Future Internet Enterprise Systems (FInES)
Standardisation Task Force Report

Draft for Comment

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1 Executive Summary

This report has examined the correspondence between research in the area of the Future Internet and Standardisation.

It can be stated there are very many teams of researchers and standards people working in this area and this report covers many of them.

The report raises the question that, if we have all this activity, how do we turn the research into standards and use both to enable the market. It is clear that if we could remove all the barriers and creating Interoperable Services that could utilize any intelligent object ("Thing") there would be significant market growth and many solutions to the issues raised by Climate Change and an ageing population would be much easier to arrive at. While this report and the Future Internet is not concerned with specific sectors, solving the issue of general interoperability and enabling the easy and intuitive creation of services and applications is a prerequisite to resolving many other issues in other sectors.

The report looks in depth at the opportunities afforded by Cloud Computing and covers the many initiatives and organizations active in this area and the ramifications of these technologies and initiatives to the Future Internet. The Report looks at the Global Standards One work in relation to the internet of things and shows that many of the methods used under GSI are transferable to solutions in the Future Internet.

The report covers Semantic Interoperability of Business Documents and explores the extension of this for realizing Software as a Service Utility and how this leads onward to the Internet service Utility (ISU).

A common feature of much of this report is that it demonstrates that while the Business to Business area is well developed both in research and in standardization, the more general case for the Future Internet is not.

Since this covers the B2C, B2M and M2M areas as well as B2B and covers applications and services it is recommended that actions are taken to coordinate work in the Future Internet and the more general case of Interoperability Standardisation, conformance and Certification. The report suggests 2 Projects should be taken forward under Call 5. a Coordination Action to maintain a strong linkage between Standardisation and Research to help shape outcomes and an Integrated Project tasked with delivering the general case (Framework) for Future Internet Interoperability for research and for standardization leading to certification and product and service conformance. This it is suggested will remove major barriers to interoperability and allow major market growth of intelligent and innovative services (ISU) to products, devices and objects (IoT).

The main conclusion of this report is that there is an ongoing need for strong links between Research in the area of the Future Internet and Standardisation and especially where these lead to resolving market barriers and enabling significant GDP growth.
2 Introduction

In a climate of profound uncertainty, standardisation has an even more critical role in providing a stable foundation, or a level playing field, to facilitate innovation and ultimately deliver choice for end users. As the Internet of Things gathers momentum and more and more intelligent “things” appear in the systems of B2B transactions, B2C transactions and most importantly B2M (Business to service to machines) transactions, the more pressing the necessity to formulate standard frameworks for overall interoperability and for standards to enshrine the work of FinES and its related projects and also to provide an understanding of what is already happening in standardisation.

According to the name of the FinES Cluster, the addressed topics will be partitioned in: Future Internet, addressing the ICT issues, and Future Enterprise Systems, focusing on the aspects of the business user.

3 FinES Standardization Objectives

The objectives of the FinES Standardization effort is to establish the requirements on interoperability, research and existing standardisation in the area of FinES, research outputs from existing projects and raise awareness on the needs, the available standards, and of the ongoing work in standardization:

- To establish a base for FinES requirements on interoperability by identifying potential barriers and concerns
- To establish contacts with groups (CEN, IFIP, W3C, OASIS, VLab, IETF and others) and projects working in the area of interoperability
- To collect and collate relevant RTD work and existing and relevant standards, ongoing work in progress in standardisation and identify areas that could be standardised in the future as current and planned RTD projects
- Prepare to set up a project to establish the set of FinES requirements on interoperability to identify work in the RTD areas covered by FinES (the Future Internet as covered by Objectives 1.2 and 1.3 of the Seventh Framework Work Plan) and ensure through affirmative measures that specifications identified as having the potential to be useful specifications (or part of) are taken forward into standardisation
- To inform, coordinate and advise both Standardisation (the ESOs and other EU Consortia and Fora) and RTD (the current and future FP7 projects) of each others activities and content and ensure that through conferences, seminars and workshops an understanding is reached between the two areas.

A particular objective of the FinES Standardization Task force is

- To prepare to set up a project to establish the set of FinES requirements on interoperability to identify work in the RTD areas covered by FinES (the Future Internet as covered by Objectives 1.2 and 1.3 of the Seventh Framework Work Plan) and ensure through affirmative measures that specifications identified as having the potential to be useful specifications (or part of) are taken forward into standardization
- A further project should be prepared to support common RTD and standardization work e.g. provide funding for the participation of experts, namely to identify and to develop selected new standards in the area of Future Internet and Future Enterprise Systems.
- To prepare a project to research, design and implement interoperability testing and proving of the interoperability of services and things in the B2C and B2M environments under which the

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2 Internet of Things: an early reality of the Future Internet, Workshop Report by Maarten Botterman
new standards can be implemented, evaluated and established as tools for certification and
testing of both services and machines or equipment.

4 The Areas Addressed by FInES

1. Cloud Computing and Virtualization: Today’s powerful x86 computer hardware was
designed to run a single operating system and a single application. This leaves most
machines vastly underutilized. Virtualization, also termed as Infrastructure as a Service
(IaaS) allows to run multiple virtual machines on a single physical machine, sharing the
resources of that single computer across multiple environments. Cloud computing, on the
other hand, is covered by three models offering Infrastructure as a Service (IaaS),
Platform as a Service (PaaS) and Software as a Service (SaaS), which all involve the on-
demand delivery of computing resources. There is indeed a need for a common,
interoperable and open set of cloud computing standards: When every IaaS, PaaS or
SaaS provider creates their own API (and they do), then customers and developers will
need to learn several different APIs in order to engage each vendor’s service.

2. Semantic Enterprise Interoperability, frameworks and harmonisation of related standards
as well as semantic Interoperability of Electronic Business Documents for realizing SaaS-
U (Software as a Service-Utility): As stated in 3 – while the utility/commoditisation concept
is potentially applicable to several ICT technologies and environments, the ISU is
particularly concerned with services and applications within the domain. One of the key
problems in the enterprise domain is the interoperability of the content of the electronic
document/messages.

3. Analysis of existing and needs for future user oriented standards in FInES., namely to
identify and to develop selected new standards in the area of Future Internet and Future
Enterprise Systems. (more tbd)

5 Standardization Efforts Related with Cloud Computing

5.1 Cloud Computing

Cloud computing is a pay-per-use model for enabling available, convenient, on-demand network
access to a shared pool of configurable computing resources (e.g., networks, servers, storage,
applications, services) that can be rapidly provisioned and released with minimal management
effort or service provider interaction 4. Some of the major cloud computing service providers are:
Vmware, Sun Microsystems, IBM, Amazon, Google, Microsoft and Yahoo. Cloud services are
being adopted by individual users through large enterprises including vmware, General Electric
and Procter & Gamble as well as many other companies and especially the SMEs. In August
2008, Gartner Research observed that “organizations are switching from company-owned
hardware and software assets to per-use service-based models” and that the "projected shift to
cloud computing will result in dramatic growth in IT products in some areas and in significant
reductions in other areas."

Key characteristics of Cloud Computing are as follows 5:

- **On-demand self-service:** A consumer can unilaterally provision computing capabilities,
such as server time and network storage, as needed without requiring human interaction
with each service’s provider.

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3 COIN IP Contribution to FInES Cluster Position Paper by Sergio Gusmeroli, Claudia Guglielmina, Man-
Sze Li, Andrew Faughy, Marco Conte, ftp://ftp.cordis.europa.eu/pub/fp7/ict/docs/enet/fpp-1st-contribution-
coin_en.pdf
4 http://groups.google.com/group/cloudforum/web/nist-working-definition-of-cloud-computing
5 http://groups.google.com/group/cloudforum/web/nist-working-definition-of-cloud-computing
• **Ubiquitous network access**: Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs).

• **Location independent resource pooling**: The provider’s computing resources are pooled to serve all consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. The customer generally has no control or knowledge over the exact location of the provided resources. Examples of resources include storage, processing, memory, network bandwidth, and virtual machines.

• **Rapid elasticity**: Capabilities can be rapidly and elastically provisioned to quickly scale up and rapidly released to quickly scale down. To the consumer, the capabilities available for rent often appear to be infinite and can be purchased in any quantity at any time.

• **Pay per use**: Capabilities are charged using a metered, fee-for-service, or advertising based billing model to promote optimization of resource use. Examples are measuring the storage, bandwidth, and computing resources consumed and charging for the number of active user accounts per month. Clouds within an organization accrue cost between business units and may or may not use actual currency.

• **Cloud software** takes full advantage of the cloud paradigm by being service oriented with a focus on statelessness, low coupling, modularity, and semantic interoperability.

One of the most prominent examples of cloud computing is Amazon Elastic Compute Cloud (Amazon EC2) which is a web service that provides resizable compute capacity in the cloud. Each cloud computing provider gives its own proprietary APIs. Yet the cloud computing market should be fair and free of monopolies and vendor lock-in situations: Open specifications with standardized protocols and data formats are needed. The expected benefits are:

- Applications could run on any cloud node
- Applications could migrate between cloud nodes
- Contingency planning/disaster recovery
- Scalability/elasticity
- Centralized and standardized security enforcement and monitoring (intrusions, secure configurations, vulnerabilities)
- Interagency billing of resources used will self-optimize growth of cloud nodes

There are a number of FP7 Projects and several standardization efforts especially from the USA related with Cloud Computing as briefly summarized in the following sections.

### 5.2 The Cloud Computing Interoperability Forum (CCIF)

CCIF was formed in order to enable a global cloud computing ecosystem whereby organizations are able to seamlessly work together for the purposes for wider industry adoption of cloud computing technology and related services. A key focus will be placed on the creation of a common agreed upon framework / ontology that enables the ability of two or more cloud platforms to exchange information in an unified manor.

CCIF is an open, vendor neutral, not for profit community of technology advocates, and consumers dedicated to driving the rapid adoption of global cloud computing services. CCIF shall accomplish this by working through the best practices / reference architectures for the purposes of standardized cloud computing use open forums (physical and virtual) focused on building community consensus, exploring emerging trends, and advocating.

Unified Cloud Interface Project is an attempt to create an open and standardized cloud interface for the unification of various cloud API’s as shown in Figure 1. The aim is to create a singular programmatic point of contact that can encompass the entire infrastructure stack as well.

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as emerging cloud centric technologies all through a unified interface. In this vision for a unified cloud interface the use of the resource description framework (RDF) is an ideal method to describe a semantic cloud data model (taxonomy & ontology).

Figure 1 Unified Cloud Interface

5.3 OMG Activities

OMG hosted “Cloud Standards Summit”\(^9\) on July 13, 2009. The goal of the Summit is to initiate a dialogue with government IT leaders on the theme of “Coordinating Standardization Activities to Remove Government Cloud Computing Roadblocks”. Potential government implementers of Cloud Computing will supply their feedback on key issues that could delay federal Cloud Computing deployments. These issues will include areas such as security, governance, SLAs, portability/interoperability across Clouds, compliance, legacy systems integration, APIs, and virtualized resource management.

5.4 Activities by VMware

VMware\(^{10}\) submitted the vCloud API to the DMTF as a way to standardize the API. Although VApps follow the Open Virtualization Format (OVF) standard, they include specific VMware features and therefore are expected to be implemented only on VMware systems. Thus, VMware is marketing vCloud to vendors who run VMware on their servers.

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5.5 The Open Cloud Consortium (OCC)

The Open Cloud Consortium (OCC)\(^{12}\):
- Supports the development of standards for cloud computing and frameworks for interoperating between clouds;
- Develops benchmarks for cloud computing;
- Supports reference implementations for cloud computing, preferably open source reference implementations;
- Manages a testbed for cloud computing called the Open Cloud Testbed;
- Sponsors workshops and other events related to cloud computing.

The Open Cloud Consortium (OCC) and the Open Cloud Testbed include the following centers and groups:

- **Members**
  - Cisco
  - MIT Lincoln Labs
  - Yahoo

- **Associate Members**
  - Aerospace
  - Open Data Group
  - Sector Project

- **Contributing Members**
  - Calit2
  - Johns Hopkins University
  - National Lambda Rail
  - Northwestern University
  - University of Chicago
  - University of Illinois at Chicago

**Working groups:**
- **Working Group on Standards and Interoperability for Clouds that Provide On-Demand Computing Capacity.** The focus of this working group is on developing standards for interoperating clouds that provide on demand computing capacity. For example, what are standard interfaces to storage clouds and compute clouds? This working group is also developing a benchmark for clouds that provide on-demand computing capacity called MalStone.

- **Working Group on Information Sharing, Security and Clouds:** The focus of this working group is on standards and standards based architectures for sharing information between clouds, especially clouds belonging to different organizations and subject to possibly different authorities and policies. This group is also concerned with security architectures for clouds.

- **Working Group on Wide Area Clouds and the Impact of Network Protocols on Clouds:** The focus of this working group is developing technology for wide area clouds. This includes methodologies and benchmarks for evaluating wide area clouds. This working group will also explore through experimental studies the applicability of variants of TCP and the use of other network protocols for clouds. This working group has access to the Open Cloud Testbed for wide area experimental studies.

5.6 The Open Grid Forum (OGF)

The Open Grid Forum (OGF) has officially launched the Open Cloud Computing Interface Working Group (OCCI-WG). Its aim is the rapid development of a clean, open API for cloud infrastructure delivered on-demand. The Open Cloud Computing Interface (OCCI) group will deliver an API specification for remote management of cloud computing infrastructure, allowing

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\(^{12}\) [http://www.opencloudconsortium.org/index.html](http://www.opencloudconsortium.org/index.html)
for the development of interoperable tools for common tasks including deployment, autonomic scaling and monitoring.

5.7 NIST View on Cloud Computing Standardization

NIST foresees a Federal Cloud Infrastructure\(^\text{13}\). The Federal government identifies minimal standards and architecture to enable agencies to create or purchase interoperable cloud capabilities:
- Agencies would own cloud instances or ‘nodes’
- Nodes would provide the same software framework for running cloud applications
- Nodes would participate in the Federal cloud infrastructure
- Federal infrastructure would promote and adopt cloud architecture standards (non-proprietary)
- ‘Minimal standards’ refers to the need to ensure node interoperability and application portability without inhibiting innovation and adoption thus limiting the scale of cloud deployments

5.8 Open Virtualization Format (OVF)

Open Virtualization Format (OVF)\(^\text{14}\) is a hypervisor-neutral, efficient, extensible, and open specification for the packaging and distribution of virtual appliances composed of one or more virtual computer systems. It aims to facilitate the automated, secure management not only of virtual machines but the appliance as a functional unit.

5.9 Cloud Computing Security

Several organizations including Cloud Security Alliance, Open Cloud Manifesto and NIST state that there is a need to define standards for cloud computing\(^\text{15}\). This set of standards includes privacy and security aspects as well. According to a survey led by IDC Enterprise Panel in August 2008, among the challenges/issues of the cloud model adoption, security is the major concern worrying the users.

When interoperability standards are not available, the number of proprietary implementations is increasing. This triggers the fact that proprietary implementations cannot be examined against privacy and security aspects. Hence, the need for interoperability standards in cloud computing cannot ignore security and privacy.

5.10 Service Level Agreements (SLA) Management

Cloud computing uses the concept of service level agreements to control the use and receipt of resources from and by third parties. SLAs commonly include segments to address: a definition of services; performance measurement; problem management; customer duties; warranties; disaster recovery; termination of agreement. Any SLA management strategy considers two well differentiated phases: the negotiation of the contract and the monitoring of its fulfillment in runtime. Thus, SLA Management encompasses the SLA contract definition (the QoS (quality of service) parameters), SLA negotiation, SLA monitoring and SLA enforcement according to defined policies. The main point is to build a new layer upon the cloud able to create negotiation mechanism between providers and consumer of services.


\(^{15}\) [http://www.cloudsecurityalliance.org/](http://www.cloudsecurityalliance.org/)
5.10.1 FP7 Project SLA@SOI

SLA@SOI is a FP7 project researching aspects of multi-level, multi-provider SLAs within service oriented infrastructure and cloud computing. An essential part of an SLA-aware infrastructure is a scalable and self-sufficient monitoring system capable of monitoring large distributed systems, in real-time. The monitoring system must support two mutually exclusive perspectives arising from the Service Level Agreement, namely the customer’s perspective and the infrastructure/service provider’s perspective. The former is interested in the SLA alone, while the latter needs to be able to optimize the utilization of the infrastructure. To help process and manage the volume and variety of monitoring data, a multi-layer monitoring architecture has been proposed by Infrastructure Management.

5.10.2 Web Services Agreement Specification (WS-Agreement)

WS-Agreement was developed in a joint working group of different partners from industry and research in the Open Grid Forum. It defines a language and a protocol to represent the services of providers, create agreements based on offers and monitor agreement compliance at runtime. It enables:

- Advertising agreement capabilities of parties
- Creating agreements based on offers
- Monitoring agreement compliance at runtime.

5.10.3 Web Service Level Agreements (WSLA)

WSLA is a framework developed by IBM for specifying and monitoring Service Level Agreements (SLA) for Web Services. It is able to measure and monitor the QoS parameters of a Web Service and reports violations to the parties specified in the SLA. It proposes a formal language based on XML Schema to express SLAs and a runtime architecture, and comprises several SLA monitoring services, which may be outsourced to third parties (supporting parties) to ensure a maximum of objectivity. WSLA language allows service customers and providers to define SLAs and their parameters and specify how they are measured. The WSLA monitoring services are automatically configured to enforce an SLA upon receipt.

5.11 FP7 Project COIN

The mission of the European FP7 Integrated Project COIN (Collaboration and interoperability for networked enterprises) is to study, design, develop and prototype an open, self-adaptive, generic ICT integrated solution to support the above 2020 vision, starting from notable existing research results in the field of Enterprise Interoperability (made available by the Enterprise Interoperability DG INFSO D4 Cluster and specifically by the projects ATHENA, INTEROP, ABILITIES, SATINE, TRUSTCOM) and Enterprise Collaboration (made available by projects ECOLEAD, DBE, E4 and ECOSPACE).

In particular, a COIN business-pervasive open-source service platform will be able to expose, integrate, compose and mash-up in a secure and adaptive way existing and innovative to-be-developed Enterprise Interoperability and Enterprise Collaboration services, by applying intelligent maturity models, business rules and self-adaptive decision-support guidelines.

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16 http://sla-at-soi.eu/
19 http://www.research.ibm.com/wsla/
20 http://www.coin-ip.eu/
This way, the Information Technology vision of Software as a Service (SaaS) will find its implementation in the field of interoperability among collaborative enterprises, supporting collaborative business forms, from supply chains to business ecosystems, like a utility, the Interoperability Service Utility (ISU). The COIN project will finally develop an original business model based on the SaaS-U (Software as a Service-Utility) paradigm on the base of the open-source COIN service platform.

5.12 FP7 Project Reservoir Project

Reservoir project \(^{21}\) will introduce an abstraction layer that will allow developing high level management components that are not tied to any specific environment. It also aims to provide a Service Definition Language, Cross Site management protocols to enable cooperation between different Data Centers.

6 Global Standards One (GS1) and the Internet of Things

Global Standards One (GS1) \(^{22}\) is a family of standards focusing on different aspects of supply chain integration such as electronic products codes, product information synchronization and the electronic document standards. GS1 was formed in early 2005 by the European Article Number and the Uniform Commercial Code organizations when they joined together. EAN and UCC were two organizations that heavily contributed to the adoption and proliferation of barcodes.

In a GS1 Network, the trading partners share three different types of data:

- Master data (identical for all same articles)
- Transactional data (describing a business transaction), and
- Event data describing an event for all individual items with serialized item numbers. An event can be a read (observation) made by a company internally or a read made with the help of sensor equipment like temperature

All these data are (primarily) communicated via electronic means, defined according to the following four GS1 Standards:

- **EPC (Electronic Product Code):** EPC is an extension to the GTIN barcode naming conventions in that it includes unique product identity.
- **EPCglobal Network** \(^{23}\): Event data is communicated and registered with the help of the EPCglobal Network. EPCglobal drives the development of the Electronic Product Code (EPC) related with RFID standards.
- **The Global Data Synchronization Network (GDSN)** \(^{24}\): Master data is communicated with the help of the global data synchronization network (GDSN). The Global Data Synchronization Network (GDSN) enables product data and location information synchronization so that trading partners have consistent item data in their respective systems.
- **Electronic business messaging: GS1 eCom** \(^{25}\) is the part addressing the transactional data is communicated with the help of the standard for electronic business messaging in this family of standards. In GS1 eCom, there are two distinct categories: the earlier eCom standards that are based on Electronic Document Interchange (EDI), called EANcom and the newer generation **GS1 XML** \(^{26}\) which is designed using XML Schema.

\(^{21}\) http://www.reservoir-fp7.eu/


\(^{25}\) GS1 eCOM, http://www.gs1.org/productssolutions/ecom/

\(^{26}\) GS1 XML. Global Standard One XML. http://www.gs1.org/productssolutions/ecom/xml/.
6.1 GS1 EPCglobal Network

GS1 EPCglobal Network\textsuperscript{27} standards are designed to improve visibility. Visibility is one of the key components of the roadmap towards the creation of the Internet of Things vision\textsuperscript{28}.

![EPCglobal Network Architecture](image)

The EPCglobal Network architecture is based on the following principles as shown in Figure 2:

- A unique number (the EPC) to identify each individual instance of a product within the supply chain.
- This unique number is held in an RFID-tag that is attached to that object.
- As this object moves through the supply chain, it is detected by RFID readers at different locations and the information is passed to filtering and collection EPC middleware (Application Level Event (ALE)).
- This middleware aggregates information, removes duplicates, applies appropriate filters and in turn passes filtered information to enterprise systems.
- When IT systems require more information about an object, they use the EPC code from the object’s tag or other EPC Manager Numbers to query the Object Naming Service (ONS) or the Discovery Service (DS).
- The ONS will return the Internet address of the EPC Information Services (EPC IS) server of the source, which holds information about the object in question.
- A comparison can be made with the Internet Domain Name Service (DNS), which translates domain names into their IP-addresses.

\textsuperscript{28} Internet of Things: an early reality of the Future Internet, Workshop Report by Maarten Botterman
• The EPC Discovery Service (EPC DS) will return the Internet addresses of the EPC Information Services (EPC IS) servers of all parties where that particular EPC code has been (www.epcglobalinc.org).
• This can be compared to a search engine on the Internet.
• The EPC Discovery Service (DS) will be used if a company does not know where data of a specific EPC resides.

6.2 FP7 iSURF Project

iSURF Project is enabling the collaborative supply chain planning across multiple domains for a flexible and dynamic environment and especially to facilitate European SMEs participation to collaborative supply chain planning process. The following standards are used in the iSURF Project to achieve its following objectives:

• Develop an Interoperability Service Utility in order to enable the interoperability with the existing enterprise legacy applications handling planning (such as ERPs, MRPs, APSs). For this purpose, these applications are wrapped as Web services conforming to the W3C standards, Simple Object Access Protocol (SOAP) and Web Services Description Language (WSDL) and served over an enterprise service bus.
• Enable interoperability in exchanging inter-enterprise planning related data including forecasts, inventory and Point-of-Sale (POS) exceptions across domains. iSURF has contributed heavily to the OASIS SET TC to develop the UN/CEFACT CCTS based semantic definitions of electronic business documents and this specification is being used for this purpose.
• Provide an open source smart product infrastructure for SMEs in order to enable SMEs to acquire the supply chain visibility information in real time from the distributed RFID devices. The iSURF smart product infrastructure provides the SMEs with the capabilities of gathering product information through RFID devices, filtering and aggregating the collected data and putting them into a business context. This smart product infrastructure is based on EPCGlobal standards.
• Enable the definition and execution of inter-enterprise collaboration across multiple domains through the Service Oriented Collaborative Supply Chain Planning Process Definition and Execution Platform. For this purpose, Collaborative Planning, Forecasting and Replenishments (CPFR®) standard is used. The predefined CPFR® building blocks are combined into a business process and executed through a standard, machine processable business process specification language, namely, OASIS ebXML Business Specification Language, (ebBP).35
• Support the architecture with a Global Data Synchronization Service Utility which conforms to the GS1 standard in order to ensure the accuracy and reliability of master data used in the supply chain by developing standard based open platform for SMEs.

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29 Simple Object Access Protocol (SOAP), http://www.w3.org/TR/soap/
30 Web Services Description Language (WSDL), http://www.w3.org/TR/wsdl
• Ensure the security and privacy of both the real time visibility data gathered through RFID
device and the planning and forecasting messages exchanged across enterprises. The
necessary identity management, security and privacy mechanisms for sharing visibility
data gathered through RFID devices and for exchanging the planning data between
supply chain partners are be based on the OASIS standards such as XACML38 and
SAML39.

7 Standards on Semantic Interoperability of Electronic
Business Documents for realizing SaaS-U (Software as a
Service-Utility)

The interoperability of the electronic documents exchanged in eBusiness applications is an
important problem in industry. Currently, this problem is handled by the mapping experts who
understand the meaning of every element in the involved document schemas and define the
mappings among them which is a very costly and tedious process.

In order to improve electronic document interoperability, the UN/CEFACT produced the
Core Components Technical Specification (CCTS) which defines a common structure and
semantic properties for document artifacts. However, at present, this document content
information is available only through text-based search mechanisms and tools.

7.1 UN/CEFACT Core Component Technical Specification

The essence of UN/CEFACT Core Component Technical Specification40 is to design documents
from standard, re-usable building blocks, called Core Components. The ultimate aim is to make
the Core Components available from a single common repository for discovery and reuse in
designing the business documents.

The initial set of Core Components are designed starting from the business processes
and using the UN/CEFACT Modeling Methodology (UMM). For example, through the analysis of
an invoicing business process, it may be revealed that a component is necessary to represent the
"tax amount" in the invoice. Once, "Tax Amount" is defined as a Core Component, it can be
discovered and reused in any business document that has a tax amount component. However, to
provide interoperability, there is a need for a fixed set of reusable data types to represent values
in the components consistently. Hence the starting point for the design of Core Components is
the Core Data Types.

Core Component Types (CCT) constitutes the leaf-level type space of UN/CEFACT Core
Components. They specify the basic information types, such as amount, binary object, code and
date time, and they are built from primitive data types (e.g. binary, decimal, integer, string).

On the other hand, Data Types define the set of valid values for a Basic Core Component.
They are based on one of the Core Component Types and further restrict it. In this respect, CCT's
can be thought of abstract types from which more specialized Data Types are produced.

A Core Component is a reusable building block for creating electronic business documents.
There are three types of Core Components:

• Aggregate Core Component (ACC): A distinct real world object with a specific business
meaning such as "Address" or "Purchase Order" is termed as an Aggregate Core
Component (ACC). An Aggregate Core Component has at least one and possibly more
Basic Core Components (BCC). For example, "Address. Details" is an Aggregate Core
Component (ACC) containing several Basic Core Component (BCC)s. Currently there are
81 ACCs in the UN/CEFACT Common Business Library.

38 http://www.oasis-open.org/committees/xacml/
39 http://www.oasis-open.org/committees/security/
40 UN/CEFACT Core Components Technical Specification, http://www.unece.org/cefact/ebxml/CCTS_V2-
01_Final.pdf
• **A Basic Core Component** describes a property of an ACC by using a Core Data Type. For example, “Address. Details. Street” is a Basic Core Component (BCC) and is of “Text” Core Data Type. Currently there are 528 BCCs in the UN/CEFACT Common Business Library.

• Sometimes it is necessary to define an association between Aggregate Core Components. This is realized through **Association Core Components**. For example, “Person. Details. Residence” is an Association Core Component (ASCC) referencing the “Address. Details” ACC. Currently there are 176 ASCCs in the UN/CEFACT Common Business Library.

A Core Component is designed to be context-independent so that it can later be adapted to different contexts and reused. When a Core Component is restricted to be used in a specific business context, it becomes a Business Information Entity (BIE). In other words, a Business Information Entity is a Core Component specialized to a specific business context and given its own unique name. The possible business contexts that can be used are defined to be: Business Process Context; Product Classification Context; Industry Classification Context; Geopolitical Context; Business Process Role Context; Supporting Role Context; System Capabilities Context and Official Constraints Context.

For example, when the Business Process Context is specialized to “Purchasing”, and the Geopolitical Context is set to be “EU”, the “Invoice. Tax. Amount” BCC becomes the “Invoice. VAT Tax. Amount” Basic Business Information Entity (BBIE). Similarly, when an Association Core Component is used in a context it becomes Association Business Information Entity (ASBIE) and Aggregate Core Component becomes Aggregate Business Information Entity (ABIE).

### 7.2 OASIS Semantic Support for Electronic Business Document Interoperability (SET) TC

The purpose of OASIS SET TC\(^1\) is to provide standard semantic representations of electronic document artifacts based on UN/CEFACT Core Component Technical Specification (CCTS) and hence to facilitate the development of tools to support semantic interoperability. The basic idea is to explicate the semantic information that is already given both in the CCTS and the CCTS based document standards in a standard way to make this information available for automated document interoperability tool support.

UN/CEFACT CCTS specifies the semantics of document artifacts in several dimensions: through the Core Components Data Types; through the structure of the core components; the semantics implied by the naming convention used; the semantics implied by the context, the Business Information Entities and the code lists. However, currently this semantics is available only through text-based search mechanisms.

In order to help with the interoperability of the document artifacts, the CCTS based business document semantics is explicated. "Explicating" means to define their semantic properties through a formal, machine processable language as an ontology and the Web Ontology Language (OWL)\(^2\) is used for this purpose.

The semantics is explicated at two levels: At the first level, an upper ontology describing the CCTS document content model is specified. Furthermore, at this level, the upper ontologies for the prominent CCTS based standards, namely, GS1 XML, OAGIS 9.1 and UBL are also developed. The various equivalence relationships between the classes of the CCTS upper ontology and the CCTS based document standard ontologies are defined. These relationships are later used to find the similarities among the document artifacts from different document schemas.

At the next level, the semantics of the document schemas in each standard are described based on its upper ontology. The difference between the document schema specific ontology and the upper ontology is that the upper ontology describes the generic entities in a document content

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\(^2\) Web Ontology Language (OWL), [http://www.w3.org/TR/owl-features/](http://www.w3.org/TR/owl-features/)
model whereas document schema ontologies describe the actual document artifacts as the
subclasses of the classes in the upper ontology.

Furthermore, some semantics is explicated related with the different usages of document
data types in different document schemas to obtain some desired interpretations by means of
such informal semantics. The intention is to give the reasoner the same information that the
humans use in transforming document schemas into one another.

When these ontologies are harmonized using a DL reasoner, the computed inferred
ontologies reveal the implicit equivalences and subsumption relationships between the document
artifacts. In other words, the shared semantic properties of the CCTS based document artifacts
together with the implicit relationships inferred, help to identify their similarities. As expected, the
Harmonized Ontology is effective only to discover equivalence of both semantically and
structurally similar document artifacts. Yet different document standards use core components in
different structures. Semantic properties of document artifacts are not enough to find the similarity
of the structurally different but semantically equivalent document artifacts; possible differences in
structures must be provided through heuristics to enhance the practical uses of the specified
semantics. This heuristics is about possible ways of organizing core components into compound
artifacts and is given in terms of predicate logic rules.

Note that a DL reasoner by itself cannot process predicate logic rules and therefore a rule
engine is used to execute the more generic rules and carry the results back to the DL reasoner
through wrappers developed. The results involve declaring further class equivalences in the
ontology.

Finally, the similarities discovered among the document artifacts are then used to
automate the mapping process by generating the XSLT rules.

The SET Harmonized Ontology contains about 4758 Named OWL Classes and 16122
Restriction Definitions conforming to the specification described in this document consisting of the
following:

- All of the CCs/BIEs in UN/CEFACT CCL 07B.
- All of the BIEs in the common library of UBL 2.0.
- All of the common library of GS1 XML.
- OAGIS 9.1 Common Components and Fields
- The Harmonized Ontology expresses the relationships among the document artifacts of
  UN/CEFACT CCL, UBL 2.0, OAGIS 9.1 and GS1 XML according to SET specifications.
- The SET Harmonized Ontology is publicly available from
  http://www.srdc.metu.edu.tr/iSURF/OASIS-SET-TC/ontology/HarmonizedOntology.owl

Related with performance, an issue that needs to be addressed is whether the gain in automation
justifies the resources needed to develop the ontological representation of the document
schemas. In order to reduce this cost, the SET XSD-OWL Convertor tool is provided to create
OWL definitions of the document schemas. This component converts a CCTS based document
schema into OASIS SET TC OWL Definition and is publicly available from

Note that, by conforming to a standard ontological representation and hence having all
the document schema ontologies in a common pool, the users of the Harmonized Ontology only
need to create a document schema ontology if it is not already in the Harmonized Ontology and
benefit from all the existing connections when they do so.

Another issue related with performance is the computational complexity of the reasoning
process involved. On a PC with 2GB RAM, the Racer Pro 1.9.2 Beta reasoner takes about 120
seconds to compute the Harmonized Ontology. Considering that the Harmonized Ontology will be
re-computed only when a new document schema or a new CCTS based upper document
ontology is introduced to the system, this performance is quite acceptable.
8 Semantic Enterprise Interoperability, Frameworks and Harmonisation of Related Standards

8.1 Overview of Enterprise Interoperability Standards

Standardisation is carried out by European and international standardisation organisations as well as by industry consortia. There exist several standards that can support particular aspects of interoperability like unifying process model representation (CEN/ISO 19440), harmonising information representation (ISO 10303), or enabling the capturing of software capabilities (ISO 16100). Current efforts are more focused on requirements for interoperability in the large by providing a framework for structuring interoperability concerns, barriers and approaches for solutions (ISO/CEN 11354). Table 1 provides an overview on existing standards and work in progress performed in CEN and ISO.

<table>
<thead>
<tr>
<th>Standard id</th>
<th>Name/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEN/ISO 11354</td>
<td>Requirements for establishing manufacturing enterprise process interoperability (to be a multi-part set of standards)</td>
</tr>
<tr>
<td>CEN/ISO 19440</td>
<td>Constructs for enterprise modelling</td>
</tr>
<tr>
<td>ISO 18629</td>
<td>Process specification language (multi-part set of standards)</td>
</tr>
<tr>
<td>ISO 10303</td>
<td>Standard for Product data representation and exchange (STEP)</td>
</tr>
<tr>
<td>ISO 13584</td>
<td>Parts Library (PLIB)</td>
</tr>
<tr>
<td>ISO 15289</td>
<td>Content of systems and software life cycle process information products</td>
</tr>
<tr>
<td>ISO 15926</td>
<td>Integration of life-cycle data for process plants including oil and gas production facilities</td>
</tr>
<tr>
<td>ISO 18876</td>
<td>Integration of industrial data for exchange, access, and sharing (IIDEAS)</td>
</tr>
<tr>
<td>ISO 15745</td>
<td>Framework for Application Integration</td>
</tr>
<tr>
<td>ISO 16100</td>
<td>Manufacturing software capability profiling for interoperability</td>
</tr>
<tr>
<td>ISO 22745</td>
<td>Open Technical Dictionary</td>
</tr>
<tr>
<td>ISO 8000</td>
<td>Data Quality</td>
</tr>
</tbody>
</table>

Some selected standardisation efforts on enterprise interoperability with focus on the business/user stakeholders, outside ISO – some of them open standards developed by industry consortia – are listed below in Table 2. In this overview, we are not considering (industry) sector specific standards.

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Name/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEN-ISSS EBIF</td>
<td>CEN eBusiness Interoperability Roadmap</td>
</tr>
<tr>
<td>UN/CEFACT</td>
<td>UN/CEFACT e-Business framework</td>
</tr>
<tr>
<td>ISA/IEC</td>
<td>Enterprise-Control System Integration</td>
</tr>
<tr>
<td>OMG</td>
<td>Service Driven Architecture (SOA), Business Process Modelling Notation (BPMN)</td>
</tr>
<tr>
<td>OASIS</td>
<td>ebXML Business Process Specification</td>
</tr>
<tr>
<td>OAGI</td>
<td>Open Applications Group Integration Specification (OAGIS)</td>
</tr>
</tbody>
</table>
8.2 Interoperability Frameworks

There exist quite a number of interoperability frameworks. Comparing architectural frameworks addressing enterprise interoperability, there is one unique fundamental property in this standard CEN/ISO 11354, namely the dimensions of interoperability barrier and interoperability concern. Other frameworks do not identify the interoperability problems explicitly, but define areas of solutions. Another difference is in the way of addressing interoperability. Table 3 lists a number of non-commercial, not national nor sector specific, selected interoperability frameworks.

Table 3: Interoperability Frameworks

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Name/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 15745</td>
<td>Framework for Application Integration</td>
</tr>
<tr>
<td>CEN/ISO 11354</td>
<td>Requirements for establishing manufacturing enterprise process interoperability</td>
</tr>
<tr>
<td>ATHENA FP6 IP</td>
<td>BIF: Business Interoperability Framework 43</td>
</tr>
<tr>
<td>CEN-ISSS EBIF</td>
<td>CEN eBusiness Interoperability Roadmap</td>
</tr>
<tr>
<td>UN/CEFACT</td>
<td>UN/CEFACT e-Business framework</td>
</tr>
<tr>
<td>OMG</td>
<td>Service Driven Architecture (SOA)</td>
</tr>
<tr>
<td>iDABC44</td>
<td>European Interoperability Framework for Pan-European eGovernment Services</td>
</tr>
</tbody>
</table>

8.3 Framework for Enterprise Interoperability (CEN/ISO 11354)

The standard is mainly based on several inputs from European R&D projects carried out in the enterprise interoperability domain. At first a thematic network - IDEAS (Interoperability Development of Enterprise Applications and Software) - was launched with the objective to elaborate a roadmap for interoperability. Then two important initiatives relating to interoperability development - ATHENA (Advanced Technologies for Interoperability of Heterogeneous Enterprise Networks and their Applications) Integrated Project and INTEROP (Interoperability Research for Networked Enterprises Applications and Software) Network of Excellence (NoE) have been implemented. Based on ATHENA IP and INTEROP NoE, two organizations were created after the completion of the two projects to continue the development of enterprise interoperability: VLab (Virtual Laboratory) from INTEROP NoE, and EIC (European Interoperability Centre) created by ATHENA IP 45

The needs for enterprise interoperability refer to the ability of enterprises (or part of them) to interact through the exchange of information and other entities such as material objects, energy, etc. Interoperability is a necessary support to allow business collaboration to happen. Enterprise interoperability can apply to both inter- and intra-enterprise needs and includes the concepts of extended enterprise, virtual enterprise and sub-systems of one enterprise. Interoperability is considered as a generic concept, and it is therefore assumed that common problems of interoperability failure and solutions to overcome them can be identified and developed for any particular enterprise.

The multiple-part standard preEN CEN/ISO 11354 defines a Framework for Enterprise Interoperability and specifies processes and underpinning metadata. These data need to be in place to establish or to enable enterprise interoperability solutions for Manufacturing Enterprise Processes (MEP) and their models. The framework establishes a base for interoperation in

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43 ATHENA Deliverable D.B3.1, 2007
44 http://europa.eu.int/idabc
unified, integrated and federated environments of manufacturing enterprises, named interoperability approaches.

Further, four interoperability concerns are identified: Data, Service, Process, and Business. Data are used by services, including Web services. Services are employed by processes to realize business of the enterprise. From another point of view, the goal of an enterprise is to run its business. To realize the business, one needs processes. Processes employ services that in turn need data to perform activities. This context is illustrated in Fig 3.

Finally, an interoperability barrier viewpoint is identified to capture the incompatibilities and mismatches that obstruct the sharing and exchanging of information and other entities. Three categories of barriers are defined: conceptual, technological, and organizational.

The framework is designed with the above-mentioned three viewpoints addressing approaches concerns and barriers of interoperability and shall express the needs of the stakeholder who is concerned with interoperability issues. Figure 4 shows the Framework for Enterprise Interoperability.
interoperability of their supporting software applications. It focuses on enabling the communication rather than defining the communication itself, and is thus independent of specific technologies. Further details of the framework, components and relationships are presented in the Annex.

The standard is originating from the European projects ATHENA and INTEROP. Part 1 of the standard – Framework for enterprise interoperability - has been at least partly supported by the INTEROP project, part 2 - Requirements for ICT-enabled Enterprise Interoperability - has been started as a new work item after project completion. The work is carried out by CEN TC310 WG1 and by ISO TC 184 SC 5 WG1.

8.4 Harmonization of standards

It is noted that there are already several standards in place and some under development that need to be placed in a taxonomy of standards relating to the Future Internet and that there is also research work to be done in identifying where the gaps are and in applying the standard specifications to fill in these gaps. In doing this there needs to be work to coordinate the knowledge of what is being done in RTD and what is already available in standardization (world-wide).

Further, it has been observed that often useful specifications developed by RTD are lost to standardization because they are part of the final output of the Project process and neither time nor money is available to introduce them to standardization.

Another issue is that many standards supporting interoperation are developed by both Standards Development Organisations (SDOs) and industry consortia, both building on research results. However, with no coordination between the different organizations these standards are providing neither a coherent nor a sufficient set of solutions.46

The European Commission recommends in their recent White paper, titled ‘Modernising ICT Standardisation in the EU - The Way Forward’ the following measures:

- Allow for a more integrated approach in ICT standardisation and the use of ICT standards and specifications;
- Strengthen collaboration and cooperation in ICT standards development, both Europe-wide and globally.
- Strengthen competitiveness of industry and fair competition by fostering the implementation of standards and specifications;

It is considered that a project should be created (under Call 5 and as a Coordination Action) to ensure that there is complete harmonisation of standards and which ensures a dialogue between the standardisation environment and the RTD environment. This project should be designed to influence research with respect to standardisation and influence standardisation by disseminating the work of projects. In particular it should look towards a more general Interoperability Framework that covers the Future Internet and especially the Internet of Things and the Internet Service Utility more directly that the existing work in B2B interoperability.

9 Analysis of Existing and Needs for Future User Oriented Standards in FInES

As the previous sections show there is no lack of tools available or in development of methods, frameworks and standards that can or will be used in FInES. This section concerns users and the first consideration is to define who the users are. To date much of the work has concentrated on the B2B area and less to the B2C and little to the B2M areas. Yet with the Future Internet both consumers and machines will become users of the tools we are considering and no “thing”

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provided it conforms to the requirements of being a describable entity, that can be discovered and
managed will be exempt. Similarly no area in business, in premises of any sort or activities by any
entity or person will be exempt from the reach of the the Future Internet, the IoS or the IoT. We
therefore need to look at the classes of “user” and what the environments of these classes may
be.

9.1 B2B

The Business to Business area has been the most clearly developed area for Process and
document interoperability to date and its boundaries are well defined (being the subject of much
work of the Enterprise Interoperability Cluster. There is probably not too much to add to
existing work other than to note that these processes will reach out in the form of Cloud
Computing to the processes of consumers and people at home as well as small businesses. This
implies a far greater need for flexibility of approach in defining the environment of the consumer
or end user. Analysis will be required to understand what will be needed to create (for instance)
and SME link to a customer/consumer to supply a product or service and then support the
product or service but tear down the initial link.

9.2 B2C

The Business to Consumer area is something new. Largely the facilities are not yet in place to
enable a business process communicate with end users unless they are using ITC devices and
while most people do have PCs and Mobile devices, there is no population wide understanding or
acceptance of being able to link business processes with consumer choice with the financial
methods for payment (which may be in either direction since it could include micro employment
as well as micro purchase). It should be noted that any X2Y model may be reversed to a Y2X set
of processes, where in this case, consumers will be initiating processes to interrogate Businesses
(or at least their processes).

9.3 B2M

There are already a range of potential Business drivers that will require interaction with devices,
sensors and things in almost any environment. In the commercial environment these are well
documented and in areas such as energy efficiency there is beginning to be a real business
(possibly human survival) requirement to be able to manage the energy use of almost anything in
any premises or environment, the same is true for assisted living where in another worldwide
requirement to reduce healthcare and support expenditure by using systems and applications to
help care for people at home. Entertainment is another area where there are many reasons for a
Business to be driving content into an entertainment system. In all cases, this may be a push
B2M system or a pull M2B system and thus be an extension of Cloud Computing.

9.4 B2A

It is highly likely that Businesses such as health, care and energy will wish to spawn Applications
into various environments and interface with them. While Applications may be seen as an
extension of local M2M transactions they may simply be proxied processes carrying out a set of
services in a particular environment and contained in a local processing device of sufficient
capability. Included in this class would be A2A (Application to Application), A2M and A2C. It is
highly likely that most of the processes in this are will be autonomous (self regulating and self
healing) and only requiring interaction with their parent business processes when they require
external intervention of any kind. Again once an application is in place it may pull services from
the Business environment.
9.5 C2C

It is almost certain that there will be myriad instances of Consumer to Consumer activity in many different business, leisure and private. These will work through a wide range of Businesses and applications and their scope will be limited only by the imagination of the human race. What will be important is the issue of ease of communication, MMI and privacy, indeed as soon as any of these classes escape from the B2B environment, privacy, security and trust become paramount.

9.6 General Requirements

What characterizes all of the above classes is:

- Each of the entities has a distinct identity, description and (as appropriate) can be discovered and managed.
- Apart from the B2B environment there is no limit to the variety and complexity of the activities and underlying processes, but they will only work if there are standardized ways of invoking standard methods and applications to enable what is wanted when it is wanted by whatever raises a requirement.
- There will be major complexity and many unknowns in the interaction of various activities and this will include multiple calls on specific entities by different services, applications and processes.
- We really have no idea about what future services, applications or requirements will be, except that for them to work there needs to be a general interoperability framework.

It will be essential to carry out work / research to identify the available and required elements that will be or need to be available.

- It will be essential to create an universal framework starting with the basics and then plugging in the “bricks” of processes, methods and entities so that any “A”, “B”, “C” or “M” can be utilized to make the activity happen.
- Any of these future scenarios must be capable of analysis, diagnosis, manipulation and rectification since outside the B2B environment we can no longer control what people will throw into the complex mix of the Future Internet. Therefore we must be able to test the Interoperability of all and any of the Business, MMI, Application, and process entities for their conformance in any potential environment (and we don’t at this time have a handle on what even a small fraction of these will be). Therefore the Framework has to be highly pragmatic, understandable, useful and user friendly.

The real challenge is to take the existing standardization and utilize it within a standard framework so that the aims of the Future Internet can be realized.

In realizing this challenge it is considered that an Integrated Project should be proposed that analyses the existing work of Interoperability Frameworks and carries out integration of existing work and the tools to enable automatic discovery, configuration and management of “things” by services (SaaS-U). This project should lead to more general conformances, testing and certification of interoperable things and the services that will utilize them.

10 Conformance and Interoperability Testing Standards and Initiatives

Interoperability is a major challenge of today’s business applications. Several standards have been developed and some are still under development to address the various layers in the interoperability stack: the communication layer, the document layer and the business process layer. Hence, there are several alternative standards for each layer. Profiling is used to overcome this problem which is predetermining the combination of the standards and even further restricting them to provide interoperability. Whether it is a single standard addressing specific layer in interoperability stack or an interoperability profile referencing several layers in the
interoperability stack, without properly testing the systems, guaranteeing the interoperability is not possible.

Interoperability and Conformance testing involves checking whether the applications conform to the standards so that they can interoperate with other conformant systems. It is clear that only through testing, correct information exchange among applications can be guaranteed and products can be certified.

The interoperability stack involves the following layers:

1. Communication Layer: This layer covers the range from transport and communication layer protocols like HTTP to higher level messaging protocols such as Simple Object Access Protocol (SOAP) or ebXML Messaging. Furthermore, security, reliability and other quality of service protocols and extensions over the messaging protocols are also considered in this layer.

2. Document Layer: This layer addresses the content of messages and administrative documents which are exchanged among applications. Restrictions specified by the standards may include
   - The document structure and semantics;
   - Code lists and taxonomies in use, and
   - Semantic rules among data elements.

3. Business Process Layer: Integration profiles and some of the standards provide their restrictions in accordance with a business process which models an identified real life use case. The business process layer, either presented in a formal business process specification standard such as ebXML Business Process Specification Schema or with an informal workflow definition like IHE interaction diagrams, provides a message choreography, exception flows (error handling) and other business rules for the eHealth application roles participating the process.

Currently, there are testing tools, test suites and testing committees which individually address a specific standard or one of the above layers. However, integrated testing frameworks which do not hard code a specific standard at any layer (because different communities may use different standards) and are capable of handling testing activities at all layers of interoperability stack are necessary for conformance and interoperability validations. Moreover, ensuring correctness of produced data or a business result according to operational semantics of the real life use case is another motivation for testing activities. In fact, this is as crucial as achieving plug-and-play interoperability. Therefore, test frameworks should extend the automation of testing to cover the real life semantics of the business cases.

It is considered that this extension should form the second phase of the proposed Integrated Project. It should call on existing work as detailed above but make this fully extensible for the IoT. In addition it should detail the requirement for Test Beds and future commercial facilities and carry out experimental implementation at various facilities in Europe.

The ultimate Goal of this project will be to remove the Interoperability Barrier and open any environment (B2B, B2C, B2M and Services and Applications in Business, Domestic and Commercial premises) to reliable and effective pre product testing in an efficient and economic manner. It is considered that doing this will release a wave of new products and services that will enable and greatly increase the competitiveness of Europe and its Gross Domestic Product.

10.1 CEN/ISSS Global Interoperability Test Bed (GITB) Project

The main objective of GITB is to develop, under EU support and guidance, a set up of a comprehensive and global eBusiness interoperability test bed system in a global collaboration of European, North American and Asian partners. This objective is planned to be achieved in three phases, the current project covering phase one.

Hence, the objective of the current project phase is to prepare a feasibility study for a "Global eBusiness Interoperability Test Bed". The global test bed would be designed to support eBusiness standards assessment and testing activities from early stages of eBusiness standards.

47 http://www.ebusiness-testbed.eu/about-gitb/
implementation, to proof-of-concept demonstrations, to conformance and interoperability testing. The project is hosted by the CEN/ISSS eBusiness Interoperability Forum.

10.2 Future Projects seen as necessary

10.2.1 Coordination Action

It is considered that steps should be taken to ensure that there is maximum harmonisation of the large set of existing and developing standards in the area of the Future Internet and for Interoperability of services and things/devices and which ensures a dialogue between the standardisation environment and the RTD environment. This project should be designed to influence research with respect to standardisation and influence standardisation by disseminating the work of projects. The project should ensure that all current and future projects under the life of the CA must ensure they have links and outputs into standardisation and where insufficient resources have been allowed for this, ensure activities are established to overcome such shortfalls. The project should hold knowledge dissemination events that attract both the research and the standardisation communities In particular it should look towards a more general Interoperability Framework that covers the Future Internet and especially the Internet of Things and the Internet Service Utility more directly that the existing work with B2B interoperability.

10.2.2 Integrated Project

While there has been significant effort and funding to ensure that the activities of the Enterprise Interoperability Cluster are realized in standardization under such projects as GITB and the eBITs coordinated by CEN, and there are many standards that are moving towards a global interoperability conclusion, it is noted that for the Future Internet and especially for the Internet of Things (any intelligent device, object, sensor, application in any premises or environment) and the Internet Service Utility or Internet of Services (which are the processes and systems that utilize the “things”) there is still no Framework or Solution which will remove the barriers from large scale adoption and utilization of intelligent devices and new and innovative services. We know already that some sectors have a pressing need for interoperability across large numbers of objects and devices and these include Assisted Living and Smart Grids and while it is not the objective of any project under Challenge 1 of the 2009-2010 Work Programme for FP7 to address these sectors, the research and development for an Interoperability Framework that can be used, can identify and use smart devices and objects, can have new services and applications written easily to utilizes the devices is a prerequisite for these and many other sectors being able to provide interoperable solutions.

It is considered that without an overall framework there will be a barrier to effective and efficient adoption of new services in these sectors and in general across any environment where large numbers of dissimilar devices under multiply different systems and protocols exist. (It is recognized that while there are certain unifying technologies such as IP, Web Services and as it becomes widely used Cloud Computing, there are nevertheless a vast range of existing and proprietary solutions that will persist and with which any solution will need to interwork with).

The initial proposal of this report is that there should be an Integrated Project to address this. It should be phased to build the framework, to identify all the relevant tools and work out how best as relevant to specific applications, services and environments, they can be called or plugged into the framework and used. To prepare detailed requirements and specifications for test environments, the actions required for testing for interoperability and for designing applications and services and flexing their interactions to confirm conformance or identify shortcomings.

As a second phase it is suggested that there should be field implementation in a number of test environments across Europe and in parallel as the test environments through practical experiment reveal the effectiveness of the framework, the requirements should be taken into
standardization and converted into ENs for the Interoperability conformance and certification of products and services under the Future Internet.

It is also considered that under this phase, the research organizations and test houses that are partners in the project will be encouraged to commence commercial businesses to undertake conformance under the emerging standards and utilizing the facilities developed under the phases of the Integrated project. It should be emphasized that this activity will be expected to result from the Integrated project and not be part of it.

The Phases of the Integrated project might be similar to the diagram below:

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11 Conclusions

This report demonstrates that there is much work in progress and completed in the area of the Enterprise Interoperability which is being standardized now. Although more is undoubtedly needed the B2B area of services and business processes is now well understood and standardization is well advanced.

There are very many initiatives and standards work in progress in the areas of Cloud Computing and the Semantic Web and the task here is to make sure that there is understanding across all the initiatives of what is being done, has been done and needs doing. The outcome of this work should be coordination of a standards framework for all of the tools and processes in the Future Internet space and an understanding by researchers as to what needs doing to complete the gaps and bridge any divide between approaches and methodologies.

What appears to be needed in the Future Internet space is a way of taking the research and delivering ways of making it work seamlessly across the whole range of systems, devices, applications and “things” of the Future Internet. We need to develop ways in which we can test and confirm Interoperability and ensure all the elements of the Future Internet can work together and interoperate as required and in conformance with known standards and certification.

There is a good case for project proposals to be prepared under FP7 Call 5 in order to coordinate the links between RTD and Standardisation and for a large scale project to deliver that widescale usability of the Future Internet.

It can reasonably stated that if we can remove the barriers to the widespread deployment of “Things” and enable the delivery of clever, innovative services and applications, the benefits to...
the EU in terms of increased GDP, in enabling Energy Efficiency, in securing Assisted Living and in many other areas the benefits will be very significant.

All of this however, needs a close correspondence between RTD and Standardisation in the area of the Future Internet.