Future Internet Infrastructure for Environmental Services, Sensors and Content Use cases

We provide this position statement based on Environmental use cases and requirements related to a Future Internet Infrastructure for the Single Information Space for the Environment in Europe (SISE), based on the ENVISION project and a related set of ongoing projects under FP7 Objective 6.4 for Environmental Services.

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Objective ICT-2009.6.4 ICT for Environmental Services and Climate Change and 6.4b on *Flexible discovery and chaining of distributed environmental services***,** This objective focuses on Environmental services platform and infrastructure by providing tools for an easy discovery of environmental service nodes on the Web and their on demand adaptive chaining (or composition), taking full advantage of international open standards. This includes generic semantics frameworks and dynamic ontology services for the discovery of and access to distributed environmental resources in a multilingual multidomain context. It also includes methods and protocols for service chaining and for the management of the effects of uncertainty propagation through service chaining.

The ENVISION project, ENVIronmental Services Infrastructures with ONtologies, www.envision-project.eu, is one of seven projects aiming at meeting the requirements of objective 6.4 above, based on the use of an underlying internet based platform.

An important challenge in today's environmental applications is to support the migration of environmental models to be provided as a service on the Web, and to be able to use other services, in the context of a potential wider environmental user community of service providers and service consumers. We refer to this shift in the way environmental modes are provided as to Model-as-a-Service (MaaS). This paper defines MaaS and introduces ENVISION – an easy-to-use framework to support the emerging MaaS paradigm. We propose a general architecture (comprising components ranging from environmental Web portals to semantic service annotations to adaptive service chains execution) for ENVISION. Our architectural choices are motivated and validated by two scenarios (one from oils spill and the other from landslide monitoring and analysis)

Together with the Single Information Space in Europe for the Environment (SISE) (Weets 2006), the Shared Environmental Information System (SEIS)[1] is one of three major initiatives, jointly with the INSPIRE Directive[2] and the Global Monitoring for Environment and Security (GMES) initiative,[3] taken by Europe to collect and share

1 http://ec.europa.eu/environment/seis/index.htm

2 http://inspire.jrc.ec.europa.eu/

3 http://www.gmes.info/

environmental information for the benefit of the global society. Major SEIS aims are: to improve information availability and quality for a better design and implementation of Community environment policies, to reduce the administrative burden on Member States and EU Institutions and to modernize reporting, to develop information services and applications that all of us can use and benefit from.

Many current environmental models are provided through monolithic and isolated applications, only linked by manual handling of input and output files and interactive data entry. In the evolution towards SISE/SEIS it as a goal that not only data become available, but also a large number of environmental models become available as services. We refer to this shift in the way environmental modes are provided as Model-as-a-Service (MaaS). This provides further requirements for an underlying internet based platform in various areas, such as Internet of services, Internet of things and Internet of content.

This position statement argues the case for using the domain of European Environmental Infrastructure for requirements gathering for, and large scale experimentation of, the Future Internet Core Platform. We propose to utilize emergent results from the FP7 ENVISION (http://www.envision-project.eu) together with other collaborating objective 6.4 projects to reach a critical mass of highly relevant use cases, future internet Environmental developer communities and future internet Environmental users.

In this position statement we outline:

- The use case of Environmental Infrastructures and utilizing the ENVISION project and other collaborating projects.
- What innovative future internet functionality and technologies that is important to succeed in the domain of Environmental Infrastructures.
- Functionalities expected from the core platform with regard to Environmental Infrastructures.
- What kind of experimentation environment would you consider necessary for broad large scale testing of the platform to be developed in your use area.
- The role of SINTEF and the Environmental Infrastructure communities

(1) Use case and scenario for large-scale experimentation with the Future Internet

In the objective 6.4 set of projects we have many environmental applications with highly appropriate scenarios for experimenting with the Future Internet (FI) platform, and especially the integration of services, content (large models) and sensors into the FI. This approach will be beneficial for a rich set of applied areas, including marine ecosystem environmental monitoring and management, climate change impact on ecosystems and biodiversity, urban industrial activities and geo-hazards management, enhanced traffic management, and green smart cities. The figure below shows the application domains and related infrastructure services above a core platform for Internet of Services, Internet of Things and Internet of Content.

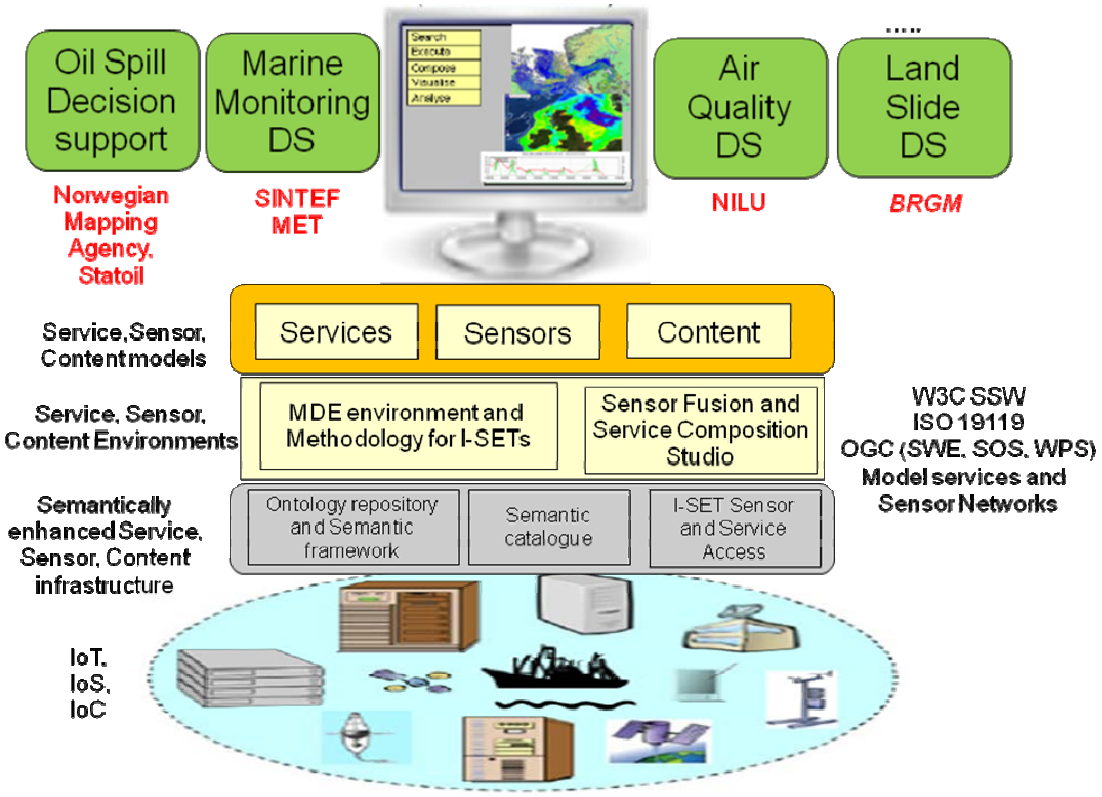

Figure 1 Application areas and services for an Environmental Infrastructure on top of a Future Internet Core Platform

(2) Important innovative Internet functionality and technologies

Applications related to each of the areas mentioned before would benefit from the use of a an Environmental services infrastructure based on a Future Internet platform that support an integration of Internet of Services, Internet of Things (Sensors), Internet of Content and Internet of Networks, as illustrated below.

(3) Expected functionalities of Future Internet core technology platform

Federated Open Trusted Platforms (FOTs): Cost effective design, development and deployment of Environmental models and applications requires FOTs to emerge, so that platforms developed for this (such as ENVISION) can inter-connect, inter-operate and inter-work with platforms for other verticals. Deploying an environmental solution does not happen in isolation, but happens in a service and platform infrastructure where connecting to other services through common and open APIs and services is necessary.

Internet of Services: As seen from the environmental requirements, we see that several services from different verticals need to seamlessly inter-connect and inter-work in order to provide a

suitable environmental service. Flexibility, adaptability and configurability of services is important to ensure adaptation to individual needs. The concept of Software as Services (SaaS) is also central to the environmental models, as costs and flexibility is crucial for sustainable deployment strategies. Services in the environmental domain, especially safety and security services rely on an infrastructure provided by a core platform that is dependable, reliable, and secure.

Internet of Things: Environmental solutions need standardised mechanisms for manageable sensors & actuators, sensor data storage and sensor fusion in order to provide the necessary quality of service. Availability through a core platform would ensure deployment in highly fragmented domains and environment, in a secure and stable manner. Models supporting this will need integrated mechanisms for handling Event Driven Architectures.

Internet of Networks: Environmental infrastructures would need to integrate and bridge many different wireless and connected network infrastructure.

Internet of Content: The Environmental community has large volumes of data that needs to be supported both in the context of simulations (suggesting use of cloud computing facilities), and in the context of efficient multi language search and retrieval. Ontologies and integrated support semantic technologies for handling this becomes important for the support of interoperability among various data sources.

(4) Requirements for an experimentation environment and prototype platform

The emerging European environmental infrastructure would be able to provide a set of interesting use cases and requirements for a core internet platform, and also be able to provide an initial set of experimental environments for the first trials for use cases.

(5) Potential role of our organization in the FI-PPP

The SINTEF Group is the largest independent research organisation in Scandinavia. Every year, SINTEF supports the development of 2000 or so Norwegian and overseas companies via our research and development activity. SINTEF has approximately 2000 employees, 1300 of which are located in Trondheim and 450 in Oslo. We have offices in Bergen, Stavanger and Ålesund, in addition to offices in Houston, Texas (USA), Skopje (the former Yugoslav Republic of Macedonia), Rio de Janeiro (Brasil) and a laboratory in Hirtshals (Denmark). SINTEF's head office is in Trondheim.

Infrastructure and partnerships that SINTEF MET (Marine Environmental Technologies) and SINTEF ICT can bring into an Environmental Use Case:

- Coordinating and participating in several European Environmental projects.
- Coordinating work on establishing one common European platform for Environmental Services Infrastructure (ENVISION).
- Established cooperation with leading industry in the domain.
- Established cooperation with public authorities, regions and clinical expertise for real life tests and evaluations of environmental infrastructures.

- Established cooperation with end user organizations and domain experts.
- Participation in standardization activities, (ISO, OGC, OMG, OASIS, W3C, …)

What we concretely can offer of results that is of value for a Use Case scenario:

- Knowledge base of end user and developer needs and requirements in an Environmental setting.
- Knowledge base of the use of standards (ISO, OGC, OMG, OASIS, W3C, …)) and contributing to the same.
- Open source and standards based service platform for the development of an Environmental service infrastructure.
- Experience from developing environmental services and running long-term field evaluations.
- Results from empirically evaluating use of technology platforms on developers and methodology for doing such research.

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