid confusion. The term “schema” has caused ambiguity in some cases, so an alternative name is being sought. However, at the current time, the term “Common Reporting Schema” is been used throughout the project, so this is the term that will be used here. The concept is defined as follows:

*The Common Reporting Schema is a single, standardised, electronic reporting document which includes all the information fields which are **necessary** and **sufficient** for reporting to Authorities in **all Member States** and across **all modes**.*

It takes the form of a data model which defines the structure and content of the information that must be reported to authorities by transport and logistics business. Because it is electronic, it has the added benefit that it can be automatically generated from transport planning and operational systems.

5.2 Design Principles and Approach

The CRS has been developed based on the following core principle:

Information should be entered only once, at the earliest opportunity, by the party who has it first

In addition, there are these further driving principles:

- To implement the core principle, information should be made available to parties “downstream” in the reporting process, subject to information security access rights and privileges (i.e. not all information submitted “upstream” will or should be available to all parties “downstream”)
- The content of the reporting model should fulfil regulatory requirements but the structure should be driven by the transport planning and booking process
- The model should be aligned as much as possible with existing models (e.g. the WCO customs data model) as well as with the other e-Freight Framework components

One of the key challenges, therefore, was to create a larger data structure which could be decomposed into smaller segments which are submitted separately at different points (and maybe by different parties) throughout the transport logistics process, without losing functionality and consistency. As an example, Table 2 lists the entities about which information is required in a typical reporting process and the party which has the information first. It also shows the related e-Freight Framework message(s) in each case. The logical order of submission is from top to bottom of the table.

LSC = Logistics Service Client
LSP = Logistics Service Provider
TNM = Transportation Network Manager
TR = Transport Regulator
TEP = Transport Execution Plan
GII = Goods Item Itinerary
TES = Transport Execution Status
TPS = Transport Progress Status

Entity	Information Owner/Provider (e-Freight Role ²⁰)	Related e-Freight Framework Message(s) ²¹
Product/Product Instance	Consignor/LSC	TEP
Booking/Invoice	LSC, LSP	TEP
Goods Shipment	LSC	TEP, GII
Transport Contract	LSC, LSP	TEP
Transport Equipment	LSP	TEP
Transport Means	LSP	TEP
Transport Movement	LSP	TEP, GII
Control and Status	LSP, TNM, TR	GII, TES, TPS
Completion	LSC/Consignee, LSP	TEP, TES

Table 2: Typical logical order of supply chain information generation

Another important challenge was to relate these smaller messages to the submission context in which they were created. The use of “key fields” (i.e. data fields which are uniquely shared between components of the same submission context) ensures that the sub-sections of the complete CRS structure are linked up in the correctly at the right time and place. Key fields can be reference numbers or ID’s specifically designed for this purpose, or they can be any other existing data field which serves this function.

In addition to the key fields, timestamps are used to allow message segments to be updated, until such point as some timeout condition has been reached. This allows users to continually re-submit information segments, encouraging them to submit information as early as possible and update it later if plans change. An example of this process is shown in the sequence diagram in Figure 7.

²⁰ Please refer to e-Freight Deliverable D1.3b for further details of the e-Freight Roles

²¹ Please refer to e-Freight Deliverable D1.3b for further details of the Framework Messages

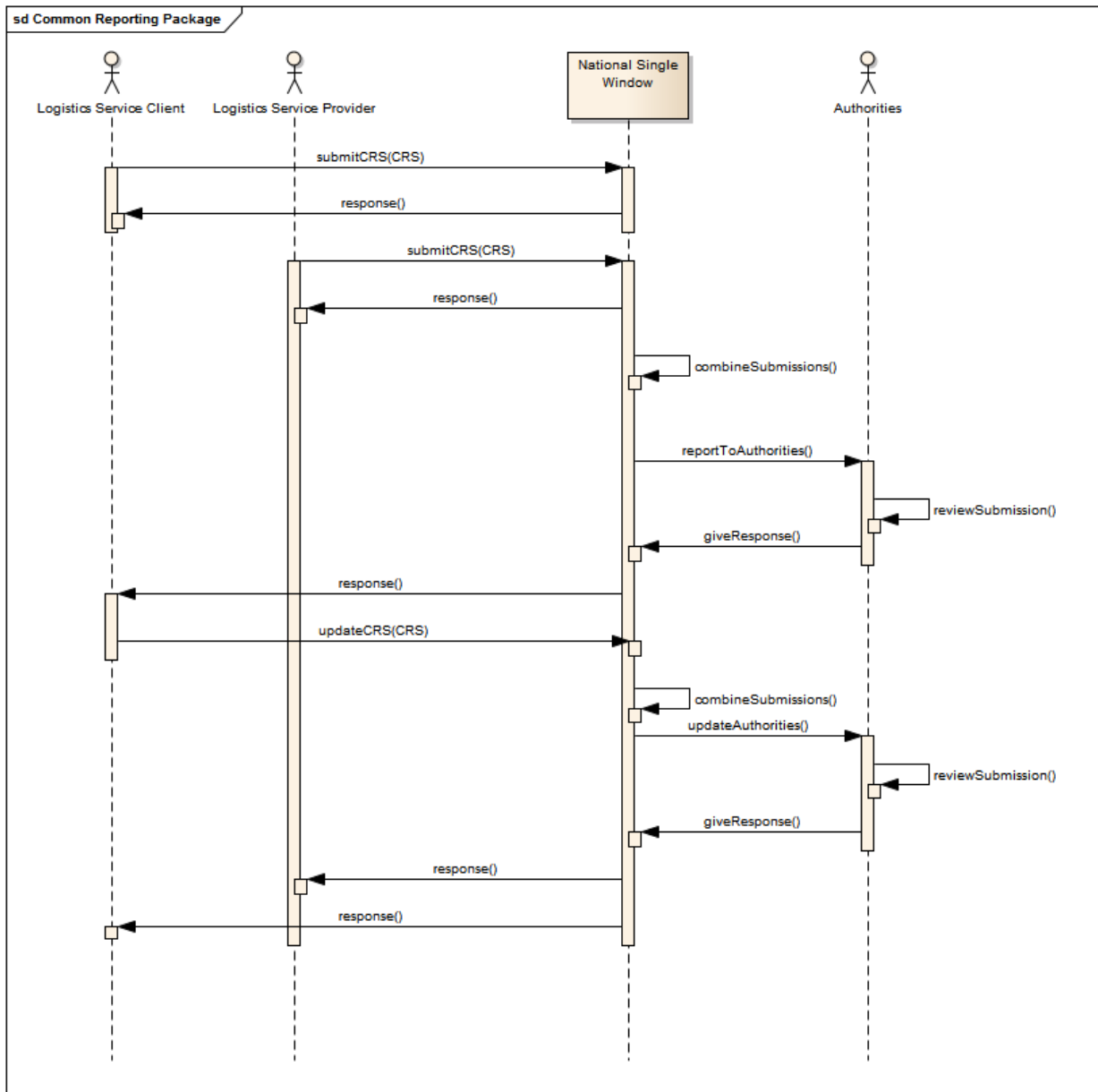


Figure 7: Common Reporting Package and NSW interaction

Finally, the diagram in Figure 8 shows how the CRS segment approach, combined with the functions of the NSW, expedites the process of reporting information to Authorities. Because the different segments are logically independent, they can be easily separated, duplicated and sent to the relevant Authorities by the NSW. The Authorities each receive the selection of CRS segments which meets their information requirements. If necessary, the segments can be mapped to a different structure, in order to invoke an existing web service, for example.

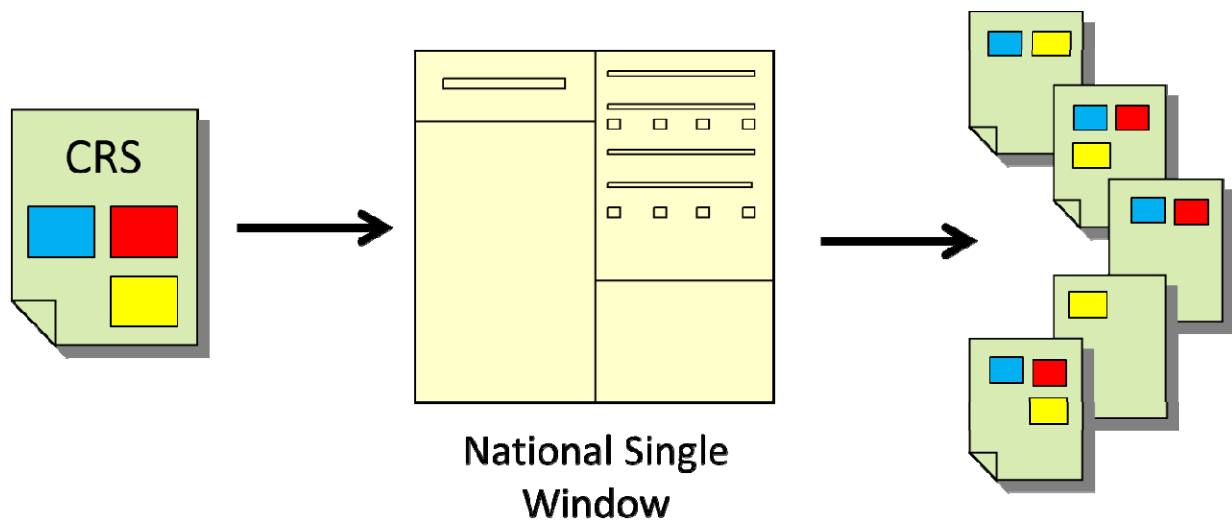


Figure 8: CRS + NSW - reporting to authorities

5.3 Data Model

To ascertain the information requirements, an extensive study of existing reporting documents and regulations was carried out. In nearly all cases, reporting requirements are laid down by mode-specific EU and international regulations, enforced by local and national legislation. In addition, the Community Customs Code regulation²² defines the requirements for customs declarations and procedures within the European Community.

The study revealed that reporting is still heavily mode-dependent, despite there being many similarities in the information required by each mode. Usually, different terminology is used in different modes to refer to the same underlying data, most probably as a result of the historical development of each mode of transport. It is this fact that has led to unnecessary duplication of information in reporting, particularly for multimodal transport operators.

Another observation was that the reporting process is significantly customs oriented. Customs data is necessarily mode-independent and so forms a common element for transport operators in different modes. In addition, the customs clearance stage is a key step for all transport operations, as failure to gain this clearance may mean the goods cannot be shipped. The analysis of the WCO²³ customs data model therefore formed an important part of the study, with the aim of identifying opportunities for alignment and re-use of the concepts.

Based on the results of the study, the project has developed a consolidated, “mode-neutral”, logical delineation of the data that is required for cross-border reporting in EU Member States. By reviewing the current requirements for regulatory information, a high-level picture began to emerge of the types of information that were required:

- **Who** is sending the cargo? **Who** is arranging the transport? **Who** will be responsible for the goods when they arrive?

²² Regulation (EEC) No 2913/92 establishing the Community Customs Code

²³ World Customs Organisation – <http://www.wcoomd.org>

- **What** is being transported? **What** is on board the vessel? **What** is being imported?
- **How** are the goods being transported?
- **When** will they arrive? **Where** are they being delivered? **When** will they be presented to customs? **Where** are they coming from?

The top level elements of the proposed data model, demonstrating the logical delineation of the content of the Common Reporting Schema, are presented in Figure 9.

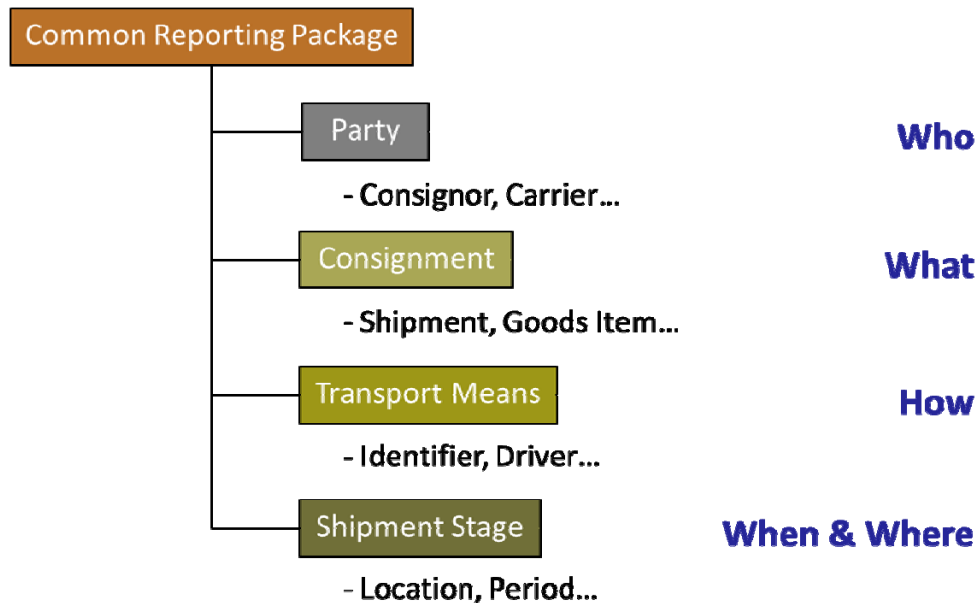


Figure 9: Common Reporting Schema logical model

The Figure shows how the **Who**, **What**, **Where**, **When** and **How** of the transport operation is captured in a standard Common Reporting Package. The Common Reporting Package can be thought of as an instance of the CRS and can contain any combination of the above elements. This Package concept allows parties to use the same document structure to submit the information they are responsible for, irrespective of their role in the transport chain.

To demonstrate alignment of the CRS with existing models and standards, Figure 10 presents the top level elements of the GOVCBR message from the WCO customs data model for comparison. The GOVCBR message embodies the whole of the WCO model and can also be broken down in a modular way.

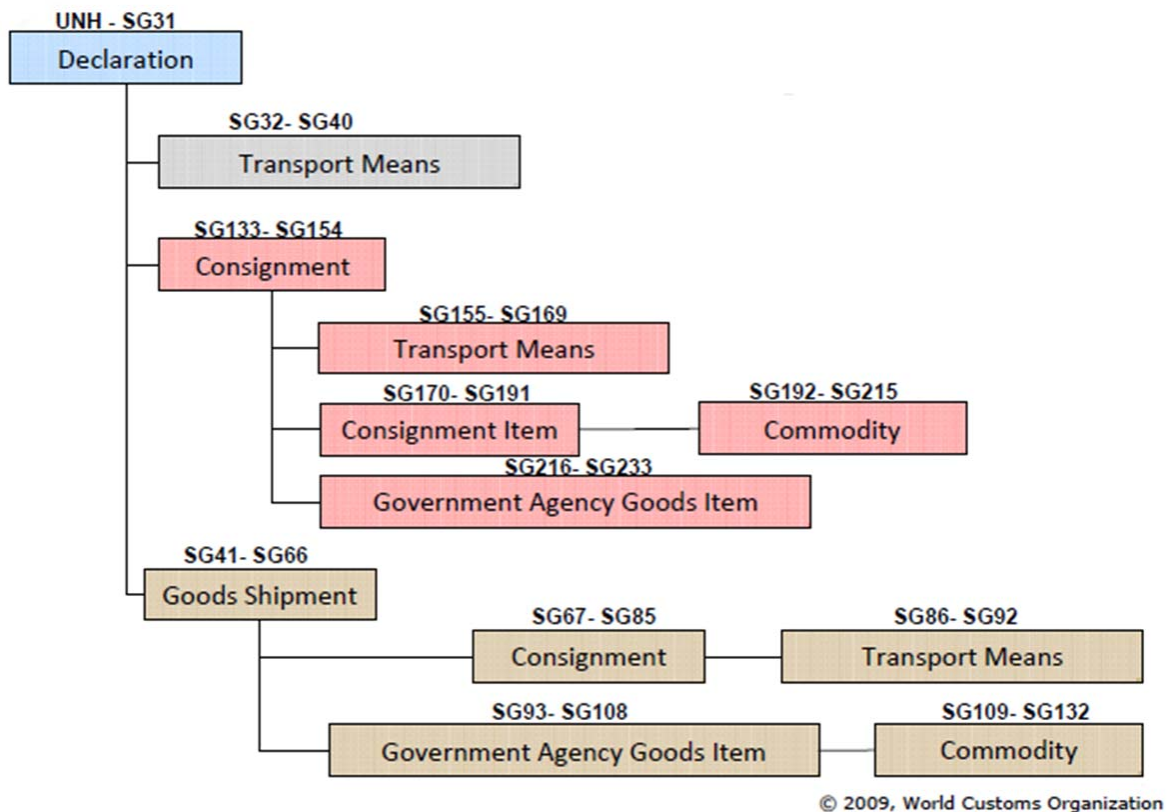


Figure 10: The WCO data model GOVCBR message structure

The similarity in structure between the CRS and GOVCBR is self-evident. Differences between the two models arise partly because the CRS extends the content of the GOVCBR to include information not directly related to customs (i.e. information relating to the transport), and partly because of the choice of modelling approach adopted in the e-Freight Framework.

The Framework documents are compliant with the OASIS UBL (Universal Business Language) standard. UBL provides a library of standardised electronic documents and common information elements related to transport and procurement. The e-Freight project has developed its own document profile based on UBL. A profile is formed by creating a subset of the UBL standardised documents to avoid including information elements that are not needed.

The CRS is an e-Freight Framework document so to ensure internal consistency of the message structures, it was necessary to use the same modelling approach. The CRS model was therefore developed using UBL information elements, the names of which are similar, but not identical, the concepts in the WCO model. However, the evident similarity in structure makes the mapping from one to the other very simple.

The full CRS data model, based on the e-Freight UBL profile, is shown in Figure 11. Elements (classes and associations) in red and the <<e-Freight>> stereotype classifier indicate where e-Freight has extended the UBL definitions. Classes in blue are “Common Elements” in the Framework, and full definitions of these can be found in deliverable D1.3b.

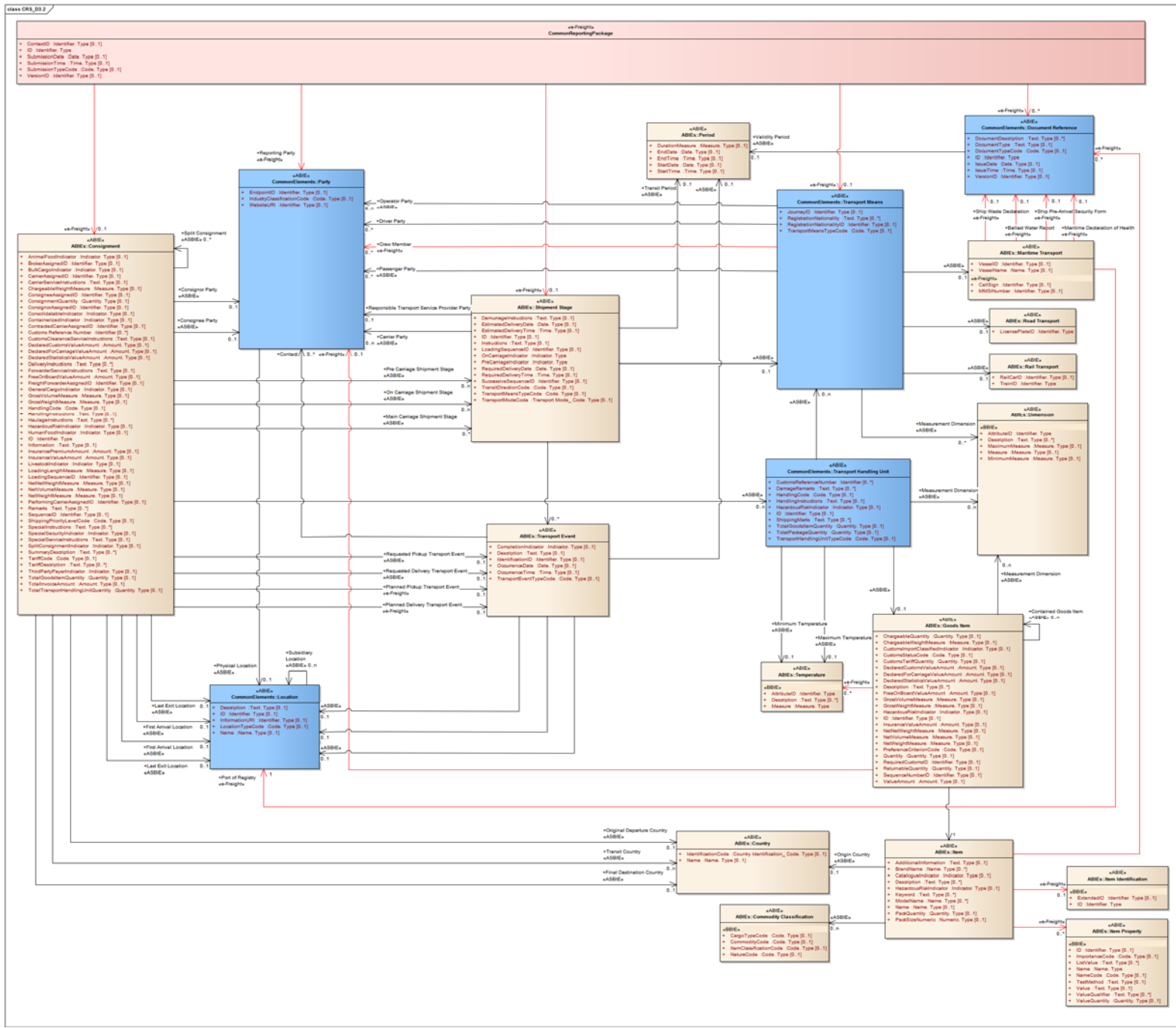


Figure 11: Common Reporting Schema Data Model

The main advantages of the CRS model can be summarised as follows:

1. **Logical delineation and modular decomposition of information** – one message can be used for many purposes and updates for time-variant data are simplified
2. **Structure and principles inspired by WCO GOVCBR message** – easy to map to existing systems using the WCO data model
3. **Uses standard UBL elements and UN/CEFACT code lists** – elements are already used and understood by a large community
4. **Inherently compatible with the e-Freight Framework** – systems using the other Framework messages can easily and automatically generate CRS submissions
5. **Electronic message data** – information can be transferred, manipulated, stored and accessed more easily and efficiently

5.4 Standardisation

The Common Reporting Schema has attracted interest from the CEN standardisation body. The initial interest was for the development of a *CEN Technical Specification*, but there has also since been a recommendation to aim for ISO standardisation. Support from 5 separate national standardisation bodies is required, so work in this area is on-going.

However, also in development is an ISO standard for electronic ship reporting. Synergies between the two message sets (EPC and CRS) are being explored and a mapping from one to the other will be demonstrated during the project. The NSW will therefore support the new ISO standard when it is completed. Work in this area will be reported in the second release of this deliverable.

5.5 Feedback and Validation

Early drafts of the CRS have been subject to various feedback and validation stages already. The concepts have been presented and discussed at project meetings, workshops and conferences and the first version which is presented in this document is the result of refinement based on these consultations.

However, the version of the CRS presented in this document will undergo a second more detailed phase of validation which will involve closer analysis of related standards and processes, mapping to real-life existing systems and testing in the project Business Cases. Results from these trials and the updated version of the CRS will be reported in the second release of this deliverable.

6 Deployment of the National Single Window Reference Solution in Latvia

This section explains the specific implementation which has been deployed in Latvia as part of Business Case 6. The final design concept is presented, along with a description of how the solution was implemented. Whilst the model for the e-Freight NSW is generic, the Latvia implementation gives an example of how the model can be realised.

6.1 User Requirements

Through the Maritime Administration of Latvia (MAL), close co-operation with the National Authorities in Latvia has been established. Several visits were made to Riga to carry out interviews and consultations with representatives of the Authorities and to study their existing systems and practices.

From the information collected, a list of specific user requirements for the Latvian NSW was distilled. The full list is provided in Appendix II, but the main high-level requirements are summarised here for convenience.

Authorities need:

- to continue to receive the same information in the same format (i.e. the NSW should not impact upon current practices)
- to receive information which they are not currently receiving because they don't have access to a system which can provide it
- the use of an information management system because they do not currently have a satisfactory means for managing electronic information
- a facility for communicating and co-operating with other Authorities

6.2 Solution Development Methodology

The solution methodology for the NSW was followed according to the definition laid out in deliverable *D2.1 – The e-Freight Platform*. This document specifies a general development methodology for e-Freight solutions, which is outlined in Figure 12.

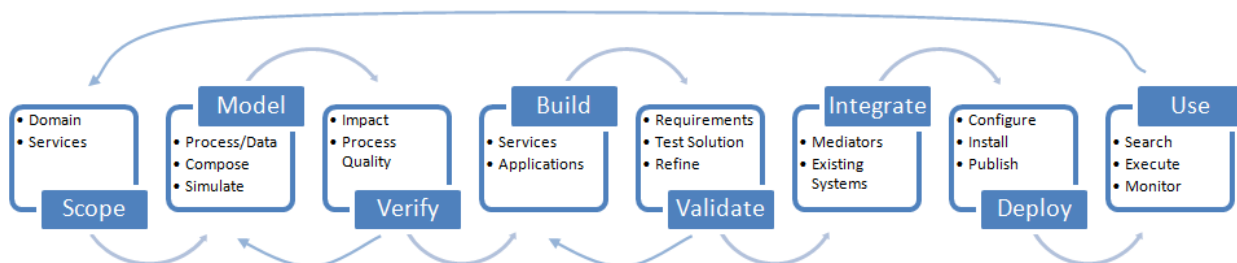


Figure 12: e-Freight Solution Development Methodology

The steps encompass an iterative development process which provides continuous feedback to the different stages, designed to ensure the quality of the results. Table 3 explains how the methodology was implemented for the NSW solution development.

Methodology Step	Implementation
Scope	Scoping was achieved by studying existing standards and regulations relating to reporting for trade and transport. The domain of regulatory information management was then specified.
Model	Process, data and domain entity models for the regulatory information management domain were created
Verify	Verification of the models was carried out through workshops, meetings and interviews. The models were then refined and the process repeated.
Build	The zAppDev application development tool was used to generate the services and application components from the domain models.
Validate	Validation of the application was carried out through demonstrators, workshops and conferences. End users were able to test the application for themselves. The models were then refined and the process repeated.
Integrate	Technical interface specifications and requirements for existing systems in Latvia have been collected and incorporated in the application. Testing of the integration will commence after deployment.
Deploy	The NSW solution has been deployed on the server in Latvia as of 30/12/2011. It is now undergoing a process of configuration in advance of the testing phase.
Use	Initially, the system will be operated in parallel with current systems whilst technical issues are resolved. The system will be tested with real data and user feedback will be collected. As the methodology suggests, this will lead to additional requirements and modification of the scope.

Table 3: Use of e-Freight solution development methodology for the NSW solution

The main advantage of following this methodology for the NSW development was the fact that this approach addresses the potential problem of continuous changes in business needs, user demands, regulations, technological advancements and other factors.

The methodology follows a trend in the Software Engineering industry called **Model-Driven Engineering (MDE)** which can cope with a highly dynamic landscape like the regulatory landscape for transport and logistics. The approach focuses on the creation of *models*, or abstractions, that are closer to the domain concepts of an application than the computing concepts.

When changes to regulatory requirements occur, the models can be easily adapted by a domain expert and the changes are automatically incorporated in the software solution without the need for a programmer to edit the application at a very low (computational) level. The effort and cost associated with updating applications is therefore much lower, as well as being less error-prone.

In the case of the NSW, the second big advantage is that the models which drive the design of the NSW can be maintained at a European level, ensuring that all solutions conform to EU regulations and requirements *by design*. If regulations and policies are updated, alterations to the models can be made centrally and all NSW solution implementations in different Member States can very easily (and in theory, automatically) be brought in line with the changes.

6.3 Solution Architecture

The NSW Reference Solution has been developed with the solution architecture in Figure 13. This *n-tiered* architecture can be divided into 3 main layers: the **Presentation Layer**, the **Business Layer** and the **Data Layer**. The Business Layer can be further subdivided into **Service** and **Domain** layers.

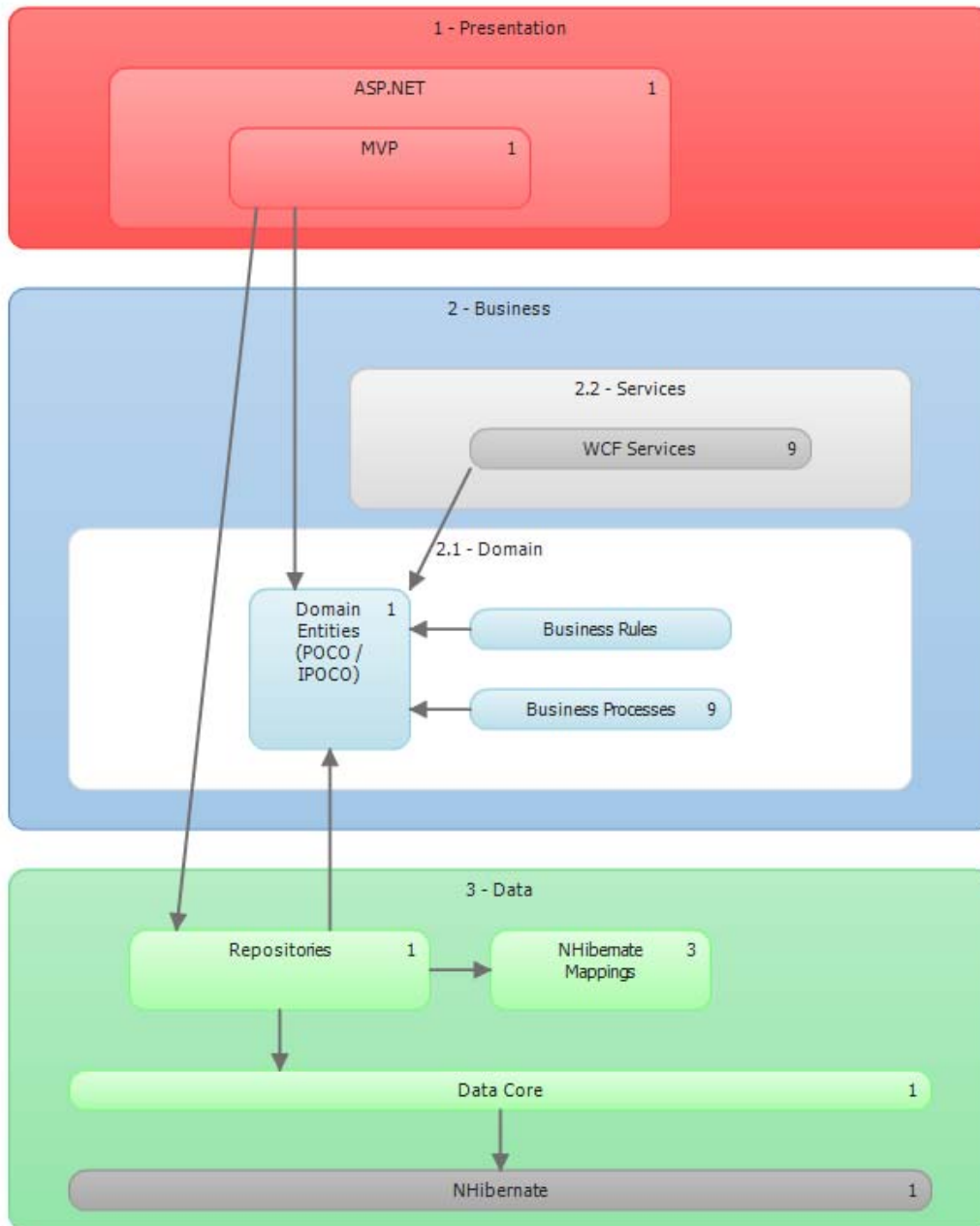


Figure 13: e-Freight solution architecture

The implementation strategy is a three-tier design with the client workstation representing one tier, a web server representing the second tier, and a database server representing the third and final tier. Key Characteristics are:

- A stand-alone ASP.NET Web application that supports complex data models
- Presentation and Business logic located on the same physical machine
- Browser interaction with the Web Server using standard HTTP GET and POST requests
- Application has full autonomy over the database schema

The diagram in Figure 14 displays the major architectural patterns used by this implementation strategy and the layers where those patterns are implemented.

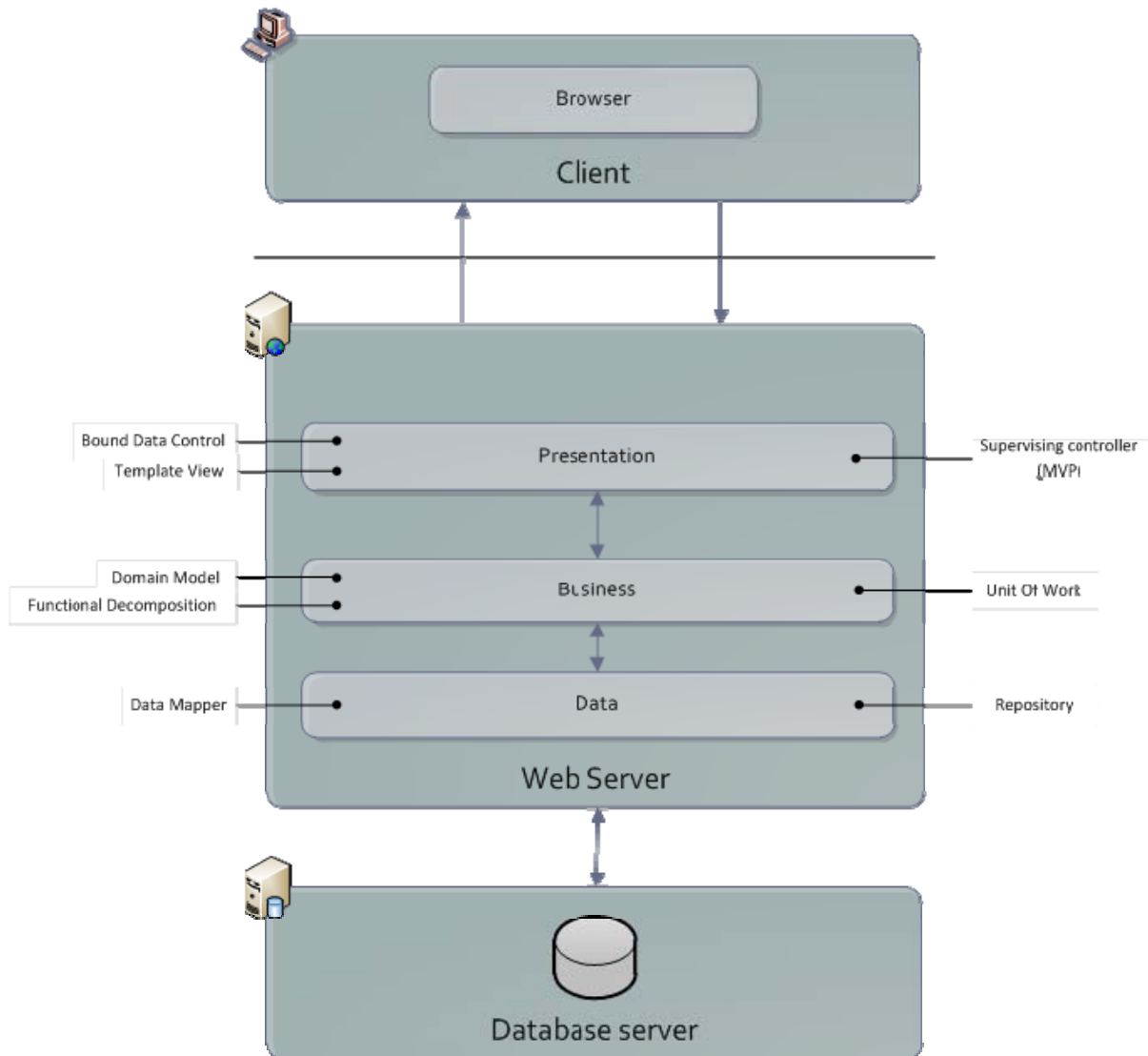


Figure 14: Architectural patterns used in e-Freight Solutions

The following is a summary of the patterns used by this scenario. Further details can be found in Appendix III.

- User Interface processing is handled by a Supervising Controller pattern
- The Template View pattern is used to define a common look and feel
- Controls are bound to objects that contain data
- The business layer uses a Façade pattern to implement a message-based interface between the presentation and business layer
- The Domain model pattern is used to model the application domain
- The Unit of Work pattern is used to keep track of everything that takes place during a business transaction that can affect the database. When the task is complete, the pattern determines how to alter the database as a result of the task.
- A Repository pattern is used to access the Data Mapper entities
- A Data Mapper pattern is used to map domain entities to the database schema and make the Domain Model persistence-ignorant

Figure 15 below represents the technical solution by replacing patterns shown in the Pattern Solution with technologies, interfaces, or objects that are used to implement the pattern.

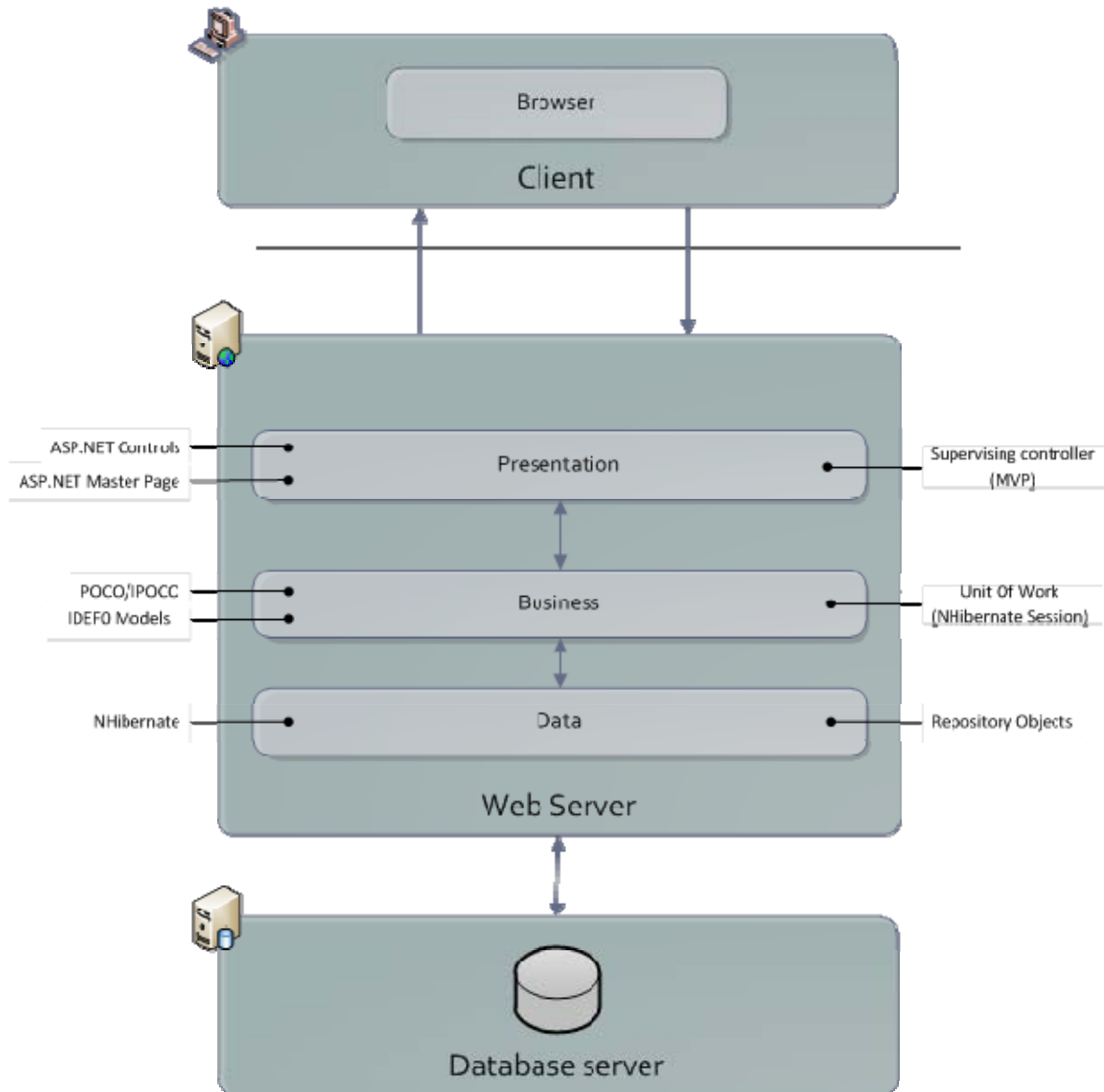


Figure 15: e-Freight NSW technical solution

The following is a summary of the key points relating to the technologies, interfaces or objects present in the technical solution. Please refer to Appendix IV for more details.

- Any browser can be used for this application scenario
- MVP libraries are used to implement the Model-View-Presenter pattern
- ASP.NET Master Pages are used to define a Template View
- ASP.NET Page, Server, and User controls are used to define the user interface
- Ajax technologies are used to provide a richer user experience
- POCOs are used to implement the Domain Model
- Repository objects are used to provide a data access interface
- NHibernate is responsible for mapping the Domain Model to the database schema
- The database used for this implementation is SQL Server

For each layer of the architecture, the MDE approach was applied and a set of models was created using the zAppDev development tool. The modelling techniques, in the order in which the models were developed, were:

1. IDEF1X97 Object Oriented Models (Domain Entities)
2. Entity Relationship Diagrams (Data Layer)
3. IDEF0 Functional Models (Business Process)
4. High Level Pseudo Code Specification Language (Business Rules)

The zAppDev tool was then used to build and configure the NSW applications from these models.

6.4 Models

A number of models have been mentioned in the explanation of the Model-Driven Engineering approach. This section contains some examples of the sorts of models that were used during development.

6.4.1 Use Case

Figure 16 depicts a high-level use case model for the NSW system, demonstrating the interaction of the two applications and the different users. As an example, a simple B2A reporting case is highlighted in blue. The Business Party uses the CRG to submit a Common Reporting Package. In turn, the CRG submits a pre-arrival declaration to the Information Exchange. Here, the information packages for the relevant Authorities are generated. An Authority System then obtains the information package by invoking a web service on the Information Exchange.

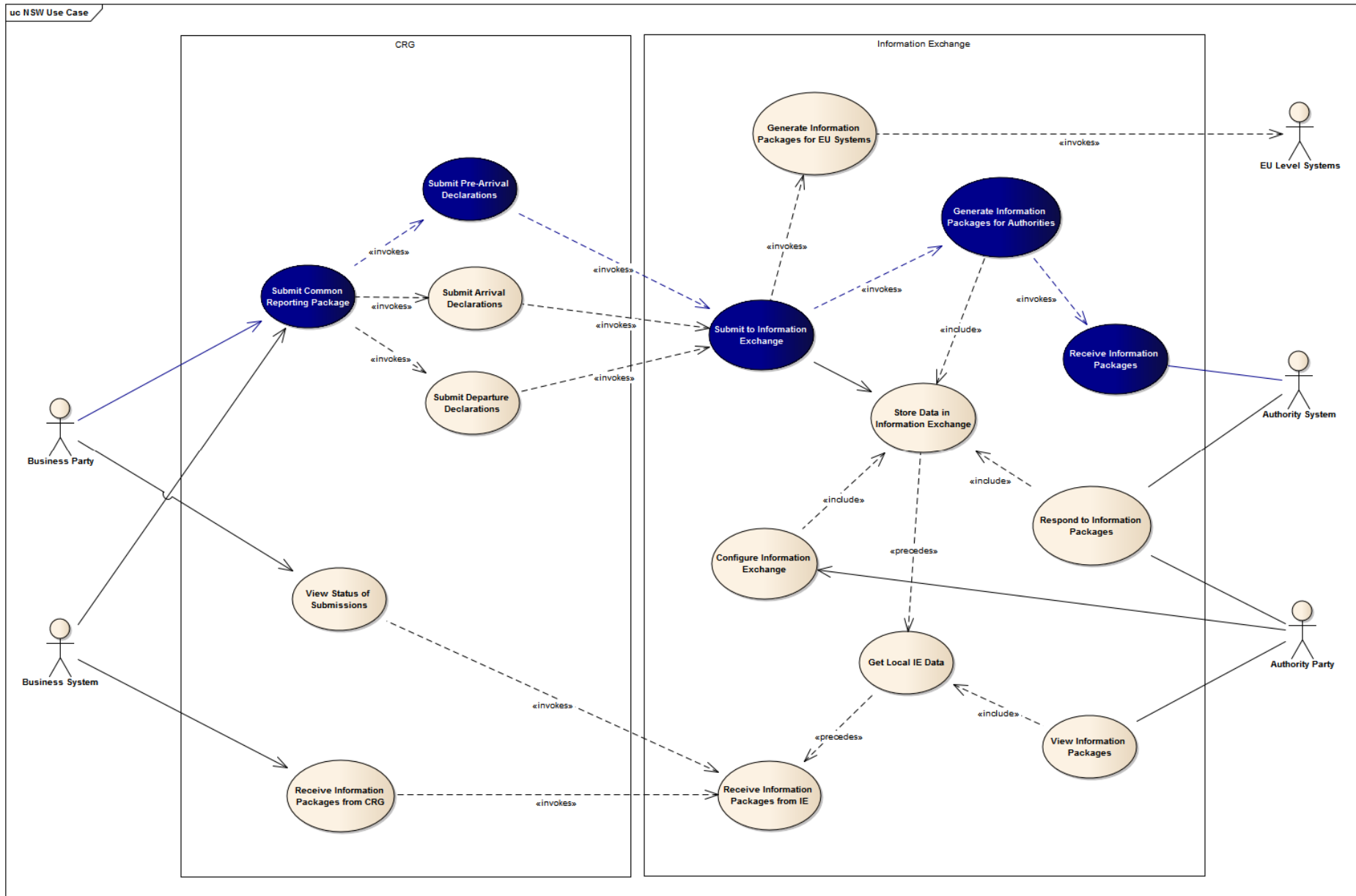


Figure 16: NSW Use Case Model

6.4.2 Database

Figure 17 shows an example of an entity-relationship model taken from the NSW solution. In the diagram, entities are represented by boxes and the lines represent the relationships between them. The example below shows that entities of type *Package* can have many *Dimensions* and that two of their attributes – *packageLevelCode* and *packagingTypeCode* – are references to entities in other tables (foreign keys).

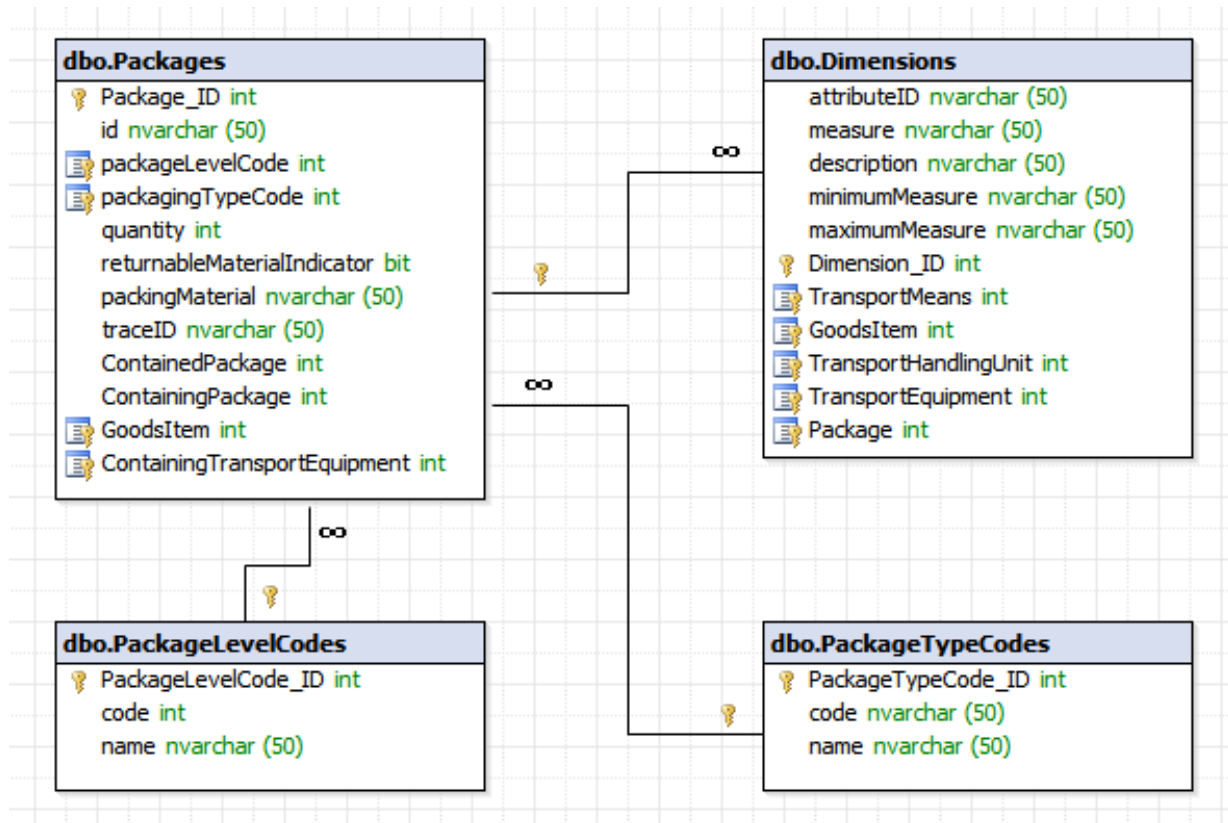


Figure 17: Example entity-relationship model for the Package domain entity

The foreign key symbols in the *Packages* table show that the *Package* entity also has relationships with *GoodsItem* and *TransportEquipment* entities, but these have not been included on the diagram in this instance.

6.4.3 Business Objects

Continuing the example of the *Package* domain entity, Figure 18 shows the *Package* business object model. The notation used in the business object models is IDEF1X97. In the case of the *Package* domain entity, there is a one to one mapping between the tables in the database model and the classes in the business object, although this is not always the case.

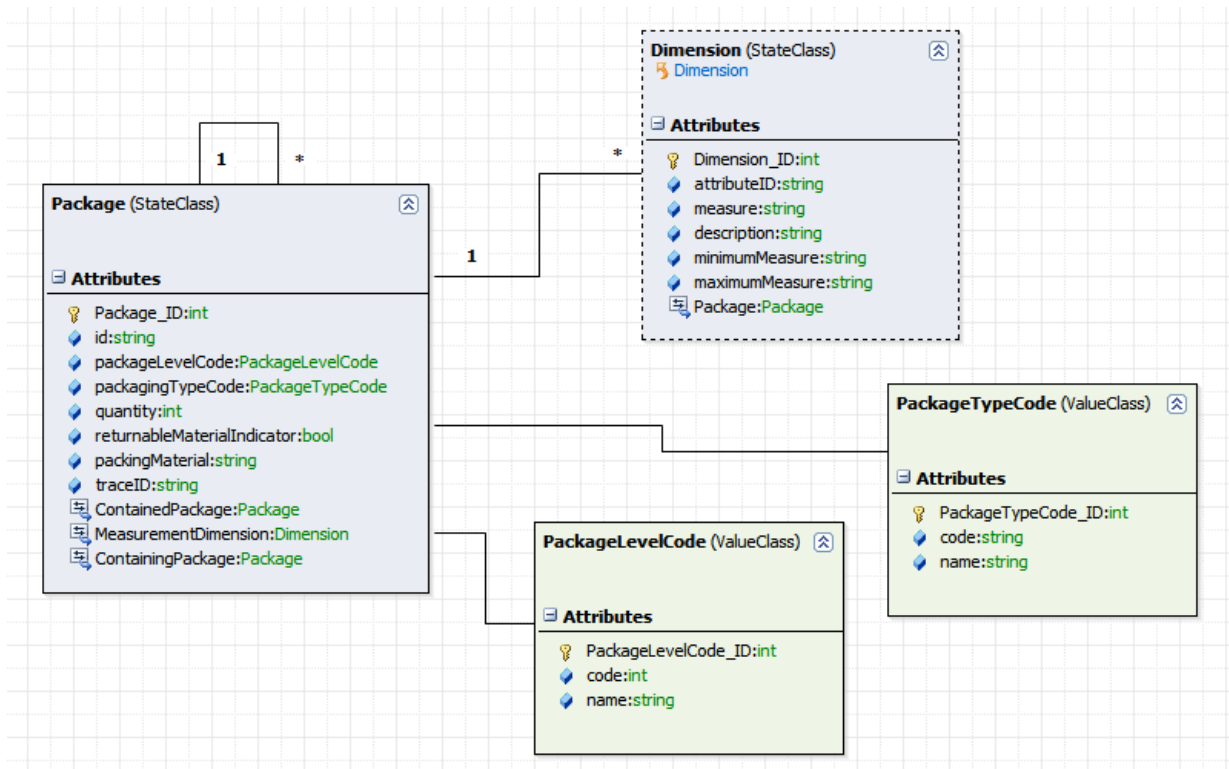


Figure 18: Example business object (IDEF1x) model for the Package domain entity

6.4.4 Business Processes

Processes in the e-Freight Framework are modelled using the IDEF0 notation (see deliverable D1.3a for more details on IDEF0 and the e-Freight Framework process models). As a result, IDEF0 has been implemented as the modelling language for processes in the development of e-Freight solutions.

Figure 19 shows one of the key top level activities in the e-Freight Framework: *Manage Regulatory Information*. In Figure 20, the top level activity is decomposed into lower level processes. The NSW solution plays a very important role in this activity as a regulatory information management tool. The Framework model defines common business processes for regulatory information management using the NSW and these have been captured in the IDEF0 process models.

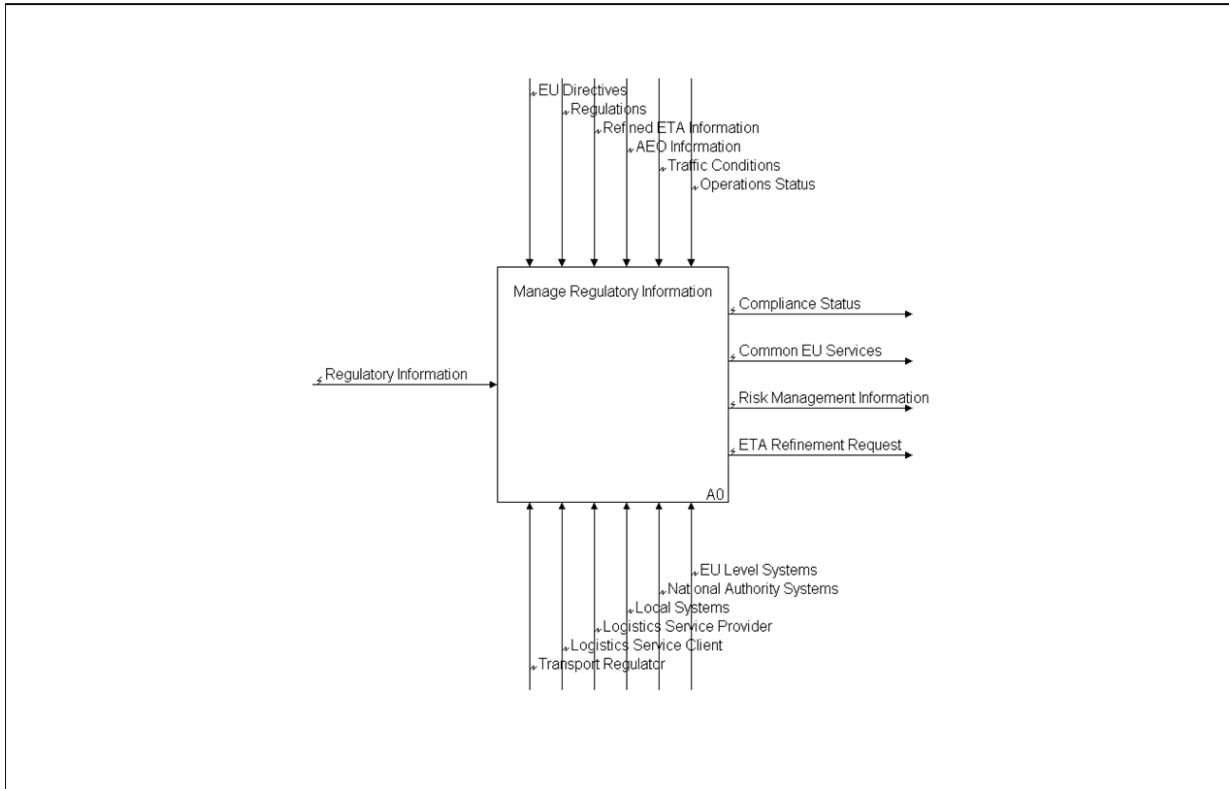


Figure 19: The top level e-Freight Framework "Manage Regulatory Information" activity

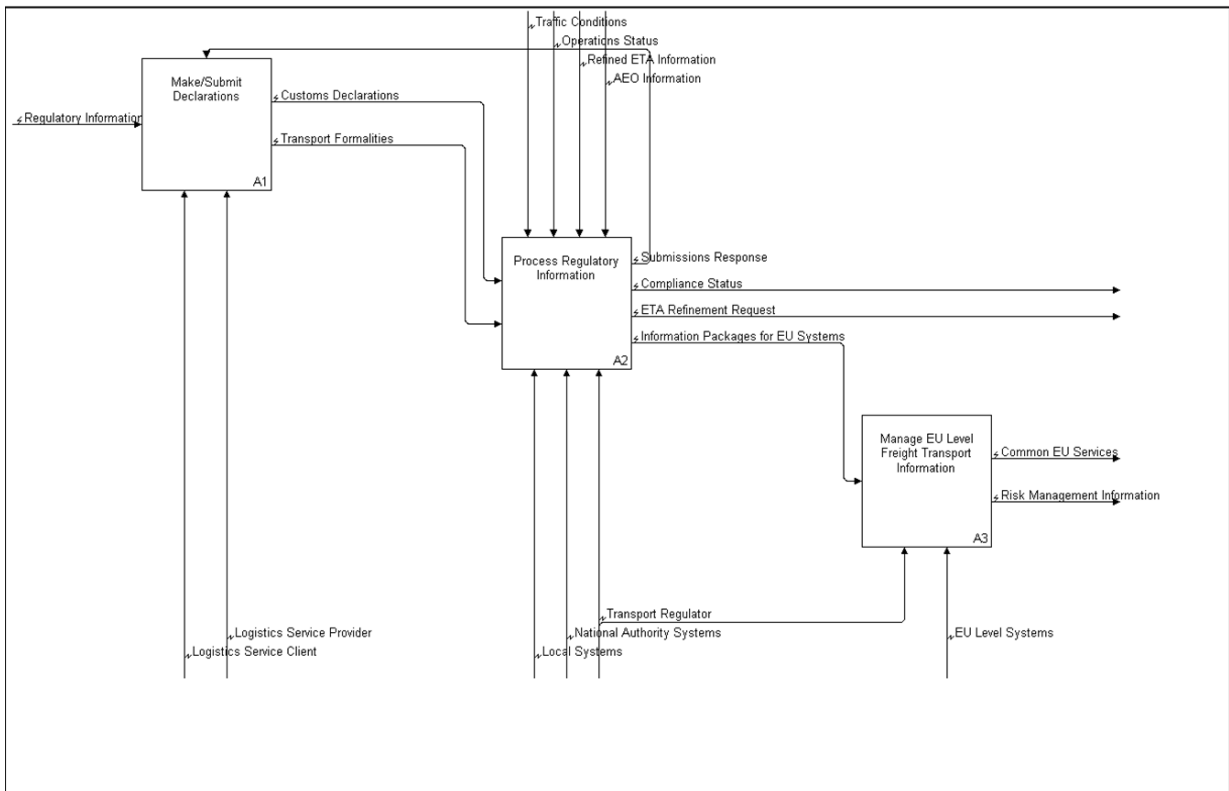


Figure 20: Decomposition of the "Manage Regulatory Information" activity

Due to its hierarchical nature, the IDEF0 language can be used to model processes on a very high level (as in the Figure above) or on much lower levels. The IDEF0 diagram in Figure 21 depicts the decomposition of the context diagram entitled “Respond to CRG input”. This is a much lower level activity and is a typical example of a process model which was developed for the CRG implementation. It defines what activities the CRG performs in responding to information input from business party users and the Information Exchange application.

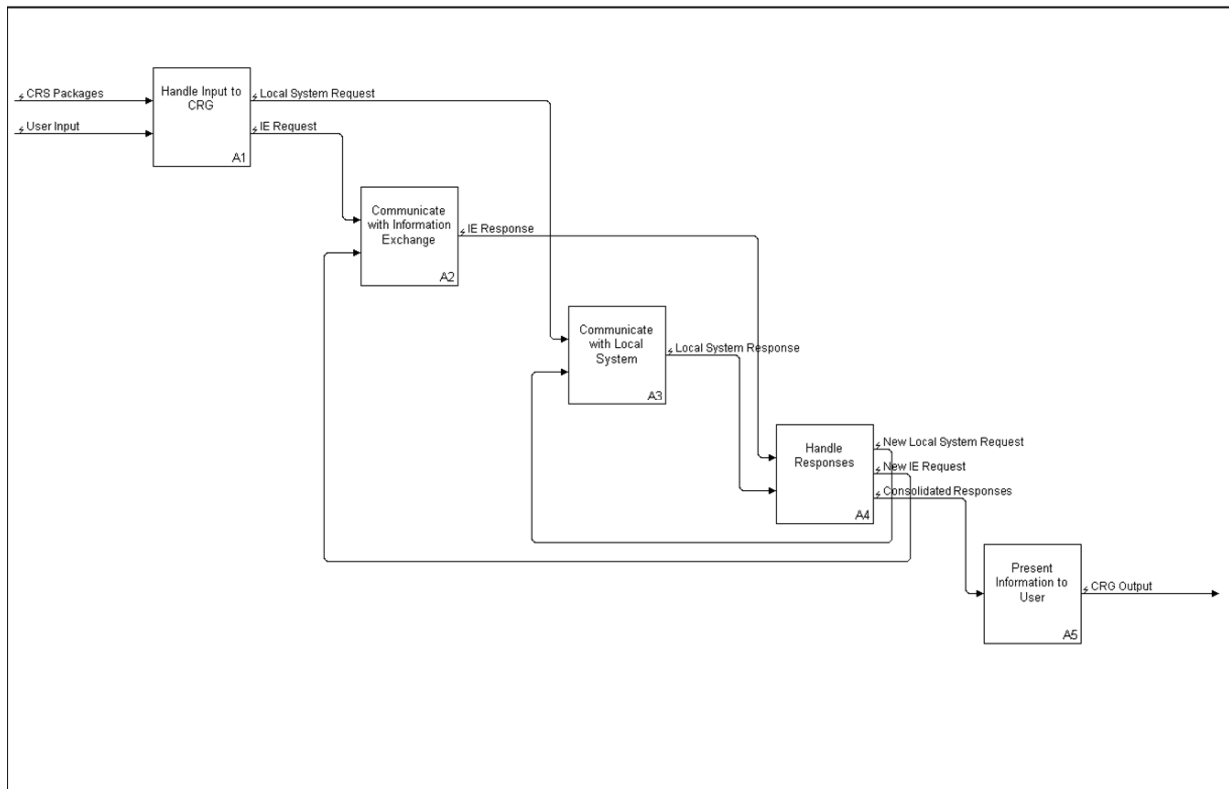


Figure 21: "Respond to CRG Input" activity decomposition

Activities are defined in the model for processing the incoming information (in the form of the CRS), forwarding information to the Information Exchange application and to a legacy system, if the CRG is being used in a distributed configuration. Further activities receive responses from the Information Exchange and present the information to the user, either through web services or via a web interface.

6.4.5 Application Referencing

Figure 22 shows the hierarchy from which all regulatory information management applications are derived. Models in the **MASTER** application can be inherited by other applications at all layers of the solution architecture, meaning that a change to a model in the MASTER application is automatically adopted by the applications that reference it. This radically improves maintenance of the different software applications and allows updates to be made in a single location. In e-Freight, it will allow specifications of standards and policies to be updated centrally and the changes to be (automatically) transformed into updated applications in Member States.

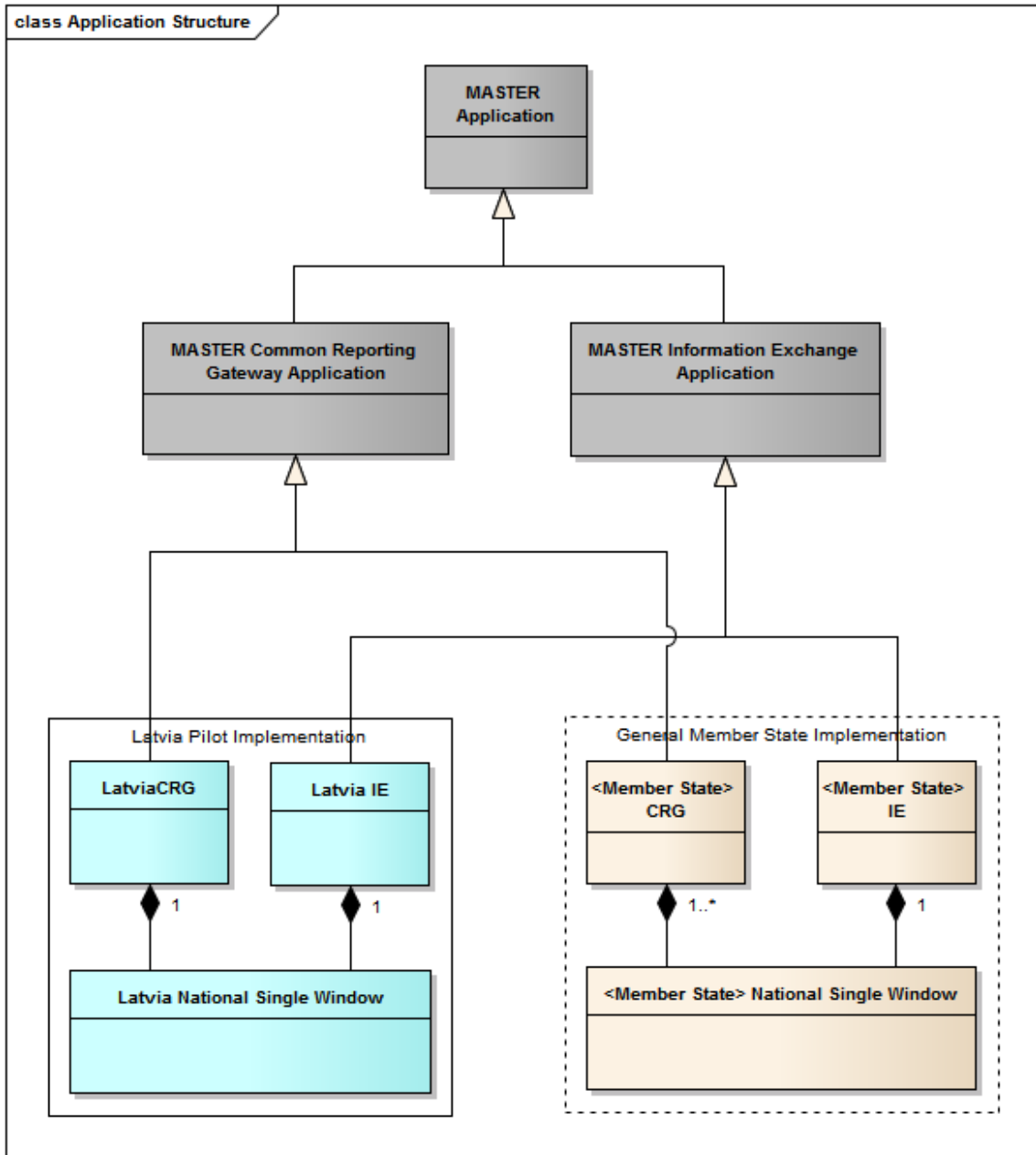


Figure 22: National Single Window application structure

The MASTER application represents functionality and data structures which are core to all regulatory information management applications. Thus, e-Freight compliance of all other applications is ensured through referencing the MASTER application. Similarly, the **Master Common Reporting Gateway** and **Master Information Exchange** applications embody the core functionality and data structures which will be common to the respective applications of each type. None of the master applications (coloured grey in Figure 22) are instantiated (i.e. they are never realised in a piece of software).

In order to implement a NSW solution, a Member State creates the CRG and IE applications by referencing the Master CRG and Master IE models, which in turn reference the MASTER application. This automatically ensures that the solutions are e-Freight compliant and hence compliant with all regulatory requirements. Each Member State is able to extend and customise the applications to their own specific needs, but the common core ensures consistent and standardised reporting systems across all Member States.

A general NSW solution (coloured brown in Figure 22) consists of an Information Exchange and at least one Common Reporting Gateway, as explained in section 4.3.4. For the Latvian pilot case (coloured blue in Figure 22), the e-Freight project has created a single (central) Common Reporting Gateway and one Information Exchange which have been customised to the specific needs of the National Authorities in Latvia.

6.5 Configuration and Deployment of NSW Reference Solution in Latvia

The NSW solution for Latvia consists of two ASP .NET web applications to implement the Common Reporting Gateway and Information Exchange, both of which were developed in the zAppDev development environment according to the general e-Freight solution architecture described in the previous section.

For deployment of the solution, a server was set up in the Maritime Administration of Latvia offices with the hardware and software specifications as listed in Table 4:

Hardware	
Chassis:	1U Chassis with 600W high-efficiency power supply
Processor:	2x Intel Xeon Quad-Core Processor E5645 (12M cache, 2.4 GHz, 5.80 GT/s Intel QPI)
Memory:	12GB, 1333 MHz DDR3 ECC Reg. DIMM (up to 48GB)
HDD:	2x 500Gb 7200 RPM 64MB Hot-swappable Up to 4x 3.5" Hot-swap SAS/SATA drives
Slots:	2 (x8) PCI-E 2.0 (1 in x16 slot) 1 (x4) PCI-E 2.0 (in x8 slot) 1 (x4) PCI-E (in x8 slot) 2x PCI 33MHz slots
Network:	2x Intel Gigabit LAN Integrated IPMI 2.0 with KVM and Dedicated LAN
Software	
Web/Application Server:	Windows Server 2008 R2 64 bit
Database Server:	MS SQL Server 2008 R2
Other:	Microsoft Office 2010

Table 4: Hardware and software specification for the NSW reference solution in Latvia

6.6 Results

This section will be completed in the second release of this deliverable, once the testing and evaluation phase has taken place.

6.7 Feedback

This section will be completed in the second release of this deliverable, once the testing and evaluation phase has taken place.

7 Feasibility of Using NSWs for Performance Indicator Statistics

Once fully operational, a large amount of data will pass through a NSW system on a daily basis. With large volumes of data, statistical analysis and reporting tools are vital to assess and understand the information contained in the system. In T3.3, a number of services will be developed for the NSW which provide Authorities with information analysis tools to support safety, security and environmental risk manage.

In addition to this, the NSW has potential use as a tool to monitor key performance indicator statistics of operations and parties within a Member State. In the second phase of T3.2, the feasibility of this use will be investigated further and the results will be reported in the second release of this deliverable.

8 Summary and Conclusions

This report has presented the background and context in which the e-Freight project began its development of the “next generation” single window concept for trade and transport. The current regulatory environment was assessed and current reporting practices in different modes and Member States were analysed. Throughout this process, initial high level requirements from the wider stakeholder community were captured.

An early demonstration of an EU single window for maritime reporting was a useful tool for gauging the feelings of stakeholders. Valuable feedback was gained in demonstrations, consultations and workshops, and in response to presentations made at meetings and conferences. Based on the feedback received, the concept was refined and presented again for validation. This process continued until a model was reached which satisfied all stakeholders.

The final e-Freight Next Generation Single Window concept consists of a multimodal National Single Window (NSW) deployed in each Member State and supported by a number of central EU services. The NSW system consists of two applications:

3. the Common Reporting Gateway provides a common interface for businesses to report all regulatory information in a standardised format, regardless of mode or country
4. the Information Exchange facilitates the distribution and sharing of information between Authorities within and across Member States, and with EU level systems

As part of the project Business Case 6, the final concept was to be implemented as a reference solution in Latvia. To this end, T3.2 worked closely with National Authorities in Latvia to identify the specific needs of each Authority. Extensive interviews and consultations were carried out to specify the design of a reference solution configured and customised for Latvia.

The final design was implemented as an e-Freight solution following the prescribed development methodology, based on a Model-Driven Engineering approach. The development phase consisted of using the zAppDev tool to model different aspects of the domain. These aspects corresponded to different layers in the solution architecture. The zAppDev tool was then used to build and configure the National Single Window solution for Latvia.

The National Single Window reference solution has been deployed on a server in the MAL offices in Riga and is now available for the Authorities to use and test. In the second phase of T3.2, the NSW system will undergo rigorous testing and evaluation as part of Business Case 6. Updates will be made routinely, based on user feedback, and new functionality will be added as part of the related task T3.3. The Central EU NSW Support Service prototypes will be implemented in the second phase, so the NSW integration with these modules will also be evaluated.

In parallel to the development of the NSW concept, T3.2 also undertook the development of the Common Reporting Schema. The CRS is a single, standardised document for reporting to Authorities across all modes and in all Member States. Its design is closely aligned with both the e-Freight Framework (whose elements are standardised in both UBL and UN/CEFACT) and the WCO customs data model. Furthermore, the structure supports the fundamental reporting principle of the NSW system which state that information should be supplied only once, at the earliest opportunity, and by the party who has it first.

In addition to the NSW and CRS development work, the University of the Aegean carried out an extensive review of the EMSA SafeSeaNet landscape as part of T3.2. The report from this work can be found in Appendix I.

8.1 Phase 2 of Task 3.2 and the Second Release of the Deliverable

As specified at several points throughout this document, some elements of the work will be reported in the second release of this deliverable. In particular, the second release will include reports on the development of the Central EU NSW Support Services and any updates that have been made to the NSW design as a result of the evaluation.

In addition, T3.2 will be investigating the incorporation of semantic technology components into the NSW implementation. The semantic technology is being developed in T2.3 and T2.4. Co-operation with the partners in these tasks has started and work has already begun on identifying opportunities where semantic technology can be exploited to enhance the functionality of the NSW. This will be continued into the second phase of T3.2 and the updated deliverable D3.2 will report on the successes and results of the research.

APPENDIX I: EMSA SSN – Review, Proposals and Recommendations

This appendix reviews the current EU maritime reporting landscape and analyses the requirements and results of the e-Freight National Single Window concept from the perspective of the EMSA SafeSeaNet (SSN) system. In particular, it asks what requirements must be met by the e-Freight NSW design and what impact the proposed concept will have on the evolution of the SSN system in the future.

Review of Current SSN Landscape

SSN evolution towards a single window for European maritime information exchange

In order to achieve secure electronic transmission of information ensuring access control, data integrity and availability, MS and European Commission should agree on a standardization of electronic formats and interfaces used by involved entities for submitting notifications to NSWs. In this context, guidelines can be adopted by the work of EMSA for PortPlus message, the work in progress in IMO FAL Committee, and standards like the ISO ISO28005-2 and the OASIS/ W3C standards related to digital security. We consider of prime importance that at international level or, at least at SSN MS level member states shall have a common agreement on issues like:

- A unique identifier to be included by shipping actors to all the notifications concerning events related to a ship voyage from Port (A) to Port (B)
- On the establishment of an EU –wide reference registry of ship operators, their fleets and their authorized agents at EU ports. This would be ideally become part of the SSN central system infrastructure accessible by all Actors concerned.
- On the establishment of:
 - A standard messaging interface for the submission of notifications to the single windows.
 - Should the adoption of a standard messaging interface would be proven not feasible, the creation of a directory accessible by the industry providing an inventory of interfaces that could be used (by the industry) to send notifications to the NSWs (e.g. this could include the WSDL files of secured web-services potentially to be utilized by the NSWs)
- On the establishment of:
 - A unique internet end-point at EU level used by the industry to submit notifications to the NSWs, and/ or (in case that MS would not agree on a common EU end-point)
 - The creation of a registrant at EU level listing the end-points offered by the NSWs to shipping industry for submitting notifications.)
- New data elements (included in new notifications e.g. security notification, waste notification, etc. not currently exchanged via SSN notifications) which are to be decided to be exchanged via SSN should be assigned a content sensitivity label and managed accordingly depending on the agreements to be made by the MS.

Current practices and implementation examples around Europe

Regarding the current practices and implementation examples around Europe e-Freight can consider the case of Norwegian Coastal Administration.

The Norwegian Government appointed the Norwegian Coastal Administration (NCA) to coordinate the development and implementation of the national component of this EU-wide system. Accordingly, the SafeSeaNet-Norway ship reporting system was established in 2005. The establishment of SafeSeaNet-Norway as a national ship reporting system was the first step towards simplifying reporting and information flow between ships and shore-based facilities in Norway.

The United Nations Economic Commission for Europe has described "Single Window" as "a system that allows traders to lodge information with a single body to fulfil all import- or export-related regulatory requirements" (UN Geneva – GE.03-30640-April-2003-2,000 ECE/TRADE/324).

The development of SafeSeaNet-Norway has been implemented as closely as possible to the above-mentioned definition. However, the current implementation emphasizes regulatory reporting requirements (Electronic Port Clearance¹) more than fulfilling information requirements related to international trade. Arrival, departure and HAZMAT reporting requirements are applicable to all SOLAS Convention ships (passenger ships and cargo ships of 300 GT and upwards) entering Norwegian territorial waters with the intention of crossing the Norwegian baseline or entering a Norwegian port. Currently the system handles on average over 7,000 ship reports every month.

SafeSeaNet-Norway enables Norwegian governmental agencies to receive, store, retrieve, and exchange information reported by SOLAS Convention ships in national waters. In broader terms the system contributes to maritime safety as well as port security and logistics.

Since the establishment of SafeSeaNet-Norway, a process of replacing traditional, non-electronic national reporting schemes, such as those related to customs, border control and port state control, has been initiated in order to make ship reporting more seamless and smooth for all stakeholders involved. The inclusion of notifications relating to customs and border control, also requires non-SOLAS ships to report through SafeSeaNet-Norway.

Norway views Single Window Systems as future components of the IMO e-navigation concept. Thus the development of SafeSeaNet-Norway will take into account the IMO e-navigation process. Since the national reporting system was established, the NCA has continuously encouraged other governmental agencies to participate in the NSW, and to implement their reporting requirements using SafeSeaNet-Norway. Through SafeSeaNet-Norway information reported by ships is distributed to the relevant governmental agencies according to their mandatory reporting requirements.

Mandatory pre-arrival declarations to Norwegian Customs were launched in SafeSeaNet-Norway in January 2011. Prior to the transition, Norwegian Customs annually received and processed approximately 180,000 paper based pre-arrival declarations. The integration of electronic reporting into SafeSeaNet-Norway eases the administrative burden for Norwegian Customs personnel, mariner and agent. Electronic notifications also provide Norwegian Customs with relevant vessel information at an earlier stage, giving the agency more time to organize and plan operations in Norwegian waters.

SafeSeaNet-Norway is now being utilized beyond its original intended purpose because of its ability to receive, store, retrieve and exchange information. This is exemplified by the Norwegian Climate and

Pollution Agency, which currently uses derived information to monitor for potential illegal transport of hazardous waste in 160 port terminals. Also the Norwegian Radiation Protection Authority and the Norwegian Coast Guard are utilizing SafeSeaNet-Norway for accident prevention and maritime safety and security within the Norwegian waters.

Current SSN architecture and proposals for the incorporation of more efficient management tools and applications

SafeSeaNet is accessible for the user's community either through the Internet or the S TESTA network. SSN is designed to have a high level of reliability and security. Following the Change Management Framework, SafeSeaNet interfaces are subject to upgrades, amendments and technical improvements, in order to keep the system updated, correctly implemented and to cope with continued evolution in the national, international or the Union's legislation.

The SafeSeaNet relies on an architecture made upon two main levels:

- National SafeSeaNet system
- Central SafeSeaNet system

The LCA is a user that may act as data provider as well as data requester at local level. It is a recipient of the SSN information and feeds the SafeSeaNet system with information. An NCA assumes on behalf of each participating country, the responsibility for SafeSeaNet management at national level. It is in charge of verifying and maintaining the national network.

The information is provided by using national SSN systems in form of notifications to the central SSN system. Authorized users within the SSN Community can retrieve information related to these notifications. The central SSN system locates and retrieves this information and provides it to the data requestor.

Enhanced SSN network and applications management toolkit

The SSN system includes several applications (already under operations or under development). The applications are designed/ implemented with Service Oriented Architecture logic.

The SSN applications are:

a. The European index server.

Under this application certain core services are implemented like the SSN textual interface, the XML/SOAP messages interface, the SSN management console and the ship particulars verification and validation tools.

b. The SSN tracking information and real time exchange system (STIRES) module

Under this application certain core services are implemented like the SSN Graphical interface (SSN GI) and SSN Streaming interface – SSN SI)

c. The SSN Data Warehouse (under development)

d. The SSN Single sign-on application

e. The Reference Vessel registry of SSN

f. The SSN dashboard application (under development)

g. The SSN accident module (under development)

Interoperability and backward compatibility with the existing SSN can be achieved by the implementation of an appropriate messaging mechanism. Following Member States decisions at SSN11 Workshop, a new messaging mechanism must be implemented, for the SSN EIS, based on SOAP compliant Web Services.

As suggested, the implementation should be based on Spring Web Services. Spring Web Services aims to facilitate contract-first SOAP service development, allowing for the creation of flexible web services using one of the many ways to manipulate XML payloads. The contract-first approach offered by Spring-WS allows the development of the Web Service starting from the definition of the web service given by the respective WSDL file.

In SSN EIS case, the Spring-WS are to be deployed as simple Web Modules. The Web Module defines a Dispatcher Servlet which is an alternative to the standard Spring-MVC Dispatcher Servlet with separate Adapters for the messages and the wsdl definitions. The Servlet detects automatically any wsdl definition defined in its application context. The wsdl is exposed under its bean name. The servlet also detects Endpoint Adapters which are interfaces implemented for each endpoint type in order to handle separate SOAP requests. Furthermore, Spring-WS provides Maven support. A Maven module generated by the Spring Web Services artifact, can be added to the existing ssn-xmlprotocol-app and can be declared as WebModule inside the existing enterprise application.

SafeSeaNet Integration - Issues for consideration

According to the provisions made in the directive on reporting formalities

1. The NSWs established by the MS latest by June 2015, will link SafeSeaNet, e-Customs and other electronic systems and shall be the place where, in accordance with the Directive, all information is reported **once** and made available to various competent authorities and the Member States.
2. The list of reporting formalities identified in the Annex of the directive does not cover the whole spectrum of ship reporting requirements according to the directives. The present draft of the directive's annex does not make reference e.g. to articles 16/17 of the Directive 2002/59/EC (consequently the incident reporting along the plan route of the vessel is not covered by the provisions in the Directive).
3. Member States shall ensure that information received in accordance with the reporting formalities provided in accordance with a legal act of the Union is made available in their **national** SafeSeaNet systems and shall make relevant parts of such information available to other Member States via the SafeSeaNet system. Unless otherwise provided by a Member State, this shall not apply to information concerning the EU Customs Codes and the Schengen Borders Code.
4. The Member States shall ensure that ships falling within the scope of Directive 2002/59/EC and operating between ports situated in the customs territory of the Union, but which do not come from, call at or are headed towards a port situated outside that territory or a free zone subject to type I controls under customs legislation, are exempt from the obligation to send the information referred to in the FAL forms 1 to 6. However the exemption shall be granted without prejudice to the applicable legal acts of the Union legislation and the possibility that Member States may request information included in the FAL forms.

The above provisions impose a number of requirements/ constraints for the e-Freight architecture, the CRID applications and CRI. These are listed hereafter.

(Refer to **ShipReporting_Req_9** above)

Ships representatives might be required to continue providing incident information directly to competent authorities at local level, e.g. SSN coastal stations. The e-Freight architecture should cater for this.

ShipReporting_Req_15

- (a) A system has to be established at pan-European level to link NSWs to:
 - The SSN;
 - The European e-Customs platform;
 - The rest of systems to be established in the future by the Union in line with the Integrated maritime Policy (e.g. EUROSUR).
- (b) Given the nature of systems to be linked, ideally this system (identified as European Union's Reporting Interface (EU_RI) need to be very loosely coupled with the pan European system for B2C reporting (identified as CRI earlier and below).
- (c) e-Freight architecture would carefully analyse and make proposals the information flows interrelating CRID applications at business level, CRI at B2A pan-European level, MS_RI at A2A national level and EU_RI at A2A transnational level.
- (d) Given the provisions in the new FAL directive, the linking of CRI/ MS_RI/ EU_RI should be achieved via the NSWs. This fact imposes some constraints in harmonizing approaches for ship reporting.

ShipReporting_Req_16

Providing specific details concerning individual voyages of ships under scheduled services under a "granted exemption" regime, imposes several requirements to shipping companies and Authorities:

- (a) Competent authorities granting an exemption should relay/ exchange the exemption lists via SSN;
- (b) There is a need to correlate information in exemption lists with ATA/ ATD notifications (no exemption granted for these as per PSC directive)
- (c) Shipping companies should keep records of the details concerning individual voyages in an electronic system to make them available on 24/ 7 basis without delay in case of a request by the competent authority that granted the exemption. This would allow to the authority to provide relevant info to authorized requestors (at national,

international level)

The e-Freight architecture should cater for the above. Refer also to ShipReporting_Reqs 11 and 12

ShipReporting Req 17

In light of requirements mentioned previously (in this or previous paragraphs) related to:

- exemption lists and provision of information on exemptions in case of requests
- notifications on Ship Calls and Incidents

e-Freight CRID applications should aim to provide solutions to industry that will facilitate the automatic generation of required Transport Documents and notifications addressing specific reporting formalities to satisfy requirements in the prevailing circumstances (scope, context, mode, country).

The concept of the CRID, taking as a basis the ship reporting formalities and requirements, is illustrated in the schema below:

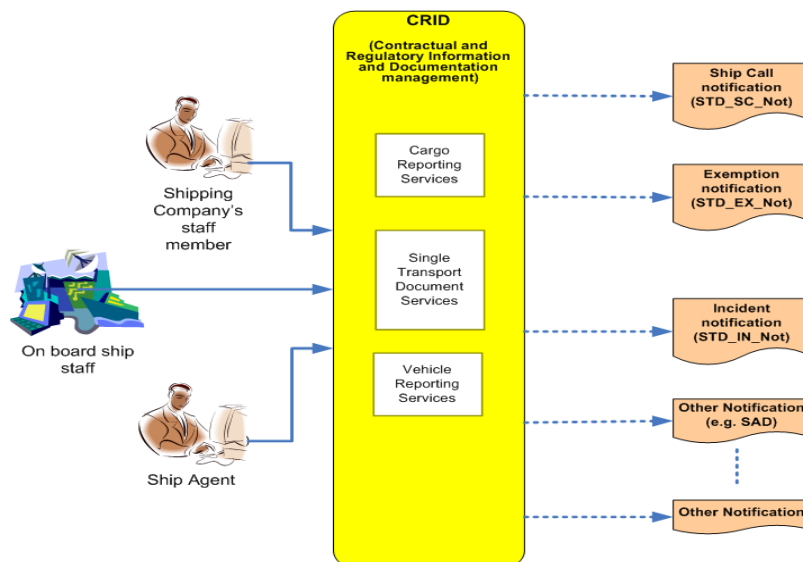


Figure A1. CRID - conceptual approach based on ship reporting requirements

An approach to e-Freight architecture in light of Single Window, SSN evolution and e-Maritime developments

As discussed in the IMO document FAL 36/5/1 that includes a first draft of the guidelines for setting up a Single Window system for maritime transport there are various ways to implement physical networked systems interconnecting ports, NSWs and commercial operators.

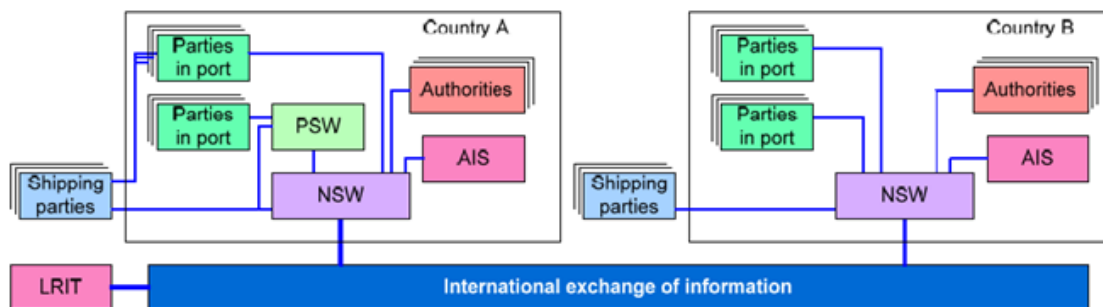


Figure A2. SW for maritime transport - example in FAL 36/5/1

In the example:

- A country A has ports where authorities are linked via port single windows handle interaction with shipping parties for port clearance as well as other ports where shipping parties have direct interaction with authorities for port clearance procedures. .
- A country B has a common national single window used both by authorities and shipping parties. Shipping actors interact with authorities for port clearance via the NSW.

The model to be chosen, as stated in the IMO document depends on what forms of information exchange national legislation allows.

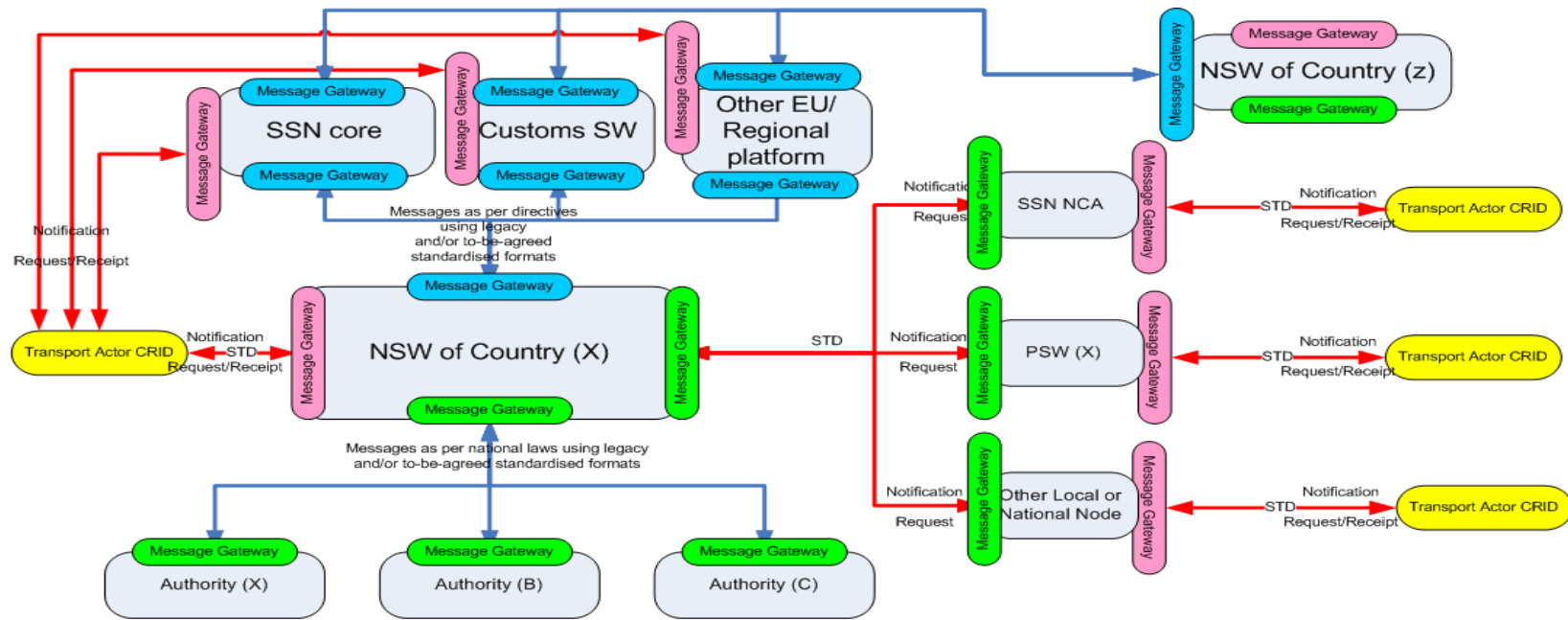
An international information exchange mechanisms is also shown in the picture above. As stated in the FAL 36/5.1 one example of this is the SafeSeaNet that is being used in Europe.

In light of the reporting requirements associated to SSN/ e-Maritime listed in the previous paragraphs of this section and IMO guidelines in the reference documents as well as other recent deliverables of the IMO FAL committee (e.g. 36/5/2, 36/5/6), this sub-section introduces a vision (refer also to figures in the next page) on:

- The use of SCDs and role of the CRID in this respect
- The implementation of CRI
- The principles for interpretability between CRID, CRI, MS_RI and EU_RI in the context of e-Freight conceptual architecture.

The guiding principles for the proposal are:

1. As far operations related to electronic port clearance the European model for single window implementation is to be aligned with the guidelines of IMO and the legal acts of the European Union;
2. The model should be expanded to cargo clearance for import/ export operations;
3. The model should facilitate the implementation of eMaritime/ Integrated maritime policy and Motorways of the Sea. Thus the model should, to the extent possible and where applicable facilitate the exchange of incident reports and information concerning scheduled services.



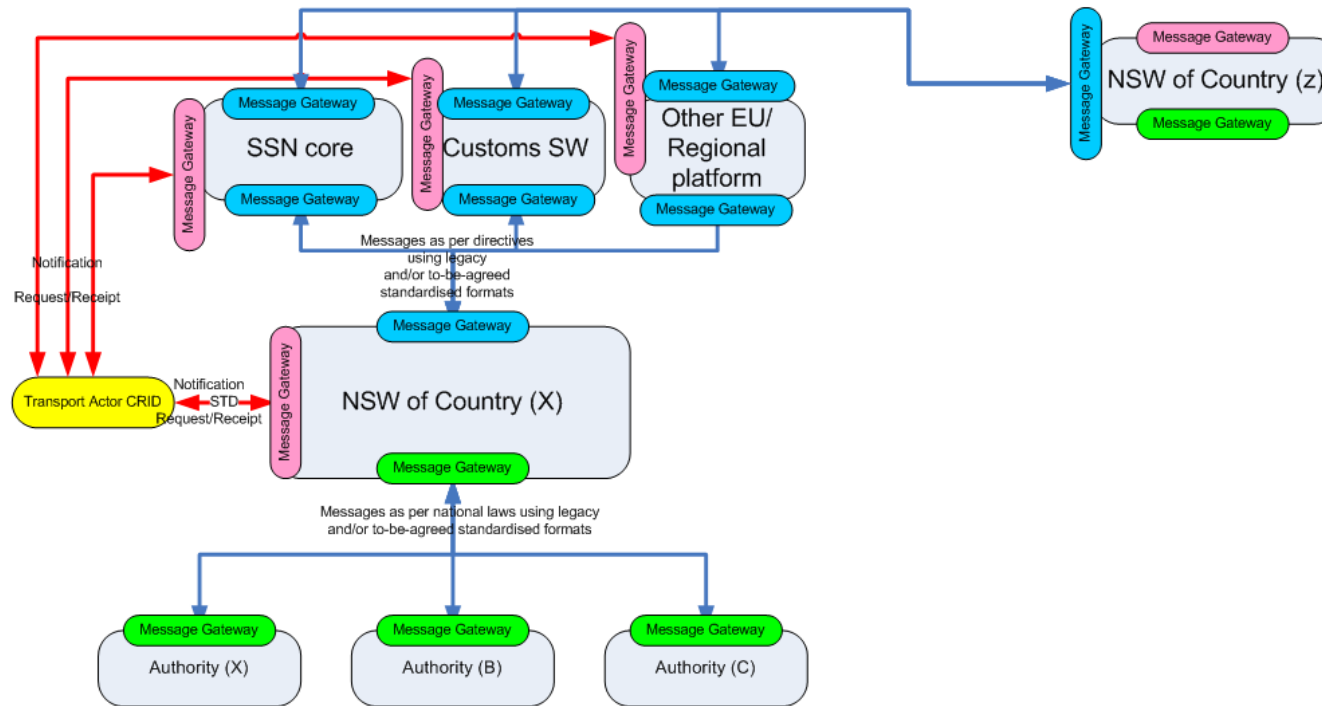
Principles:

1. A single reporting entry point for B2A transactions for each transport business actor
2. A single coordination mechanism per country for processing / dissemination of the data submitted by shipping industry
3. A2A functions added as per the evolving legislative framework – Architecture open to encompass new standardised formats but back-wards compatible with existing legacy mechanisms

Legend:

1. In yellow background components of the Transport actor CRID CRID
2. In blue background components of the EU A2A Reporting interface EU_RI
3. In green background components of the A2A reporting interface at national level MS_RI
4. In magenta background components of the B2A Common reporting interface CRI

Figure A3. A ship-reporting based paradigm / Common reporting interfaces and CRID - Conceptual approach/ Corresponds to country (A) example in FAL 36/5/1

**Principles:**

1. A single reporting entry point for B2A transactions for each transport business actor
2. A single coordination mechanism per country for processing / dissemination of the data submitted by shipping industry
3. A2A functions added as per the evolving legislative framework – Architecture open to encompass new standardised formats but back-wards compatible with existing legacy mechanisms

Legend:





1. In yellow background components of the Transport actor CRID  CRID
2. In blue background components of the EU A2A Reporting interface  EU_RI
3. In green background components of the A2A reporting interface at national level  MS_RI
4. In magenta background components of the B2A Common reporting interface  CRI

Figure A4. A ship-reporting based paradigm / Common reporting interfaces and CRID - Conceptual approach/ Corresponds to country (B) example in FAL 36/5/1

Based in the models presented in the figures:

1. European countries may adopt the approach as per figure A3 or A4 best suited to their situation (legal, organizational/ operational)
2. To support any potential choice to be made by the European countries, the CRI is to be realized by “service/messaging gateways” that could be located at:
 - Local level (e.g. Coastal stations / LCAs of SSN, PSWs, etc.);
 - National level (NSW and, if applicable – based on a Member State choices “mode-specific” SWs e.g. SSN NCA, rail mode NCA, etc.); and
 - International level (server (s) whose address and location is to be defined by the EC. We propose gateways of CRI to be co-located/ hosted at the centers hosting SSN the e-customs SW, the EUROSUR core, that is in any location hosting systems which now or in the future shall interact the NSWs).

The benefits/ justifications for installing CRI nodes in each European System is discussed below. However the reader should note that the principles discussed herein even if EC and/ or the MS will not accept such a proposal.

3. Each business actor will interact with the CRI via a CRID application. The CRID will enable the creation and transmission of SCDs aiming to satisfy contractual requirements in the prevailing circumstances (scope, context, mode, country). As was described in the SCDs generated by CRID will include e.g. the ShipCall notification as per **ShipReporting_Req9**.
4. Depending on the applicable circumstances the CRI would allow the submission of SCDs via:
 - A web interface; or
 - A web-service; or
 - Via e-mail; or
 - Any other “technology-independent” electronic data interchange mechanism aligned with the IMO recommendations and guidelines.
5. SCDs structure, message format should allow the transmission of public, commercially sensitive and confidential/ personal information.

<p>Digital <u>signing of messages</u> should be analysed by the e-freight, among or in combination with other available options, to guarantee security and quality of service.</p>

6. The SCDs to be generated by the CRID applications of shipping companies must include the required information that is available for the time and place (phase of the ship voyage) of its submission.

7. The receiving node will automatically forward the SCD to the NSW of countries where the Competent Authorities entitled to be notified reside. The NSW will decompose the message into several modules / notifications, specific for each competent Authority and forward them to those concerned. In parallel NSW will extract the essential information and provide notifications to SSN core application, according to the agreed formats and procedures between Member States.

An illustration of the proposed architecture is depicted in the following Figure A5.

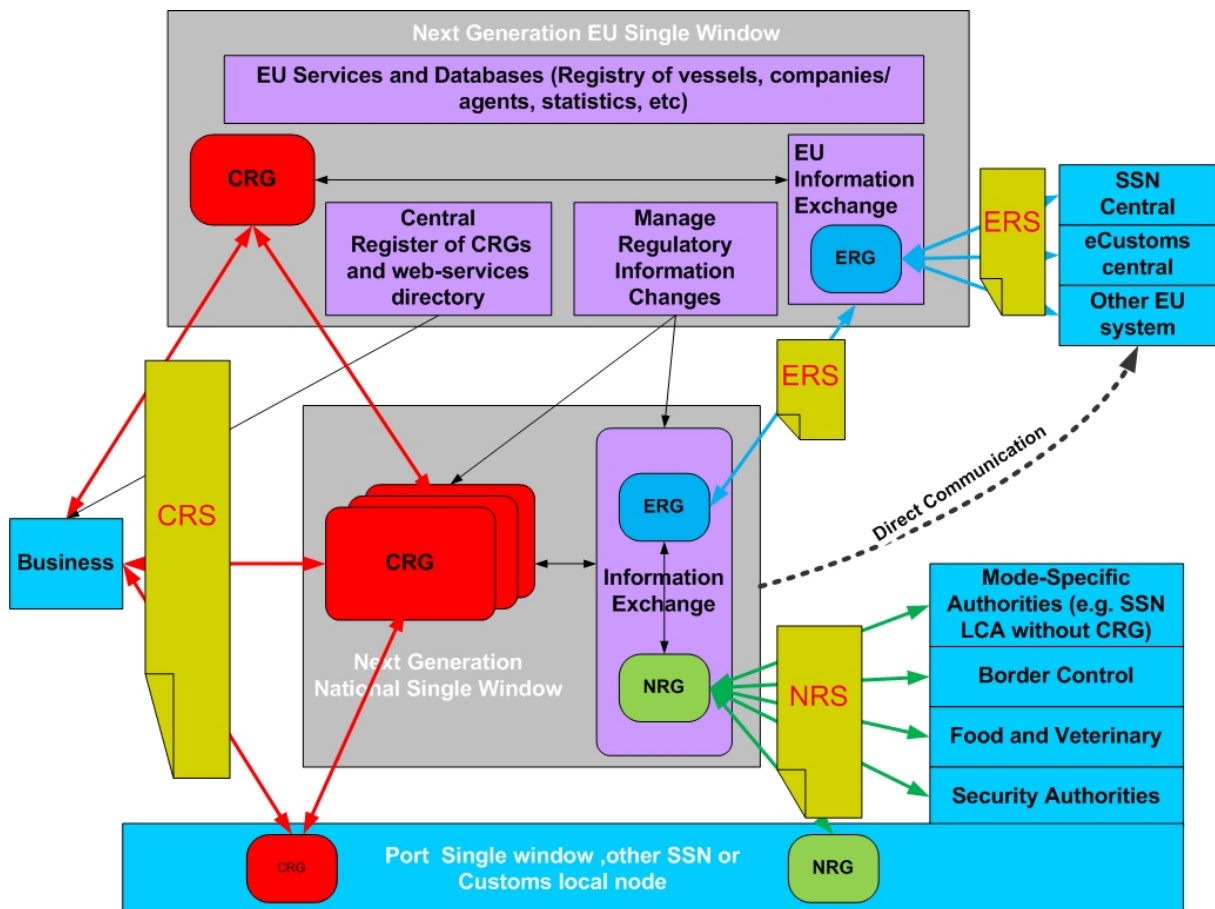


Figure A5. Single Window and SSN evolution proposed Architecture

In the context of the e-Freight project recommendations (propose functional specifications) are foreseen for the following modules:

- The Common Reporting Gateways (CRGs)
- The National Reporting Interface (NRI), and
- The European Reporting Interface (ERI)

In the proposed architecture SSN central would connect to NSWs via the ERI. The basis would be the present PortPlus / Shipcall messages that would be involved to address the requirements introduced

by the directive on reporting formalities. CRGs must be installed at EU level too (e.g. to facilitate reporting from ships, which occasionally call to EU ports and their operators are not familiar with EU national procedures) as well as for back-up purposes (e.g. some MS unable to comply with the directive requirements. CRG at EU level could facilitate ship reporting to these MS). Furthermore, what is called the EU single window should encompass the functionality of the system that as per directive on reporting formalities relates with statistics on maritime traffic at EU waters.

Finally, ships should be able to submit notifications directly, not only via a web application, but also via web-services and / or e-mail. In this respect, reader should refer to the proposals under discussion in the FAL committees of IMO (e.g. the Korean proposal on the messaging framework).

Technical Design Requirements

Regarding the technical design and architectural principles we propose the adoption of a Service Oriented Architecture (SOA). SOA is a software design methodology for implementing an information system comprised of interoperable and reusable services. In other words, SOA implements a distributed information system so that services can be discovered and used within multiple, separate sub-systems across several business domains. Flexibility is enhanced through the loose-coupling of services. Interoperability is enhanced across heterogeneous software applications by using a well-known standard for defining and accessing these services. That combination, flexibility and interoperability, enables agile adaptation to rapidly changing business environments.

In principle, a Single Window system for transport business should be independent of the hardware system, scalable in its structure, and, to the extent possible, reusable. It must also define all the necessary business processes and low-level functions as simple service components. These components are stored in a service repository. They can be used as is, or composed (assembled) into more complex services as needed. Users and other organizations can access this repository using standard communication protocols such as TCP/IP, HTTP, WEB Service, and SMTP.

The set of services needed to process that data, and the sequence in which they are executed, are determined by additional external logic typically written in Java/C# or any other object-oriented language.

Future system scalability is facilitated using well-known and well-tested features of SOA, including platform and application independence. Therefore, new functions or services can be added to a system with minimal modification of its existing components systems. In addition, SOA facilitates system interconnection among organizations or Single Window systems because SOA standards are used to define both the services themselves and the communications among them.

In service-oriented architecture (SOA), the concept of service can be understood as a software component that executes a business process from a business point of view. In SOA, services are loosely coupled, platform independent, and neutral interface. Therefore, the effects on other services are minimized when any particular service is changed. Because of this, a system based on SOA is agile in dealing with business changes and its components can be reused in many different combinations.

Main features of SOA include:

1. Model-driven development methodology.
 - a. Developing a software system is an abstraction of complicated business.
 - b. Process of making abstract business implementable.
 - c. Use of Unified Modeling Language (UML) as a modeling language.
2. Service-oriented development methodology
 - a. "Service orientation" is based on the "separate of concerns" in software engineering theory. In other words, it is based on the concept of dividing and classifying a big problem into individual areas of interest.
 - b. Services are platform independent and accessed by applications in a standardized way.
 - c. Services are reusable and loosely coupled.
 - d. Services can be combined.

Proposed model and Conclusions

Following an analysis of the current state of play in relation to SSN and e-Maritime, previous sections have presented a thorough analysis of requirements impacting to the e-Freight architecture from a ship reporting perspective.

The sections introduce a model for CRID, CRI and NSWs that is based on a revision of the Maritime Information management approach of MARNIS considering the recent evolution in the legislative framework (third maritime package and new "FAL" directive). This concept foresees the introduction of CRI as a distinct "service/messaging gateway" that, if adopted, should be implemented at all the locations hosting a component of the SSN network at local / national/ international level. Such a CRI would allow shipping/transport actors to submit (via a web interface or via a web-service and/ or via e-mail and/ or any other appropriate technology-independent, SOA-enabled electronic data interchange method) SCDs prepared in accordance to the prevailing circumstances (scope, context, mode, country). The receiving CRI node will automatically forward the notification to the NSWs of countries where the Competent Authorities entitled to be notified reside. The NSW will decompose the message into several modules / notifications, specific for each competent Authority and will forward them to those concerned.

To ensure the highest level of security for A2A transactions, the reporting interfaces (MS_RI and EU_RI) should be separated from the CRI. Interconnection of CRI, MS_RI and EU_RI is achieved only via the NSWs,

The NSW of the country receiving an SCD of maritime-transport relevance will extract the information required, as per applicable legal acts of the Union, and generate the information to be relayed to / exchanged with the Authorities from other MS via SSN.

The implementation of the proposed model certainly require decisions to be taken by Member States at operational level (by the High level group of SSN and the technical SSN group, coordinated by EMSA) but it does not depend on further changes in the legislation. The technical and operational feasibility of the approach could be investigated within the eFreight project, during the course of execution of the business cases foreseen in e-Freight's DoW.

As regards the interdependencies of CRID, CRI, NSWs and SCDS the following issues are mentioned:

1. The SCD structure and the specifications for the CRID and CRI must be agreed by all Member States (MS) at SSN operational level (EMSA/SSN group). eFreight would develop a proposal for the relevant specification and would seek consultation with EMSA for potential consideration by the SSN work-group;
2. Each shipping actor must be provided with a CRID application enabling the generation of SCDs; thus e-Freight may provide a demonstrator of this application.

Each MS should implement an NSW in line with the provisions made in the new FAL directive. This could be realized as an upgrade of the existing SSN NCA systems and/or an independent system linked to the SSN NCA system. The NSWs can be implemented following a SOA based approach to facilitate their integration into the existing MS applications. e-Freight would provide a demonstrator of functioning CRID, CRI and NSW implemented using the tools incorporated within the e-Freight framework.

APPENDIX II: Latvian Authorities' User Requirements

The table below records the results of extensive interviews and consultations with representatives of the National Authorities in Latvia relating to their requirements for the National Single Window solution.

ID	Authority	User Requirement	Description
UR1	Coast Guard	<i>The NSW shall electronically submit all information required by the currently Latvia SSN application</i>	The Latvia SSN application is well established for maritime reporting requirements so the NSW must use the existing interface to pass information. This includes information contained in the 6 IMO FAL forms, Declaration of Health, Declaration of Dangerous Goods and 24h Pre-Arrival Security Notification
UR2	Coast Guard	<i>The NSW shall have a connection to a trusted and up to date ship database to ensure that entered ship information is accurate</i>	This requirement ensures that information about ships, such as gross tonnage and length, cannot be falsified (deliberately or otherwise), as these parameters are used to calculate taxes. The Latvian SSN system contains a database of ship details, but it is two years old so may contain errors
UR3	Coast Guard	<i>The NSW shall have an intuitive and robust method of selecting ports</i>	Currently, there is confusion when Ship Agents enter port names or codes into the system. This arises because port names vary across different languages (e.g. Copenhagen, København) so searching alphabetically is difficult. Problems also arise when two ports in different countries share the same name (e.g. St Petersburg port in Russia and USA). Ship Agents can easily enter the wrong UN LOCODE because they have found the wrong port. A further complication is that the LOCODE database also contains errors!
UR4	Border Guard	<i>The NSW shall require information about passengers or crew who are 3rd country nationals to be submitted</i>	Currently, this information is not in the Latvia SSN (as it is not part of the IMO FAL forms) but this information is required for the checking of VISAs. For Road and Rail, this information is checked at the border
UR5	Border Guard	<i>The NSW shall facilitate the arranging of inspections</i>	Border Guard can access system and lodge need for inspection. Port and Border Authorities to be notified that an inspection is required
UR6	Border Guard	<i>The NSW shall enable the previous port of call to submit information about inbound passengers and crew</i>	When a ship leaves port, the complete list of passengers and crew is known, so this information could be forwarded directly to the Latvian Border Guard in advance
UR7	Border Guard	<i>The NSW shall notify Border Guard of cargo which must be checked for radiation levels</i>	At ports and border crossings, the radiation levels of cargo must be checked. ETA information would facilitate the checking procedure

UR8	<i>Border Guard</i>	<i>The NSW shall allow Border Guard to make approvals to FAL 6 form by connecting with their existing system</i>	Currently, Border Guard must log in to separate window for Latvia SSN. It would be much better if their system was simply extended to send and receive electronic messages directly
UR9	<i>Health Inspectorate</i>	<i>The NSW shall allow the submission of Health Declarations and related documents directly to the Health Inspectorate</i>	Currently, Latvia SSN does not provide this functionality
UR10	<i>Health Inspectorate</i>	<i>The NSW shall facilitate the inspections of ships</i>	Currently, inspections are carried out on the request of the ship's captain and arranged through the ship agent. To improve this, the NSW shall automatically highlight the need for inspections. Ship's captains/agents shall also be able to make requests for inspections through the NSW
UR11	<i>Health Inspectorate</i>	<i>The NSW shall forward information from FAL Form 1 to the Health Inspectorate</i>	Currently, Latvia SSN does not provide this functionality
UR12	<i>State Emergency Medical Service</i>	<i>The NSW shall inform the Emergency Medical Service if a sick person will cross the border</i>	There is currently no standard way of doing this but information on the Health Declaration form can trigger an alert automatically
UR13	<i>Food and Veterinary Services</i>	<i>The NSW shall notify the FVS before arrival of controlled cargos</i>	Regulations 136 and 282 (2004) require that information must be submitted prior to arrival. Different time restrictions apply to different categories of goods. These procedures currently do not happen
UR14	<i>Food and Veterinary Services</i>	<i>The NSW shall allow messages to be sent to the consignment owner</i>	This has been shown to be possible in the system used in Southampton and the FVS desire similar functionality. Currently, phone calls and emails must be used
UR15	<i>Food and Veterinary Services</i>	<i>The NSW shall use electronic messages for information</i>	Currently, paper and PDF documents are used, so information must be entered into the FVS systems manually. Automatic entry using electronic messages is preferred.
UR16	<i>Food and Veterinary Services</i>	<i>The NSW shall allow consignors to attach copies of certificates to the submission</i>	This is to allow the FVS to view and approve certification in advance, rather than waiting until the goods have arrived
UR17	<i>Food and Veterinary Services</i>	<i>The NSW shall operate such that the FVS must approve relevant goods before information is sent to customs</i>	Integration with customs must be improved. At present, the FVS is lucky to receive information regarding controlled goods at all. Often, when information is received, it is weeks or months after the goods have arrived. Customs may give approval to goods without permission from FVS, leading consignors to believe that they have received approval, so the FVS want to give their approval first. An alert should be raised if customs gives approval to a consignment which has not been approved by the FVS

UR18	<i>Food and Veterinary Services</i>	<i>The NSW shall utilise the Common Veterinary Entry Document</i>	This document is a requirement of Regulation 669 (2009)
UR19	<i>Food and Veterinary Services</i>	<i>The NSW shall integrate electronically with existing national and EU systems</i>	The FVS operates with 3 systems: the EU TRACES system, and two national database systems. Direct electronic messaging is desired where appropriate
UR20	<i>Food and Veterinary Services</i>	<i>The NSW shall inform consignment owners and carriers of need for inspection in advance</i>	This will smooth the inspection process as all parties will have advanced warning and can make the necessary arrangements (consignment must be presented to FVS authority)
UR21	<i>Food and Veterinary Services</i>	<i>The NSW shall facilitate the requirements of Directive 97/78 Article 13</i>	This Directive concerns trans-shipments between member states where controlled goods are transferred from ship to ship (and also plane to plane). In these cases, information must be forwarded to the next member state authority. The NSW could include this functionality
UR22	<i>Railway Authority</i>	<i>The NSW shall forward electronic submissions in the required format to the Railway Authority systems</i>	Existing systems are in place to deal with rail transport so the NSW must interface seamlessly with current operations
UR23	<i>Railway Authority</i>	<i>The NSW shall facilitate electronic data exchange with ports</i>	Currently, this is not available but would be useful for coordinating transfer of goods from ship to train
UR24	<i>Railway Authority</i>	<i>The NSW shall facilitate management of Consignment Notes</i>	Consignment Notes must be submitted by consignment owners and approved by Rail and Customs. Integration with Customs system will improve the efficiency of this process
UR25	<i>Railway Authority</i>	<i>The NSW shall make rail operations information available to other authorities</i>	A national database of internal operations is maintained. Access to this may be beneficial for security services, customs etc. Border crossing operations are logged in the central database system for Baltic states
UR26	<i>Railway Authority</i>	<i>The NSW shall provide a new message link with customs for notification of physical customs controls</i>	Customs has the power to stop goods at the beginning of a train journey so various parties must be aware of inspections and their consequences (e.g. if a consignment is stopped at a port)
UR27	<i>Road Transport Directorate</i>	<i>The NSW shall provide a direct integration with customs</i>	On road border crossings, waybills and licenses are checked by customs. Notification of problems/issues with documents should be made by customs to the road authority using the NSW. Customs may also use the licensing database of the road authority to check documentation
UR28	<i>Road Transport Directorate</i>	<i>The NSW shall provide an electronic interface for haulier companies to communicate with road authority</i>	An electronic interface has been trialed with some hauliers but a standard interface for all companies is desired. This will reduce the need for manual entry of data

UR29	Road Transport Directorate	<i>The NSW shall facilitate arranging extra checks which are sometimes required by customs</i>	Customs may decide extra controls are required for a consignment. Currently, these are arranged manually through phone, email etc. The NSW could provide a useful interface for all parties involved to organize these checks
UR30	Road Transport Directorate	<i>The NSW shall improve the speed of approvals for road</i>	Haulier companies do not start to move consignments until all approvals (customs, FVS etc.) have been received. Automatic collation and notification of approvals through the NSW will make the approval process simpler and hence faster, allowing consignments to move sooner
UR31	Road Transport Directorate	<i>The NSW shall provide the Road Authority with an interface for monitoring and analysing data regarding road transport in Latvia</i>	The Road Authority would like to be able to view historical and current data to analyze trends in haulier operations, cargo, market management and so on
UR32	Customs	<i>The NSW shall submit information to the customs systems using the prescribed existing electronic interface</i>	The customs systems already accept direct electronic data connections (used mainly by larger companies) as well as their web interface. The NSW shall submit electronic information directly using the format stipulated in the technical documentation
UR33	Customs	<i>The NSW shall provide extra information to the customs Risk Analysis module</i>	The Risk Analysis module analyses risk on a consignment by consignment basis using the information provided in the customs declarations. This functionality may be further enhanced by including other information which is submitted to the CRG, either for the same consignment, or historical and planned operations. The NSW may also provide information from other databases (e.g. Rail, FVS etc.)
UR34	Customs	<i>The NSW shall provide external (controlled) access to the customs system</i>	This functionality does not yet exist but may be required for security services and other authorities. The NSW shall provide a single interface for anyone who is permitted access, based on data exchange agreements in Latvia
UR35	Customs	<i>The NSW shall provide information about different licenses to customs</i>	Licensing information is maintained and controlled by other authorities (Road, Rail, Maritime etc.) so access to this information through the NSW would improve the approvals procedures. Information regarding special licenses (e.g. AGRIX for agriculture) would be particularly useful
UR36	Customs	<i>The NSW shall use information from the EU-managed CCN/CSI, CS/RD and CS/MIS databases</i>	These EU databases contain common customs information available to all member states and act as a gateway to send information between member states. Access to this information would enhance the functionality of the NSW
UR37	Maritime Administration of Latvia	<i>The NSW shall integrate with the EU THETIS system to gather</i>	Ship Agents can be notified of need for inspection. This information is currently available through the THETIS we interface but

		<i>information on ship inspection requirements</i>	could be easily and usefully integrated into the NSW interface (so that all the information is available in one place)
UR38	<i>Maritime Administration of Latvia</i>	<i>The NSW shall provide and interface for the Maritime Authority for viewing information in the maritime domain</i>	The Maritime Authority gathers information for reporting to the Ministry of Transport. An NSW interface would provide another tool for gathering data for analysis
UR39	<i>Maritime Administration of Latvia</i>	<i>The NSW shall notify the Maritime Authority automatically of any incidents in the maritime domain</i>	The Maritime Authority is currently informed of any incidents via email or phone but notifications could be built into the interface described in UR38
UR40	<i>Latvian Security Police</i>	<i>The NSW shall provide an interface for the Security police for viewing all information available in the transport domain</i>	The Security Police gather intelligence from many different sources and analyse it to assess security threats. The NSW will provide a valuable tool for monitoring and searching for information in the security domain
UR41	<i>Latvian Security Police</i>	<i>The NSW shall notify the Security Police of any security related alerts</i>	This is important, as the Security Police are responsible for responding to security threats. Currently, they are notified manually by authorities but an automatic notification system will improve the speed of response
UR42	<i>Port Authorities</i>	<i>The NSW shall provide a mechanism for submitting ship formalities to Port Authorities</i>	In 6 of the 7 ports in Latvia, ship formalities are received through the Latvia SSN system. The exception to this is Riga, who still receives the formalities by hand in paper format. The plan for the future is to either integrate Riga port with the Latvia SSN system or directly with the NSW. There is also potential for formalities to be sent to the ports and SSN application simultaneously. This requirement is subject to decisions made by the Latvian government whether or not to enforce the use of the SSN system by all ports

APPENDIX III: Architectural Patterns Used in the e-Freight National Single Window Solution

Section 6.3 (Solution Architecture) identifies the primary patterns used in this implementation strategy. This appendix provides additional information about each pattern, and how the patterns are used within the design. Each table below represents a logical layer in the design and contains the patterns associated with that layer.

As a high-level summary, the NSW solution:

- uses a Model-View-Presenter (MVP) pattern to handle user interaction
- uses an ASP.NET Master page to define a common template for all pages
- implements the Domain Model pattern to represent business entities
- interacts with the database using Repository and Data Mapper patterns

Web Server – Presentation Layer

The presentation layer is responsible for accepting user input and rendering the user interface that is returned from the web server.

Supervising Controller	
User Interface processing is divided into three separate roles.	The three roles are Model, View, and Presenter. The Model represents data, the View represents the user interface, and the Presenter is responsible for processing requests.
The web page handles requests and passes them off to a controller	Requests are sent to the View (web page), which then passes control to a provider that is responsible for initializing the Model, returning control back to the View, or passing control on to a different View.
M-V-P do not depend directly on each other (Dependency inversion)	M-V-P do not depend directly on each other. Instead, they depend on interfaces (e.g. IView, IPresenter)
Template View	
An ASP.NET Master page is used to provide a common look and feel.	Common elements such as background, page layout, menus, header, and footer are defined in the master page.
ASP.NET pages focus on content that is specific to each page	Each page is associated with the master page, which renders the common content. As a result, the page only needs to contain user interface elements that are not common across all pages.
Bound Data Control	
ASP.NET Server and User controls are bound to business entities returned from the business layer.	Business entities returned from the business layer can be bound to web controls, which will use data from the entity when rendering the display.

Web Server – Business Layer

Business layer components implement the core functionality of the system, and encapsulate the relevant business logic.

Domain Model	
The domain model is comprised of POCOs (Plain Old CLR Objects)	The Domain Model consists of POCOs that are related and fully describe the application domain. POCOs are "...ordinary classes where you focus on the business problem at hand without adding stuff for infrastructure-related reasons. ... The classes should focus on the business problem at hand. Nothing else should be in the classes in the Domain Model." (1)
POCOs also contain domain logic.	The POCOs also have methods that implement the business logic.
The POCOs are completely Persistence Ignorant (PI)	This allows us to : <ul style="list-style-type: none"> • Design the Domain Model independently from the Database Model. • Design, build, and test any business logic relatively independently of the database and the persistence infrastructure code.
Unit Of Work	
The Unit of Work keeps track of changes during a business operation, and saves the changes to the database.	<p>When you're pulling data in and out of a database, it's important to keep track of what you've change. Similarly you have to insert new objects you create and remove any objects you delete.</p> <p>You can change the database with each change to your object model, but this can lead to lots of very small database calls, which ends up being very slow. Furthermore it requires you to have a transaction open for the whole interaction, which is impractical if you have a business transaction that spans multiple requests. The situation is even worse if you need to keep track of the objects you've read so you can avoid inconsistent reads.</p> <p>A Unit of Work keeps track of everything you do during a business transaction that can affect the database. When you're done, it figures out everything that needs to be done to alter the database as a result of your work.</p>
Used for business operations that need to be executed as a single unit.	Within the Unit of work operation all changes a tracked, one or more business operations are performed, and the changes are only propagated to the database depending on the outcome of the business operations.
Can also be used to manage context information.	This pattern can be used to implement a single point of entry for each request where context can be initialized and used throughout the request processing.
Functional Decomposition	
Business Processes are implemented using the Functional Decomposition pattern. Each process is broken down to sub-processes and modeled using IDEFO models.	<p>A function is achieved by a sequence of sub-functions.</p> <p>A combination of a super-function and its sub-functions is called a functional decomposition pattern. Its definition consists of a super-function, sub-functions, functional relations among sub-functions, and behavioral conditions. These functions are described in terms of the functional concepts.</p> <p>For example, a super-function "heat object" has two sub-functions; "generate heat" and "give heat". There should be a proportional-type functional relation among them. The behavioral condition is that the objects receiving the heat are identical. In general, a function has some functional decomposition patterns to achieve it.</p> <p>A super-function is decomposed into sub-functions by specifying something related to the ways to achieve it. (In the task context of the functional hierarchy understanding, the reverse operation of the functional decomposition, the information is lost.) According to what is specified, we can categorize the functional decomposition patterns as follows (the notation of the examples in the list is that super-function → sub-function + sub-function2, if any):</p>

Web Server – Data Access Layer

Data layer components provide access to data that is hosted within the boundaries of the system, and data exposed by other back-end systems.

Repository	
A repository provides an in-memory representation of domain entities.	In systems with a complex Domain Model, it can be worthwhile to build another layer of abstraction over the mapping layer where query construction code is concentrated. This becomes more important when there are a large number of domain classes or heavy querying. In these cases particularly, adding this layer helps minimize duplicate query logic. A Repository encapsulates the set of objects persisted in a data store and the operations performed over them, providing a more object-oriented view of the persistence layer.
A repository provides clean separation between layers.	Repository also supports the objective of achieving a clean separation and one-way dependency between the domain and data mapping layers.
Criteria objects can be used by the repository to generate database queries.	In cases where you have multiple complex queries to retrieve an entity, a criteria object can be used to define selection criteria that are passed into a single get operation.
Data Mapper	
Impedance mismatch between the Domain Model and relational data require mapping layer.	There are several factors that cause a mismatch between object and relational database structures. As a result, a mapping layer can be used to map object structures to database schemas. This allows developers to perform operations against the objects without having to know the database schema.



APPENDIX IV: Details of the Technical Solution for the e-Freight National Single Window

The technical solution provides information about technologies used to implement patterns that were identified in the pattern solution in section 6.3 of the main document. Each table below represents a logical layer within the design and provides information and examples related to implementing patterns in the solution.

As a high-level summary, the NSW solution:

- uses MVP libraries to implement the Model-View-Presenter pattern
- uses ASP.NET Master Page to define a common look and feel for all pages on the site
- uses ASP.NET page, user, and server controls to create a composite view
- hosts the web application using Microsoft Internet Information Services (IIS)
- uses a Domain Model comprised of POCOs to describe the application domain
- uses NHibernate to map the Domain Model to the database

Client Workstation

Check & More Info	Example
Target browser is any web browser	Check the Browser agent for appropriate identification information, such as “MSIE 6.0”.

Web Server – Presentation Layer

Check & More Info	Example
<p>MVP</p> <p>Events in the view, ASP.NET Page, are passed onto the presenter, which is responsible for processing actions from the view.</p>	<pre>protected override void OnInit(EventArgs e) { base.OnInit(e); presenter = new CustomerPresenter(this, new CustomerController()); } protected override void OnLoad(EventArgs e) { base.OnLoad(e); action = GetFormArgument("action"); requestedEditCustomerCustomerID = Request.QueryString["ID"]; if(!IsPostBack) { presenter.OnViewInitialized(); } presenter.OnViewLoaded(); }</pre>
<p>The presenter class is responsible for interacting with a controller, which then interacts with the business layer. Operations in the presenter are associated with events from the view to perform different actions.</p>	<pre>public void OnViewLoaded() { //Add handlers to View Events view.ControlChanged += view_ControlChanged; view.cmdCustomerSaveClicked += view_cmdCustomerSaveClicked; view.cmdDeleteCustomerClicked += view_cmdDeleteCustomerClicked; view.CustomerTypes_DataBound += view_CustomerTypes_DataBound; view.CustomerTypes_PreRender += view_CustomerTypes_PreRender; PerformAction(view.RequestedAction); } private void PerformAction(string action) { try { string actionresponse; LogEntry log = null; switch (action) { case "EditCustomer": if (!view.UserRoles.Contains("Administrator")) { Apply security and log action } view.SetPageTitle("RES_PAGETITLE_EditCustomer"); actionresponse = controller.EditCustomer(view.RequestedEditCustomerCust view.UserRoles.ToArray(), view.UserHostAddress, view.UserName); PopulateView(controller.Customer); } } } }</pre>

	<pre> public void EditCustomer(object RequestedCustomerID, string[] Roles, string UserHostAddress, string UserName) { try { Apply Security policy and log action Repository repository = new Repository(); Customer = repository.GetCustomer(RequestedCustomerID.ToString()); } catch(Exception) { // Rethrow throw; } } </pre>
ASP.NET Master Page	
An ASP.NET Master Page is used to define a common layout.	A common use of the Master Page is to define the layout for all pages of the application. This approach provides a consistent look and feel across the web site.
Menus are defined in the Master Page.	Instead of using User controls for common menus they are defined directly in the Master Page.
ASP.NET Page, User and Server Controls	
ASP.NET Page controls are used to define each page of the web application.	The ASP.NET page control is used to render an HTTP page that will be sent back to clients.
ASP.NET User and Server controls are used to provide the interface	ASP.NET user and server controls are used to generate HTML interface elements, such as INPUT, that are used to provide a user interface into the application.
Ajax technologies are used for a richer user experience.	ASP.NET's Update panel Control is used to provide the user with a richer UI experience.

Web Server – Business Layer

Check & More Info	Example
<p>Domain Model</p> <p>The Domain Model is implemented as POCOs which are completely persistence ignorant.</p>	<pre> public class Region : INotifyPropertyChanged, ICloneable { #region Region's Fields [DataMember(Name="RegionID")] private int regionID; [DataMember(Name="RegionDescription")] private string regionDescription; #endregion #region Region's Properties public virtual int RegionID { get { return regionID; } set { regionID = value; OnPropertyChanged("RegionID"); } } public virtual string RegionDescription { get { return regionDescription; } set { regionDescription = value; OnPropertyChanged("RegionDescription"); } } #endregion Region's Participant Properties Constructors INotifyPropertyChanged Members Implementation of ICloneable } //Class: Region </pre>

POCOs also contain domain logic.

```

public class InventoryTransaction : INotifyPropertyChanged, ICloneable
{
    InventoryTransaction's Fields

    InventoryTransaction's Properties

    InventoryTransaction's Participant Properties

    Constructors

    INotifyPropertyChanged Members

    #region Business Logic
    private decimal UpdateDebit(decimal value)
    {
        if (this.inventory == null) return value;
        this.inventory.Balance = this.inventory.Balance - this.debit;
        this.inventory.Balance = this.inventory.Balance + value;
        return value;
    }

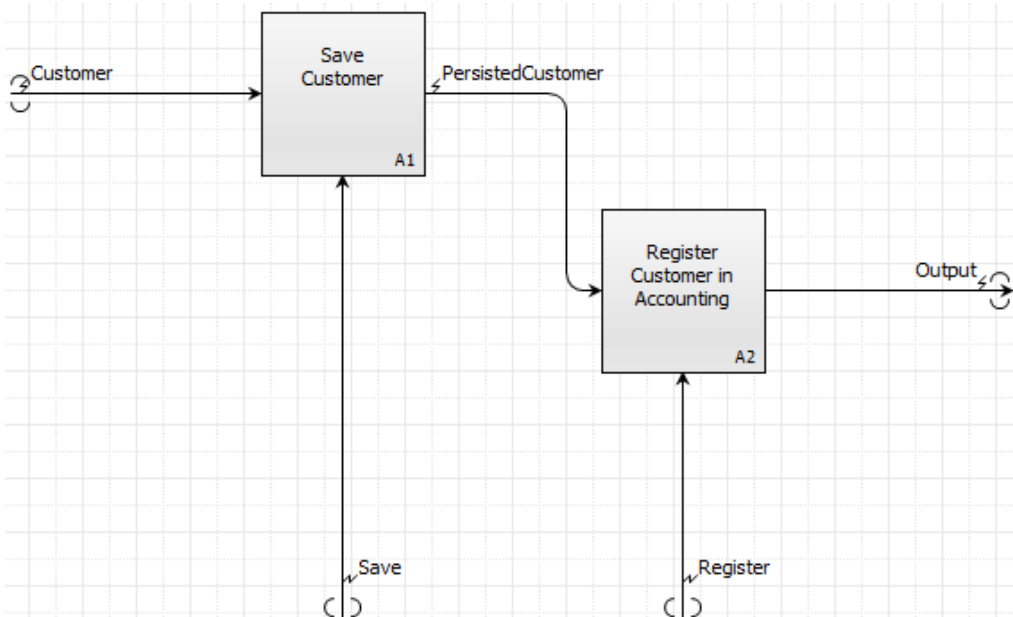
    private decimal UpdateCredit(decimal value)
    {
        if (this.inventory == null) return value;
        this.inventory.Balance = this.inventory.Balance + this.credit;
        this.inventory.Balance = this.inventory.Balance - value;
        return value;
    }
    #endregion

    Implementation of ICloneable
}

```

IDEFO Models

Multiple business operations that need to be included in a transaction are combined in a single operation exposed by a business process object that is defined in an IDEFO model that implements the Functional Decomposition pattern.



<p>The Workflow engine then executes the operations in a single transaction</p>	<pre>Dictionary<string, object> inputs = new Dictionary<string, object>(); RequestParameters reqparams = new RequestParameters { Action = RequestedAction.ExecuteProcess, ServiceId = "Customer.SaveCustomer", Roles = Roles, RequestSourceIp = UserHostAddress, User = UserName }; inputs.Add("Customer", Customer); Response response = CLMS.WorkflowEngine.WorkflowEngine.AcceptRequest(reqparams, inputs); Customer=(BO.Customer)response.Outputs["PersistedCustomer"];</pre>
<p>Unit Of Work</p>	
<p>Business operations that need to be included in a transaction are handled by the Unit of Work pattern.</p>	<pre>public void SaveProductCategory(NWS.BO.ProductCategory productcategory) { if(productcategory == null) { throw new ArgumentNullException("productcategory", "No ProductCategory was specified."); } using (TransactionScope scope = new TransactionScope(TransactionScopeOption.Required)) { UnitOfWork.CurrentSession.SaveOrUpdate(productcategory); UnitOfWork.Current.Flush(); scope.Complete(); } }</pre>
<p>Unit of Work can be used to initialize a data context that spans across multiple requests.</p>	<p>This approach allows you to maintain context with one object while processing a long business operation. This ensures that all updates to business entities are saved when the operation is completed. The context is the NHibernate session object and Unit Of Work takes care of holding that context until the long operation is completed.</p> <pre>if (UnitOfWork.IsStarted && UnitOfWork.InLongConversation) { UnitOfWork.EndLongConversation(); UnitOfWork.CurrentSession.Clear(); } UnitOfWork.StartLongConversation();</pre>

Web Server – Data Access Layer

Check & More Info	Example
Repository Object	
<p>The repository contains methods for each parent business entity in the Domain Model</p>	<p>Parent objects represent the top level object in a in a group of objects that are related.</p> <pre>public class Repository : IRepository { #region Implementation of IRepository #region ProductCategory Methods public NWS.BO.ProductCategory GetProductCategory(int CategoryID) ... public void SaveProductCategory(NWS.BO.ProductCategory productcategory) ... public void UpdateProductCategory(NWS.BO.ProductCategory productcategory) ... public void DeleteProductCategory(NWS.BO.ProductCategory productcategory) ... #endregion Supplier Methods Shipper Methods CustomerType Methods </pre>
<p>For objects that can be retrieved using multiple complex queries generic methods are supplied by the repository which accept criteria expressed in Linq.</p>	<pre>public List<T> Get<T>(Expression<Func<T, bool>> predicate) ... public List<T> Get<T>(Expression<Func<T, bool>> predicate, int startRowIndex, int pageSize, Dictionary<Expression<Func<T, IComparable>>, bool> orderBy, out int totalRecords) ... public List<T> GetAll<T>() ... public List<T> GetAll<T>(int startRowIndex, int pageSize, out int totalRecords) ... </pre>
NHibernate Mapping Files	

XML files provide mapping information of the Domain model POCs to NHibernate.

```

<hibernate-mapping xmlns="urn:nhibernate-mapping-2.2"
    schema="CLMSApps_NWSample_Alpha_Northwind.dbo"
    default-lazy="true"
    auto-import="false"
    assembly="NWS.BO"
    namespace="NWS.BO">
  <class name="Region"
    table="`Region`">
    <!-- Key -->
    <id name="RegionID"
      column="RegionID"
      type="Int32">
      <generator class="assigned" />
    </id>
    <!-- Properties -->
    <property name="RegionDescription"
      column="RegionDescription"
      type="String" />
    <!-- Relationships -->
    <bag name="territories"
      access="field"
      inverse="true"
      cascade="all-delete-orphan" >
      <key column="RegionID"
        foreign-key="Region_To_Territories"/>
      <one-to-many class="Territory" />
    </bag>
  </class>
</hibernate-mapping>

```

Database Server

Check & More Info	Example
Tables and views are accessible to the data access layer.	Security in the database is configured to allow access to tables and views from the application tier.
Trusted sub-system is used to access the database.	Define a common business identity and then use that identity when accessing tables and views in the database.