This position paper outlines the response to the five issues and open questions to be addressed for the 'Towards a Future Internet Public Private Partnership'.

Key Features needed in the Future Internet Core Platform

The overall perspective for the Future Internet Core Platform is sound. Certain aspects need more focus. Two such aspects are highlighted:

- Support for *Solution-as-a-Service (SOaaS)* i.e. the new cloud computing paradigm that envisions delivering *cloud-based solutions* instead of 'software', 'platform' or infrastructure' services
- Support for *rapid* service design, optimisation and lifecycle management using *automated*, *model-driven* architectures, tools, techniques and paradigms for *SOaaS*

Ensuring "Future-Orientation"

The current industrial paradigm for delivering an 'internet of services' using cloud computing is based on variations of the 'SPI Model' i.e. Software, Platform or Infrastructure - as a Service, respectively. However, the industrial landscape based on this model has certain inherent limitations such as single 'SaaS vendor' lock-in, and limited end-consumer service composability, customisability and flexibility.

The *Solution-as-a-Service* or *SOaaS* paradigm, which envisions *solution providers* leveraging multiple SaaS platforms into composite, unified, and managed customisable solutions, proposes a more open structural and behavioural model that focuses on end-consumer issues like easy service configurability, managed personalised usage and flexible business scenario support for services of the future.

SOaaS is described as a cloud computing paradigm that envisions delivering *cloud-based solutions* instead of 'software'. SOaaS focuses real-world business and end- user needs and delivers solutions that are user-centric (not software centric), collaborative (not closed), truly personalised (not template based) and manage-free (not 'install and continuously update'). SOaaS, *pre-packages the integration* necessary between technology stacks and functionality silos, multiple softwares, applications (offline and online), SaaS platforms, functional workflows and service interfaces. SOaaS is therefore a sound paradigm that directly addresses the topics of *Portability and Interoperability* as well as *Evolution and Adaptability* that are crucial capabilities delivered by Generic Enablers (GEs).

Innovative Future Internet Functionality, Technologies

The following are some recommendations for Innovative, Future Internet Functionality and Technologies in the form of Advanced Components and Implementation Options:

Advanced Service Components :

- *Cloud-Based Data Components Suite* – this suite should supports extracting essential pieces of information from large amounts of data. The suite in particular should support cloud-based data collection from several sources, pre-processing for normalization, outlier detection and persistence management to enable other consumer systems to automatically evaluate metrics, rules, characteristics and functions to be applied to the extracted data with significant flexibility in terms of usage of aggregation and data profiling mechanisms. Finally the suite would enable export of diverse, composed data profiles and elements that can be accessed by internet services

This Component addresses the 'Event and Data Management and Processing' topics.

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Implementation Options : Service Facilitation Platform

- *Cloud-Bus* – a cloud-based platform that provides an implementation of the generic service bus concept to support the *SOaaS* paradigm as a driver for the user-centric collaboration of services approach that will be a key aspect of how the future internet will benefit citizens. This approach assumes that each individual is assigned a central authority in a services ecosystem. The *SOaaS* paradigm would use the Cloud-Bus platform to enable on the one hand transparent and autonomous provision of external systems with data related to a citizen and on the other hand, dynamic and autonomous service collaborations between independent services to ensure scenario enactment. This approach uses Cloud Computing technologies to *enact* the personal authority, its interconnection with services and its provision and persistence management of user-related data. Therefore, the authority citizen is able to organise information and collaboration into domains, for instance personal information, finance, health, locations, schedules, and so on.

This Implementation Option addresses the 'End-user Access, Adaptation, Service Handling and SOA Support ' topics.

Support for Use Cases and Scenarios

The FI-PPP defines several usage areas and encourages cross-domain applications and services. From our our perspective an 'Open Ecosystem for Personal Data and Services', using *Solution-as-a-Service (SOaaS)* as an enabling paradigm would serve as an *enabler for several scenarios and use cases across domains* with *specific applicability for the Smart Energy domain*.

Scenarios

Typical scenarios in the various use cases use case depend on the efficient gathering and provisioning of relevant data, information and services. Information is gathered by a multitude of various, heterogeneous sources, like *energy meters*, stationary sensors, RFID chips, mobile devices and software services. Out of these sources, vast amounts of data emerge. In order to utilise the information intrinsic to this data, data must be analysed and provided dynamically, depending on the volatile context of a given scenario, like *demand-supply balance in Smart Grids*. In order to detect these contexts appropriate means are necessary, in general, a platform for the ubiquitous availability of information relevant to dynamically emerging use cases. Scenarios are described below:

1) *Gathering and metering energy consumption* would enable a key cross-domain feature of raising personal awareness of citizens as well as leveraging the means to minimise energy consumption. A city on the whole could for example, track the daily energy consumption of its citizens in transit and provide them with a detailed daily report including the amount of used power and the Energy and CO_2 footprints. To enable this, the city would have to detect the single usages of power-driven facilities as well as the energy costs of products and services.

2) Capturing traffic and crowdedness of public streets, places and sights and computing respective average profiles would enable the city to provide citizens and tourists with individual travelling plans for each day. Therewith, the *amount of energy wasted due to traffic and overfilled sights and places could be minimised*. In order to do so the city would have to be able to analyze traffic and crowds and distribute travelling plans to citizens, individualised and depending on the citizen's daily schedule, which would optimise their energy consumption and CO2 footprints.

3) If public transportation schedules could be combined with the current location and the daily schedule of citizens, the citizens could be made aware of the most energy optimised yet personalised routes. Stores and service providers could also be integrated and provide further information about their products to citizens in a energy friendly manner as they would be targeted and not broadcast. City infrastructure could gather this information and forward it to the citizen. The effect of all this would be to *help citizens fundamentally alter their energy consumption patterns towards more sustainable ranges*.

FI-CP Platform support, Experimentation Environment

We believe that the FI-CP Platform will need to support the following set of capabilities which in turn can be validated using Large Scale Experimentation Environments:

- Support for *Solution-as-a-Service (SOaaS)* i.e. the new cloud computing paradigm that envisions delivering *cloud-based solutions* instead of 'software', 'platform' or infrastructure' services
- Support for *rapid* service design, optimisation and lifecycle management using *automated*, *model-driven* architectures, tools, techniques and paradigms for *SOaaS*

Future Internet services and solutions will be massively distributed over a set of heterogeneous platforms and devices. Because contemporary imperative and object oriented programming languages do not support this kind of distribution very well, we expect that we need to shift from these paradigms to a combination and integration of programming and specification distributed architectures.

Relevant Assets, Expertise and Facilities Contribution

This position paper is a combined statement from *THALES Information Systems, Belgium* and the *Software Engineering Department at RWTH Aachen*.

THALES Information Systems Belgium (TIS) has and is involved in multiple EU projects. TIS, brings to the FI PPP, extensive, cutting-edge, expertise in the area of Solution-as-a-Service, System Architectures (Web-based services, SOA, MDA/ MDE, Peer2Peer, Grid, ICT convergence, etc.), Critical Information Systems and Systems Monitoring as well as competencies in Open-Source Software and Open Standards. TIS also brings to the project extensive, expertise in the area of pan-EU projects management including for ARTEMIS, NESSI and MODELPLEX (combined value of several hundred millions of Euros). TIS will be represented in the initiative by *Mr. Kumardev Chatterjee, who is the EU Innovation Manager and Senior Software Architect* for THALES Information Systems, Belgium.

The Solution-as-a-Service Competency center (*SOaaS* CC) at RWTH Aachen is a part of the *Software Engineering department led by Dr. Bernhard Rumpe*. The department is multidisciplinary and focuses on both Research *and* Innovation (R&T). The department has a long history of Research and Innovation Excellence and is staffed by both experienced researchers *and* industrial experts n the domains of Cloud, Software Architectures, Complex Systems Software Architectures, Model Driven Architectures, Engineering, Software Tooling and Integration. The *SOaaS* CC builds on the department's more than 10 years of experience and expertise in multiple industry domains, including Industrial Engineering, Energy , Transport (Automotive, Rail, Air), Insurance and Telecommunications. The department collaborates intensively with European Industry including THALES, SIEMENS, Generalli, Ericsson and others. The department has substantial involvement in Industrial, National and EU projects including MODELPLEX.

To support the development and adoption of the Future Internet, the SE Labs has developed several of the ideas, concepts and assets discussed here in collaboration with THALES Information Systems, Belgium.

A generic platform infrastructure (i.e. Cloud-Bus) that supports *SOaaS* has been developed using MODELPLEX Technologies, and building on the NESSI Open Reference Model and Architectures. This platform addresses several of the challenges posed by cloud computing w.r.t to security and trust aspects and has been evaluated in a project for energy applications.

Further a framework for the efficient development and processing of data models, domain specific languages (DSLs) and tools i.e. MontiCore is available. MontiCore is well-suited for data and service integration between several services using a model-driven approach and support agile development processes. It can easily be used to setup a model-based process that allows for the rapid and evolutionary development of service ecosystems. Among the most recent tools developed with MontiCore are ProcEd, a Web Editor for Domain Specific Process Languages, and MontiWeb, a tool for completely model-driven development of web-based information systems. With MontiWeb and ProcDSL we have gained immersive experience in building tools and frameworks for the rapid design, development, deployment and management of service ecosystems in multi-environmental contexts like the Future Internet platform.

Based on our solution delivery, tool environment and experience in language design, and with our knowledge in generative software engineering methods, we can substantially contribute to both the design, development and deployment of *SOaaS* for the FI-PPP as well as the development of new approaches, languages and tools for the development of distributed software systems running on heterogeneous platforms and devices. Model-based approaches are also well-suited to tackle further crucial issues of smart cities, like integrating heterogeneous services and components, specifying data and security constraints and providing easy-to-use means for non-programmers to formalize information.