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The EUROPEAN FUTURE INTERNET INITIATIVE (EFII)

Position paper on the Core Platform needed to support the Future Internet Projects

1 Motivation

The European aspiration of creating the most competitive and dynamic knowledge economy and rapidly raising standards of living must be based on the Future Internet being integrated in the business processes of all industrial sectors with a special focus on helping new and innovative SMEs and start-ups to succeed by providing a more flexible and less costly IT infrastructure and SW. This will enable these sectors to be more efficient in terms of using resources, reductions of emissions, improving their business processes and helping people.

To achieve this, there is a need to confront, understand and support the expectations and requirements of the different sectors in order to deliver a common, standardized, efficient Internet.

This challenge requires bringing together the competence of the application sectors (Usage Areas) and the ICT sector to work out common solutions from an end-to-end perspective. This entails a multidisciplinary and integrated approach, where massively distributed services and applications are run over large scale and secure internet platforms. This is the only adequate way to deal effectively with the increasing complexity of intertwined application and service demands and still ensure compatibility and interoperability of the solutions.

The EFII has analysed a number of representative “Usage Areas” and determined sets of applications that may share common domain expertise, technological and services requirements so that they can, in turn, share framework, technologies, generic common enablers and architectures in the provision of working systems.

This concept of maximum commonality across application sectors is crucial to facilitate the creation of a critical mass for advanced services and the creation of European-scale markets for smart infrastructures, with integrated advanced communications functionalities.

Hence, The EFFI is proposing to develop and deploy a platform that instantiates a **unified and consolidated** open architectural approach that globally enables the creation, deployment and execution of applications by using hardware, software, network enabling capabilities etc. **This is what we refer to as the Future Internet Core Platform.**

A platform is an aggregation of computing capabilities, communication capabilities and software supporting functions that are combined in an orderly manner according to an architecture, and which allows applications to execute.

The "core platform" is defined by a finite set of generic enablers that are common to many usage areas. A generic enabler provides computing, communication or software resources, functionalities and support services or a meaningful combination thereof.

2 Overall Approach and Rationale

The Future Internet must be based on shared frameworks, technologies, common enablers and architectural principles. These will be defined through the Future Internet Core Platform (FI-CP) concept. This is built on the need to evolve from a set of communication-centric, content-centric, service-centric, resource-centric isolated infrastructures to a polymorphic infrastructure, where the boundaries between systems are more flexible and allow blending, and where the emphasis is on the integration, interrelationships and interworking of their elements through new service-based interfaces.

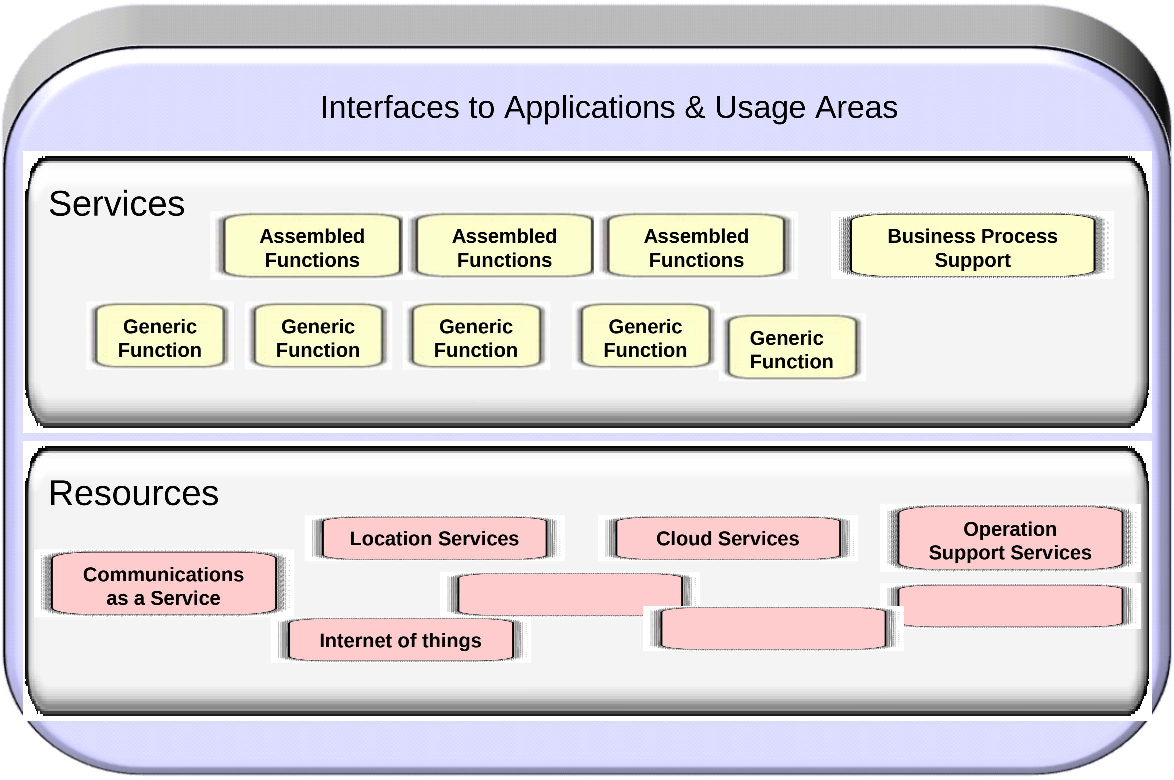
By architecture we mean a set of rules to define the structure of a system and the interrelationships between its parts.

Future Internet enabled Applications will typically be built on top of Future Internet Core Platform Instances (FI-CPI). A set of Generic Enablers is provided with the aim of building such instances in an easy and affordable way, and with the intent to support sharing of the same architectural principles across all instances, enabling interoperability between applications running on top of different instances.

Generic Enablers, selected for a given platform instance, are configured and "glued" together to provide an appropriate set of functionality. Future Internet Application Providers can use standard interfaces provided by such a Platform to deploy and monitor the type of applications for which the platform was designed.

The benefits of such an approach would be to:

- Analyse and classify the needs from Usage Areas and identify commonalities
- Define open interfaces between enablers and assembled functions
- Develop or integrate functionalities which meet the needs of Usage Areas according to a sound methodology



Such a Future Internet Core Platform would not be built from scratch but would be assembled on an iterative basis to meet design specifications coming from Usage Areas. This assembly will also make use of existing results coming from various Framework Programmes, National Initiatives or companies´ internal developments.

3 The Core Platform Architecture

3.1 Basic Architectural Principles

The Future Internet Core Platform provides the means to support many different applications and business processes, which may have different requirements on the Core Platform capabilities. Therefore, different instances of the Core Platform can be established comprising different Generic Enablers (GEs). However all instances should adhere to a common architecture and some basic architectural principles.

Each Future Internet Core Platform Instance will be created based on the combination of a number of the Generic Enablers defined above, targeted to cover the needs of Future Internet Applications. These GEs should be designed to support **interoperability** of applications as well **as portability** of a given application across alternative implementations of the supporting FI-CPI and allow the **evolution** and adaptation of the each FI-CP and FI-CPIs to the changing needs of the Usage Area and the new advancements in the state of the art.

Portability and Interoperability

Enablers available for the creation of FI-CPIs will provide open interfaces that applications will employ in order to benefit from the Core Platform services and functionality. They may also require that applications provide some data in compliance with some metadata definitions. Therefore,

- A common communication model will be defined based on the requirements of the usage areas (e. g. Quality of Experience, mobility and security issues) and operational constraints following the next generation network architecture (data control, management plane).
- A unified set of interface specifications – based on the communication model and where needed and appropriate- should be defined that will be adopted by all GEs and FI-CPIs.
- Interfaces must be invoked in a standard manner to ensure a sound model and a coherent usage of enablers.
- Open standard metadata specifications have to be defined for all those pieces where standardization of metadata will be required to support portability and interoperability (e.g., service specifications to be used during marketplace registration)

In order to meet its objectives, the FI-CP will have to address this issue in a pragmatic way, selecting and promoting those solutions that best solve the requirements coming from the usage areas and minimizing fragmentation in terms of the GEs implementation and integration. Service orientation, Web oriented architectures, REST vs. WS-*, commonly accepted ontologies and XML standards, new solutions proposed by many parties like USDL will all be analysed and adopted where appropriate.

Evolution and adaptability

A FI-CPI can be considered as a composition of enablers into a platform that supports a particular family of smart FI applications and services. This composition evolves over time, i.e. enablers can be added, removed, reconfigured, and managed in a continuous platform life-cycle. From an engineering perspective the focus must therefore be put on supporting the controlled evolution and change of FI-CPIs over time.

4 What will the Core Platform Offer – Initional Set of GEs

To tackle the provision of services at a global scale, FI-CPIs might support the following principles at global level:

- **Accessibility**: Every entity in the Future Internet must be made accessible anywhere-anytime. This is related to ubiquitous connectivity.
- **Identification and Naming**: Every entity in the FI must be uniquely identifiable.
- **Run-time explorability**: Every entity in the FI must be self-describing. This is essential to allow the exploration of entities at run-time – not only at design time.
- **Data**: All data exchanged between applications must be self-describing.
- **Trustworthiness customization**: every entity must be able to adjust or to expose adjustment rules regarding security, privacy, integrity, compliancy and certification aspects based on the interactions in which it operate at run-time in a global level
- **Non-Functional Aspects**: Elementary non-functional aspects such as quality, governance, accountability, resilience, availability, and integrity must be properly supported in various degrees by entities in the FI globally.

The FI Generic Enablers Development activity will focus on how the above core platform objectives can be implemented my means of a core set of Generic Enablers. The architectures, interfaces and information flows will also be defined to allow these GEs to be developed, integrated and managed to create FI-CPIs. The intention is to standardise the interfaces to encourage global take up of the results of this initiative.

The identification of the highest priority Generic Enablers in accordance with the overall goals and objectives of building the Core Platform will be based on which enablers can support the most generic sector requirements. Obviously the enablers that are critical to all sectors will be highest priority.

The iterative exercise to identify, define and characterize the generic enablers is already taking place. The emphasis is to selecting a realistic set of Enablers and to find pragmatic ways to implement them in the given time frame. Use of available results from previous research work is part of the strategy.

The following sections provide more detailed information about the overall vision and motivation behind some of the Generic Enablers identified so far.

4.1 End-user access, adaptation and composition of Resources

This GE encompasses specific enablers responsible for empowering users in the usage and adaptation of the different available resources. By resources, we mean any end user valuable software or content, that is data sources (RSS, OpenData, web contents…), Services (WS*, REST, IMS, Telco Services, …) or Applications (Web Clients, Gadgets,…)

In other words, the ultimate goal of this GE is to offer the necessary technologies to allow end-users to access and adapt every resource to any delivery context, situation and process, taking into account a wide range of scenarios covering any daily-life common tasks and the fusions of roles users take at any moment and any place (work, entertainment, family, home etc.)

End-users of any application must be able to act as prosumers, creating new content and applications and sharing their knowledge in well controlled crowd-sourcing environments. Technologies that empower end users to create and compose new resources by means of lowering as much as possible the technological barriers will be developed and integrated in this GE. At this moment Mash-up technologies applied to Data, Services and Applications are the best candidates to fulfil this need.

Moreover autonomous helpers are desired, able to solve generic issues that could appear during the creation or exploitation phase, such as context awareness, including but not limited to delivery context (device, network etc.), user context (identity, preferences, profile role, and social information), environment context (location, sensor information, “things” offering information or services etc.) or situation (time, date, season, at home or at work, on vacation, on a business trip, mood etc.)

4.2 Service Handling and SOA Support

This GE will encompass components in charge of providing all the basic services required for a next generation SOA approach, where all computing and networking infrastructure resources, IoT elements, devices, SW functionality etc. are encapsulated and handled and offered as services, both internally within the platform and externally to the Usage areas.

Representative functionalities offered by this GE are (among other possible candidates):

- Uniform naming resolution for any *Entity in the platform (services, things, devices, nodes, resources, etc.)* that supports both public and private spaces, together with the ability to handle large number of entities (millions)

- An efficient, scalable and distributed *Service Repository* that will also support management and federation of various domains (public and private repositories).

- A common *Application Communication Infrastructure* that supports multiple paradigms, such as request/response, publish/subscribe, multicast, etc., as well as transactional properties.

- Meta-data indexing and inference to enable Entity/Service Indexing, Searching and discovery

- Modelling, Composition, orchestration and execution of business processes and telco services

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4.3 Event and Data Management and Processing

This category will encompass all those enablers whose functions are related to handling, composing, transforming, classifying and, in general terms, managing all kind of data and events:

- Event / data aggregation, correlation and filtering -This enabler will allow the aggregation and hierarchical handling of data and events (e.g. event filtering and aggregation at different levels).
- *Event Transformation* – This enabler deals with the inference of new events and/or semantics; application of syntactic pre-processing etc. Real-time and data mashups will also be elements related to this enabler.
- *Data classification* - Functions such as processing data, clustering and usage of semantics on classification are provided by this Generic Enabler.

4.4 Multimedia analysis and semantic support

4.4.1 Multimedia analysis

We live in a multimedia world, where we daily interact with both professionally and user-generated content. In particular, the amount of user-generated multimedia content has increased exponentially in recent years, creating new challenges in multimedia analysis and the pervasive problem of digital media overload, where users have a very hard time finding desired content in their ever increasing repositories of personal media. In addition, an increasing amount of multimedia content is stored in the 'cloud', thanks to pervasive Internet broadband access and a steady reduction of storage costs.

In this scenario, new multi-modal approaches to multimedia analysis are needed, including novel methodologies to fuse multi-modal multimedia content with its associated contextual information (e.g. location, metadata, tags, user feedback, etc…). Automatic tagging techniques and innovative interfaces to encourage users to add context to their content will enrich the multimedia information and improve the results of multimedia search engines while, at the same time, increase the knowledge about the users and hence enable personalization and recommendations (discovery of new and relevant multimedia content). Given that most of the multimedia content is (and will be) user generated, there are additional challenges that need to be tackled when building multimedia management systems, including: efficient near-duplicate image and video copy detection; algorithms and user interfaces for multi-modal multimedia summarization; computational models of the aesthetic value of multimedia content (increasingly important due to the large variance in the quality of user-generated content); and novel ways to create rich multimodal user experiences by experimenting with new paradigms of consuming multimedia.

Another aspect that can mark a significant evolution is the analysis of Digital Footprint - large-scale human behavioural data. With this challenge we refer to capture, storage, visualize and analyze large-scale multi-modal data coming from different source: Internet of Things, sensors, social networks, mobile users geo-location, etc. From these data and with new algorithms for inferring and predict human behaviour, CP can offer valuable information for building smarter applications in all the usage areas.

The Core Platform will need to provide algorithms for multimedia content analysis that would tackle the previously stated challenges, enabling content filtering and aggregation at different levels, personalization and creating unique user experiences suited to the needs of its users.

4.4.2 Semantic Support

One of its most outstanding characteristics of FI applications will be their capability to understand the meaning of the information exposed or interchanged. This capability, which will be provided by the so called Semantic Technologies, will make it possible to build a more human Internet, diluting the current communication barriers between software systems and their users, as well as more intelligent applications we are not even able to imagine nowadays. In this sense, Semantic Technologies will revolutionize Internet as we know it today.

To be aligned with the previous statement and predictions, the Platform will need to include these semantic capabilities from the core so that any other additional feature to be included in the Platform directly benefits from them. These semantic capabilities will include not only mechanisms to generate the semantic information, including mechanisms to automatically extract meaning from already existent content as well as manual mechanisms to involve the final users in the semantic annotation of the information they manage, but also mechanisms to store and to exploit the semantic information available.

4.5 Preferences, profiling and context

The society is evolving to a more and more such a heterogeneous ecosystem: in order to cover all the needs and provide goods and services customer-tailored, the knowledge of users' environment and preferences is a key factor. In this way it aill be possible to satisfying demand's diversity and creating new business opportunities.

This enabler collects big amount of data from users' activity and after applying ETL process and specific Analytic Models, it infers information about users like users' age, mobility patters, tastes, social interaction, etc. This valuable information is an input to the Recommendation Engine together with contents provided by external suppliers. The results of these recommendations are provided to services and applications located in the Usage Area.

Profiling allows services and content to be tailored automatically to the end-user's preferences (e.g. content consumption in the past) as well as the user's context (location, current connectivity, mood, etc…). Personalization is not just limited to on-demand TV, video or music, but also for life experiences like social interaction, education, leisure, shopping, etc.

The Context Awareness is much more than location awareness alone, or merely the immediate situation. The vision is to have a middleware infrastructure capable of collecting all user's context information from devices, sensors, database and from the environment in general, in order to decide what is worth for the user depending on her/his preferences and instantaneous state. Privacy policy will be implemented for retrieving and analyze users' information.

Main objectives of this working work would be to define (among others):

- A platform independent & distributed approach encompassing all types of services.
- A support infrastructure that is aware of the user's situation (location-based information, mood, etc.).
- Analytic algorithms for modelling users' behaviour based on SNA technologies, Neural Networks, etc.
- A recommendation engine supported by a Personalisation Engine as common enablers for services and applications deployed in the Usage Areas.
- Additional mechanisms for managing users' privacy and controls the information they desire to provide to the platform, preserving rest of data.

4.6 Identity, Privacy, Confidentiality

Creating trustworthy and secure applications that provide at the same time an appropriate end-user experience will greatly depend on the FI-CP offering a shared framework that will span applications, services and enablers, giving easy and uniform access to authorization, authentication and identification features.

Under this initial perspective, advanced functionalities must be provided to solve issues like account management, single sign on, federation, profile and personal context sharing in social environments, establishment of privacy and access policies. A common Identity management architecture will improve the integration of all the core platform enablers, helping in the "one platform" user perception. A common identity management framework should also be responsible of handling privacy constrains and all kind of legal issues related to personal data protection.

Convergence of IT standards and technologies and in this area with exist Telco capabilities (SIM Cards, trusted connections between devices and network, established trust relationships with end users etc.) will also be a focus of the work, in order to achieve the best possible compromise between security and user experience.

4.7 Resources as a Service

Cloud hosting proposes an easily usable and accessible resource provisioning model (X as a Service) of virtualized resources. It will facilitate the rapid delivery of Internet Services (and even other core platform enablers) by automating the provisioning, management and operation procedures. Therefore time-to-market and development, deployment and management costs of Internet Services will be reduced.

Cloud hosting capabilities are traditionally classified as **Infrastructure as a Services (IaaS), Platform as a Service (PaaS).** Service Providers may rent from IaaS clouds dynamic infrastructure resources (virtual machines, communications and storage) to deploy service components, but they remain in charge of managing and maintaining the software stacks installed on each virtual machine and control the scalability of the provided resources. PaaS gives a higher level of abstraction for service provisioning where the platform provides development tools, application containers, integrated technologies (libraries, APIs, utilities, etc.) and automatic scalability tools, allowing the Service Providers to concentrate on the development of their Service Components.

Together with IaaS, PaaS capabilities can be exposed to the Usage Areas and help promote the vision of an Open Global Service Delivery Framework that reduces the complexity of service and application development and delivery, integrating generic application containers and technologies (Web, Java, Python, etc.), and giving access to other platform Services (Databases, Network enablers, etc.). The PaaS management capabilities may also be used to easily integrate and give access to other Core Platform enabler's technologies and APIs.

4.8 Content Delivery Network and Video

Multimedia content have become an essential part of current Internet Services. The streaming concept requires a continuous data flow between service provider and end user. It means high costs in network resources and a risk of servers' collapse, in case that the network has to deal with a huge amount of data. So we have two main challenges to solve: remove the inefficiency caused by having only one content distribution point and optimize network utilization by transmitting information from points near to the end users. The use of new architectural paradigms is a need.
Content Delivery Network is the solution to these problems; it consists in the integration of a set of equipment that will distribute in an efficient way multimedia contents.

Content Delivery Networks is the solution to these problems. It consists in the integration of a set of equipment that will distribute in an efficient way multimedia content. More specifically, a CDN is composed of an Ingest point (entrance point for content), a Delivery point (equipment that provide the content to the final user), a CDN Controller (mechanism for indicating the user the best delivery point), a Management system of the CDN. The solution has to be absolutely flexible and scalable.

The key objective of the CDN is to allow all Usage Areas to efficiently handle multimedia contents through the FI-CP. Nevertheless, a CDN should not be considered as an isolated element. It can add more value if integrated in FI-CP as a whole. For example, a CDN can supply information to the profiling server about users' contents consumption.

Also another fundamental task in this area will be the study of the new paradigms to deliver content. Low cost P2P architecture for ISPs that better utilize the network resources and offer a competitive CDN infrastructure for the content providers should be considered in the FI-CP. The P2P philosophy follows the cloud computing design principles to reduce the cost and increase scalability and reliability (commodity hardware, scalable on demand, flexible solution, virtualization technologies, etc.).

3D technologies and ultra-high quality contents will play an essential role in the development of the Future Internet. The Media Internet has to evolve to support new user experiences, such as immersive environments in which the communication is more and more a natural experience. New technologies for 3D content generation and reconstruction will contribute to this objective and can potentially benefit any Usage Area.

4.9 Internet-of-Things

The IoT-Enabler will be a major component of FI Core Platform as the technological foundation for a true interconnection of physical and digital worlds that will enable the integration of person-to-object and object-to-object communications in advanced business processes.

Future smart services that are based on the recognition, location, access and control of things and everyday objects pose important challenges on various interrelated technologies. Among them this GE should provide capabilities to ensure the efficient integration of IoT applications into the service layer of the FI-CP, the distribution and aggregation of information from the physical and virtual worlds, and the communication among heterogeneous and geographically dispersed objects. Novel information-centric networking paradigms should lead to a unification layer between objects and Services that supports the multiplicity and mobility of communications across objects. This will require the development of an important number of underlying technologies such as self-management, self-configuration and self-healing, scalable look up and discovery of resources and services, as well as privacy and security mechanisms and tight integration and provide new requirements to many other GEs of the FI-CP.

Due to the huge number of objects, information services, and large number of devices, common information models, which rely on advanced semantic representations, and new event-based processing paradigms for distributed intelligence should be addressed. Finally, considering the important number of connected objects and the large scale of the communication infrastructures, energy efficiency management should be a relevant key component in this Enabler.

4.10 Connectivity

One of the key required characteristics of the FI-CP is the convergence of cutting-edge IT, Web/Internet and Network technologies inside the context of the main pillars of the Future Internet. This GE will provide the necessary interfaces to network elements and capabilities that will allow for other GEs to implement their required functionalities and meet their ubiquitous access and service quality objectives.

More concretely the following desired connectivity requirements have been identified so far (this list is subject to revision):

- *End-to-end Quality Control* - Both the FI-CP itself and the Usage Area applications will require full control and guaranteed SLA compliance on various quality properties of the network connections.
- *Nomadism, Mobility and Ubiquitous Connectivity* - Dynamic discovery and mapping capabilities will be required, especially for IoT scenarios, to deal with the consequences of mobility as an ever increasing number of devices and “things” are continuously getting connected, using various types of wired or wireless access networks, and more and more applications are being accessed from anywhere and at any time.
- *Discontinuous connectivity and End-to-End Connectivity resilience* - In the FI many devices and “things” will not have permanent network connectivity so intelligent connectivity support will be provided based on their local environment or on remote information systems. This will be also highly relevant to define energy efficient communication protocols. This is the element enabling the support of delay-/fault-tolerant Networks; as well as low power (embedded devices with limited CPU/mem); and lossy network environments. and Communication stack means to circumvent connectivity failures (may come as complement to traffic re-routing at intermediate network communication nodes)
- *Communication protocols abstraction* - Provide unified access to the information regardless of the particular underlying communication protocol used (i.e. different sensor networks technologies ZigBee, 6LowPan, ISA-100.11.a, etc.) so that services can be agnostic to the communication protocol used.
- *Communication for localization and tracking* - Physical world location determination and tracking for handsets, devices and “things”.

4.11 Developers Community and Tools

In addition to the infrastructure elements and enablers that expose their functionality through open interfaces and APIs, the FI-CP will also provide developement tools and resources so that 3rd parties & customers can create their own applications. APIs, SDK, specifically tailored IDEs and application containers all fall inside the objectives of this GE. Automatic configuration management, building, testing and quality assurance tools will also be actively pursued so that to allow software developers, managers and users to better manage the complexity of their applications and convert the FI-CP to a fully featured service development, deployment and delivery platform for Future Internet applications.

To further foster the adoption of the platform and exploit the power of knowledge communities, the creation of a community formed by customers, developers, testers, telecom operators, internet players, etc. will be actively pursued. The first objective is to create a place for services concepturalisation, implementation, testing and launch to the market. But there is also an opportunity to evolve this community into an emerging ecosystem of developer communities, apps stores, platform-as-a-service, and software-as-a-service, a cloud full of capabilities where all the actors potentially can mash-up their own assets with others and create a virtuous circle of innovation.

This requirement comes in response to changes and new needs in the market; it creates a place for application development and distribution that enables users to reap the benefits of innovation processes, open doors to new markets and create new business opportunities, as well as reach clients with a wide range of applications.

The benefit is shared by all participants that have a common goal, the creation of new value.

4.12 Monetization and business models enablers

One of the key issues when providing a platform for the creation and deployment of services is to enable the monetization of those services through flexible and innovative business models. In order to do that, it is necessary to provide frameworks and tools where services can be commercialized and benefits shared among all the actors involved in the process. Not only the services, but also the infrastructure that is used by those service providers has to be exploited.

This objective requires three main groups of functionalities to be provided:

- Business models management: A layer for the definition, provision and analysis of business terms and conditions for the commercialization of simple and composed services, as well as infrastructure. This includes management of policies purchase models, revenue sharing models, infrastructure usage, promotions, SLAs, embedment of advertisement, etc. It also includes business follow-up.
- Next generation business environments: The eMarketplace enables the commercialization of services and infrastructure and it has to be flexible to be easily adapted to different scenarios. It is fed with the business terms and conditions defined in the Business models management layer. The eMarketplace supports registration of services, configuration of service business terms and conditions, business model support to composition and bundles, service contracting by end users and semiautomatic negotiation with 3rd parties.
  As one of the monetization strategies that will be used is advertising, an advertising platform is also part of the business environments. This platform is designed following the next paradigms: deliver targeted cross-channel advertising campaigns, leveraging the richness of customer intelligence and ensure relevance, reach, value and measurable return. The business advantages of including this platform will be: an efficient planning (target audience, segmented inventory forecast and metrics), an inventory aggregation and time2market reduction. It will allow advertisers to improve their advertising ROI, reaching their target users with efficiency and measurability.
- Costs and incomes distribution: The final step for the monetization of services is to charge users for the contracting and use and distribute the incomes among the service providers. Costs must also be shared, such as the cost of the infrastructure where services are deployed. So it is necessary to integrate rating, charging, paying and billing functionalities. Then, a revenue sharing engine must process the different income sources and calculate revenue sharing among all the actor that participate in the service lifecycle, taking into account service composition. QoS and SLA assessment must be included in order to determine penalties derived of SLA violations. This layer will feed the Business management layer to enable the business follow-up and the consequent analysis of the best performing business models

4.13 Lifecycle management, traceability and accountability

This category contains enablers responsible for the lifecycle management of applications as well as traceability and accountability of process and applications.

- *Lifecycle Management Support.* - This module is about the lifecycle of applications/services, components of the Core Platform as well as devices. It's not only about monitoring during execution but covering the entire cycle of components from activation, publishing of capabilities, deployment etc.

- *Application user usage accounting*. - It should take care of privacy and fairness issues (unbiased) taking into account EU regulation. It should allow end users to track their usage and give users the possibility to determine which information can be processed by platform components.

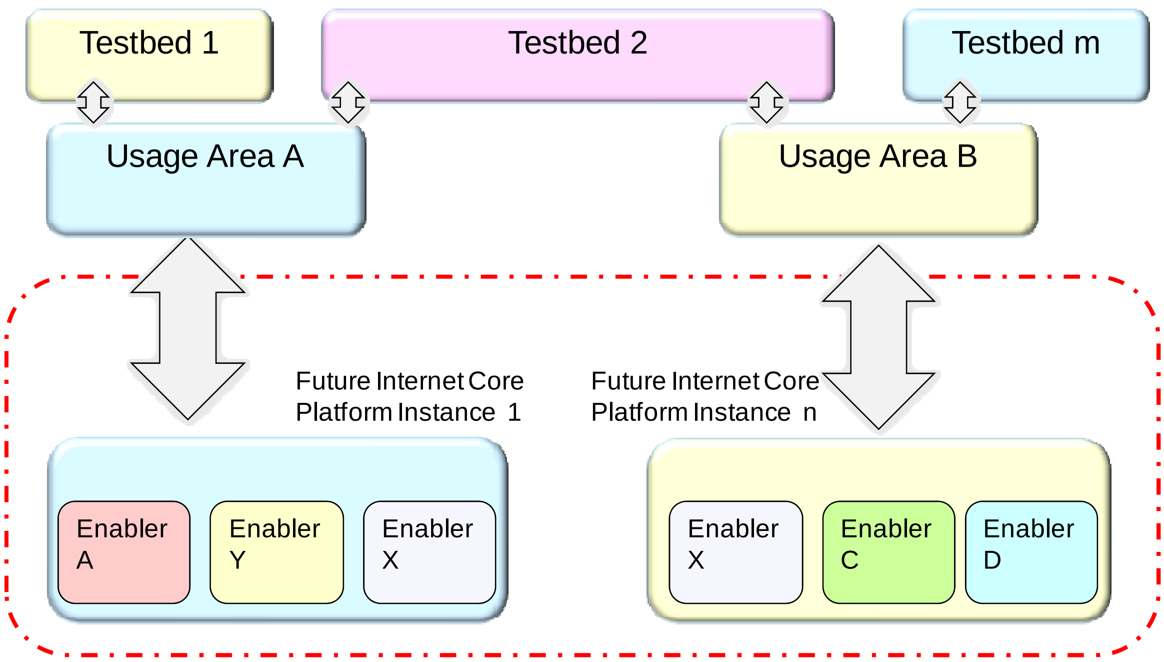
- *Platform usage accounting & logging*. - This enabler is required to support IaaS (Infrastructure as a Service) and PaaS (Platform as a Service) Cloud hosting, for example. It should allow platform users to monitor/track the usage or resources in the Platform.

- *Support for Analytics*. - Enabler taking care of mining data gathered with the two previous components. Tools will be provided both to the Platform provider but also the application providers.

5 Building EFII Core Platform Instances

The adopted approach of FI-CP and FI-CPIs allows that for different application domains there might be different domain-specific instantiations of platforms each of which is built on a selection of Generic Enablers belonging to the categories listed above (see Figure).

A core platform instance is a specific aggregation of configured computing, communication and software enablers and support services that serve the purposes a specific usage area applications.



The Future Internet Core Platform should define both a consistent minimal infrastructure (enablers which are expected to be present in all platform implementations - mandatory) and a set of optional extensions which may be supported in a specific platform. The set of mandatory Enablers should be as small as possible while providing sufficient flexibility to developers of Future Internet applications.

Among the first set of mandatory Enablers, the followings might be remarked:

- Enablers allowing generation, composition and sharing of data (about things, contents, users, etc., which indeed may be exploited as info about context). This will be required to make applications become context aware but also to support data cross-fertilization among applications running on top of different Platforms,

- Enablers for application-related services, things and contents to be visible and accessible by end users in a uniform way, with the ability to mash-up them together. This will be required to make applications ultimately usable and more suitable to users' needs. It also enables applications running on top of different Platforms be accessed in a consistent manner,

- Trust and Identity enablers that facilitates end users and service providers to be identified globally in a trusted manner including lawful interception.
- Communication enablers which are high capacity, scalable, easy to use, reliable, resilient, trusted and secure based on wire-line, wireless and satellite access technologies.

Moreover, Future Internet Core Platform Instances will be created by following an implementation process for FI applications and services:

- **FI-CPI Profiling**: Smart FI applications can be designed based on open specifications linked to GE interfaces, metadata and protocol specifications. The application or service design is therefore mapped onto a selection of GEs. GE implementations (open source or not) compliant with open specifications of selected GEs are chosen depending on their supported features and characteristics, deployment location, cost of operation, reliability, etc.
- **FI-CPI Federation**: GE implementations are then configured and federated by the available open mechanisms to support their assembly. Both experimentation and production phases will be supported.
- **FI-CPI Management and Operation**: Finally, the necessary runtime management facilities have to be put in place by configuration and the implementation of appropriate management cockpits. After validation and certification activities the systems can go live.

6 Phasing of work – Plan.

The Core Platform development will be closely coordinated with the development of the usage areas. Various liaison groups will be created to implement the different interactions necessary and an iterative and agile approach, with various requirements-specification-prototype-experimentation cycles, will guarantee early availability of results and continuous feedback from both parts.

The overall work plan will be divided in three phases:

- In such a way that in Phase 1 the Core Platform receives requirements from the Usage Areas, compiles them, detects commonalities, drafts architecture by detecting non-existing components compared to State of the Art and models the system as a whole. The integration and development activities of the initial set of the generic enablers will be carried out.
- In Phase 2, the trials will be under way and integration and interoperation of different platform instances will be experienced. In addition a further set of generic enablers will be implemented based on work done in the usage areas in phase 1.
- In Phase 3, the Core Platform must provide support for the creation and running of applications from many different developers and running in many different infrastructures.