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Advanced Beyond 3G service delivery environment: the SPICE service platform design principles

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***Abstract*— The project SPICE (Service Platform for Innovative Communication Environment) is addressing the still unsolved problem of designing, developing and putting into operation efficient and innovative mobile Service creation/execution platforms for networks beyond 3G. The IST project SPICE is part of the Wireless World Initiative (WWI).**

With the growing diversity of services, devices and connectivity means, Service Platforms such as the SPICE platform will provide (mobile) end-users with communication means and tailored applications anywhere, anytime and on any device; and service providers, SMEs and non-professional users with service enablers that ease and quicken (context-aware) application development.

Operators – like the ones in the SPICE consortium – will take up the role of Service Provider (/Service Platform Provider) and research and develop an advanced B3G service delivery environment. The key principles of the SPICE project will be described, and the technical approach of the project will be presented in this paper.

***Index Terms*—Mobile Service Platforms, Service Architecture.**

INTRODUCTION

MOBILE communications and Internet services have become an essential part of everyday life of European citizens. However, most end-users today consider mobile communication and Internet as totally separated ICT facilities. Voice telephony and SMS are the dominating communication services in mobile communication. Despite good availability of broadband radio technologies, the business of new mobile services has not yet taken off with full force for the following reasons:

- Time to market for new services developments is too long due to a lack of suitable service creation environment and to a vertical design approach;
- Integration and deployment cost are too high due to the inherent complexity and heterogeneity of service execution environments;

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- Service provisioning involves more and more parties - Telco, content/service providers, third party networks and service providers, and even end-users – increasing the complexity of the environment in which services must live.
- Users own many different communication devices and are surrounded by many access technologies but they usually cannot handle the complexity of accessing their services via several of these devices. In these cases, they look to the access and service providers for help.
- Continuity of service from fixed to mobile access and seamless roaming of services across operators and network is far from being a reality

The SPICE consortium acts on this by developing a method for rapidly generating new services that hides the complexities of the new communications environment and allows commercial services to be developed and deployed efficiently and economically.

To achieve this ambition, the SPICE consortium integrates the competence and knowledge of leading European telecom operators/service providers and key IT and telecommunications suppliers. SPICE also includes SMEs and research institutes with

appropriate specialist knowledge in the project team.

SPICE is co-ordinated with several established Integrated Projects via the Wireless World Initiative organisation. Details concerning the Wireless World Initiative can be found in [1]

In the rest of this paper, the objectives of the SPICE project are presented, and the principles and main areas of the SPICE technical approach are covered.

I. SPICE Project objectives

SPICE (**S**ervice **P**latform for **I**nnovative **C**ommunication **E**nvironment) will research, prototype and evaluate an extendable overlay architecture and framework for rapid creation and deployment of intelligent and personalised Mobile Communication and Content /Information Services.

The **key SPICE project objectives** are:

- **Provide an easy and simple way to create and roll out innovative services to reduce development time and introduction of costs and risks**
- **Provide a unified and seamless way to deliver services over heterogeneous execution platforms, network and terminals**.
- **Enrich the service landscape, through an overlay structure supporting the users and offering a personalized user experience anytime, anyplace**; the service platform will provide appropriate service enablers distributed onto service platform components and mobile devices allowing the delivery of smarter context-aware services. In other words providing the user with meaningful access to personalised services anytime, anyplace and delivering content services adapted to the user's communication sphere, access technology and personal situation
- **Create a trusted and open platform that will simplify the use of services and devices through personalisation and customisation**; SPICE will revisit communication paradigms and promote communication with persons as well as authorised devices; Services will be available on a multitude of terminals, allowing the user to choose the most appropriate communication means.
- **Enrich current service platform functionality** with content management and distribution, features and intelligent service-controlled context-information processing.
- **Open-up to new business models and value chains**. The flexibility of the SPICE platform environment will specifically support the demands from TelCos, SMEs and 3rd party service developers and providers for open service platforms.
- **Enabling Pan-European service provisioning**. Mobility-aware capabilities in the service platform environment will enable applications and services to roam seamlessly across commercial, country and cultural boarders.
- **Promoting the uptake of innovative IT software technologies in a telecommunications grade service platform environment.**

SPICE will deliver technical solutions that provide simplicity and convergence at the service layer to enrich the service landscape and to ensure a faster deployment and adoption of new services.

II. SPICE Principles

This section introduces the key principles that represent the overall philosophy of the project and characterise the telco/network approach to intelligent/user centric content and service provisioning and delivery.

a. Platform-centric approach

Considering one important underlying objective of the SPICE project which is fixed-mobile service convergence, it is worth noting that nowadays most of the Telecommunication Operators are active in all aspects of providing communication means. Their business is no longer limited to delivering different kinds of access networks and associated services to their subscribers (classically 2G, 3G and DSL in residential environments). More technologies are emerging, and their impact on daily life increases rapidly. In terms of relationship with the customers this means that new opportunities for the operators originate: Telcos are in a perfect situation to take the role of service provider with a strong bond to a wide customer-base, because:

- The Telco knows about the customer and his/her service and network usage in different roles and contexts (at home, in the car, on the move, at work, etcetera)

- The Telco knows (and manages) an ever increasing number of terminal/devices and gateways;
- The Telco knows different ways of accessing (fixed/mobile) a given end-user according to his/her current situation.

We foresee that successful Telco's will shift their role, which is today focussed on providing merely access, towards service provisioning. Consequently fixed/mobile services will converge towards "aware" services where the kind of access technology merely is one constituent (among others) of communication. The necessity of coping with heterogeneous access technologies and devices, and keeping in mind the aforementioned fixed/mobile service convergence, it seems inevitable and most appropriate to have Service Platforms with functionality enabling seamless mobile applications, serving human communication needs. There are numerous advantages to this approach, where Telcos can take the role of Service Platform operator:

- The plethora of heterogeneous communication devices and channels will be handled as one global communication sphere; of which optimal usage (selecting and combining services) will be made, tailored to the user's situation and needs;
- Platform capabilities will be shared among different classes of applications and will adapt to the (network) resources considered during service delivery;
- Intelligent services hosted at the Service Platform side will be available to Telco's, third party Service Providers, Application Service Providers and end-users. Advantage can be taken from the added value of the service enablers depending on e.g. the terminal characteristics;
- Charging and billing related to the use of services can be handled easily and reliably
- Telco platform can implement extensive technical support to the end-user and assist in management of his/her personal information and data.
- Platform enablers allow for fast and easy (tailored) mobile service- and application-development by SME's, service providers (ASP's) and even non-professional users.

b. Multi-terminal, Multi access Distributed Communication Sphere (DCS)

It appears more and more that mobile communication should not merely target one end-user using one mobile terminal connected through one network/radio interface. Instead, the user will be moving in a sphere in which multiple access technologies will provide the connectivity for multiple devices that altogether deliver the service a user may wish to use. This involves many devices and many distributed service enabling elements and forms a person's Distributed Communication Sphere (hereafter referred to as DCS). To deliver the complex services of tomorrow, the DCS will need to have the inherent possibility to access/connect via a number of different access technologies and access network umbrellas. In a nutshell, a person's DCS will contain:

- all terminals, gateways and devices that can participate in and can contribute to a person's mobile connectivity and communication means (e.g. Cell Phone, PDA's, car displays, laptops),
- all available and permitted communication technologies and channels (access network),
- the whole direct communication environment including people, devices, services, resources, etc.
- all services as well as all system and other information that can be used in the context of a communication act.

The DCS is subject to frequent changes as the user moves. This basic feature implies that communication devices may be only temporarily associated with a user and the connection types as well as devices and their capabilities are changing all the time, thus making the configuration of the DCS highly flexible and changeable over time. Some of the most important enablers are discovery, analysis and optimization of the direct user environment in order to represent its abstraction in form of a Communication Model (see Figure 1 below). In addition, the SPICE project considers that for achieving the optimal support for service provision within the DCS, its management is to be facilitated from within the telco/network side. A number of reasons for this approach were explained in section II-a.

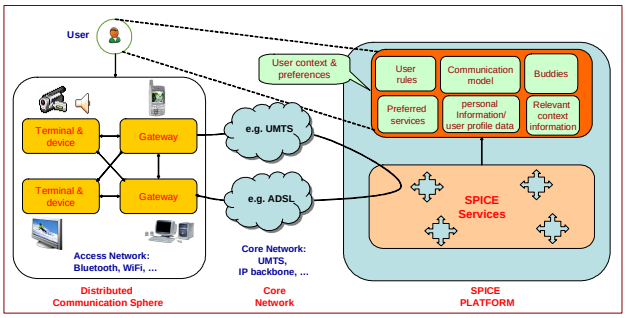

Figure 1: DCS and its abstraction (Communication Model)

c. Service composability and loosely coupled approach

During service creation, services will be composed of a collection of service enablers or any other existing services. A service itself can be realised as a component that in turn is composable again. This property will enable the creation of complex services based on previously created ones. It will ease and speed-up the service creation process by providing reusable service components that can be embedded into new services. The service description language that SPICE will research and extend upon will allow the service architect to refer during service creation to actual, well identified and running components, without having to worry about where they are located. It will also allow the same architect to refer to abstract services (those described within service ontologies) that are not tied to actual service instance already. These actual instances are being searched out (using semantic discovery) and the whole set is dynamically orchestrated at run time. This *a posteriori* mapping between service blocks and actual instances explains the term “loosely coupled”.

Loosely coupled Service Components have the flexibility to co-operate dynamically with each other, even across heterogeneous middleware technologies, when a composition of their functionality is needed to reflect, for example, changing business roles, adaptation to new system and service demands etc.

As these components will potentially exist in many different administrative domains, it will be necessary for them to co-ordinate in order to set-up mechanisms for translating and mapping security and privacy policies between them.

d. Semantic enhanced platform

A shared understanding both of semantics and syntax is a prerequisite in order to communicate, cooperate, etc. This also holds for software systems: two applications cannot interact with each other without common understanding of terms used in the communication. This is where ontology comes into the picture. An ontology is a formal specification of concepts, their relationships (expressed in a logic) and specific instances, somewhat like an enriched thesaurus. This enables ontology to support the sharing and reuse of formally represented knowledge among applications.

Ontology will be used by the SPICE project for the main purpose of publishing, discovering, (re)using and combining content, services, multi-media modalities, resources, devices et cetera. Based on such semantic enhanced description the discovery process becomes extremely accurate and therefore eases using, reusing and combining.

III. SPICE Technical Approach

The following aspects of the SPICE technical approach will be developed in the sequel:

- SPICE architectural framework
- Middleware and service enablers
- Intelligent Service enablers
- Service creation and life-cycle management
- Service access control and trust management
- Information and content delivery

a. SPICE architectural framework

Architecture activities are instrumental for defining the scope and direction of **SPICE** and ensuring that **the overall objective of SPICE** is met, that is:

Shape a Service Platform facilitating an Innovative Communication Environment for all – i.e. providing an architecture and framework for mobile communication and information services. This means the following:

- Access to information and services independent of technology and geography, such as location, network, operator and device independence.
- Continuity of services.
- Continuity of end user’s operations (tasks) and information needs.
- Discovery and awareness of information services.

- Easy, direct and user-friendly access to services available to average citizen.

Operators are currently adopting the SDP architecture, but only for operator driven services (replacement of old IN systems). They have begun looking at ways to open their infrastructure to 3rd parties using OSA/Parlay, Web Services and similar technology (in a small scale and individual basis).
Service Platforms do not address the cross-domain issues (from an application or service point of view), meaning the lack of managing application view across operator borders, countries, information and administrative domains. Service and information brokering (including content provision) does not cross the service platform and domain borders.

To arrive at a next generation service platform, **a scalable overlay architecture** and **framework for the rapid creation and deployment** of mobile communication and information services will be developed. The SPICE project will provide:

- A novel service platform architecture that facilitates/enables cross-domain service and information roaming.
- An architecture organisation for service, application and information roaming architecture mechanisms
- Architecture support for inter-domain service interaction and cross-service interaction mechanisms
- Global service and information brokering (including content provision mechanisms), i.e. mediation mechanisms between the end user (also 3rd party service provider) and the services/information – framework for dynamic and automatic brokering (with SLAs / SLS service framework).
- Novel business models that encompass service and information roaming (incl. 3rd parties), and allow flexible distribution of business roles.
- Advanced business models and enhancement of existing ones for global use.

In the SPICE project, relevant **requirements** from the stakeholders will be collected and analysed, addressing user, enterprise, technical and open market business requirements, which will then be fed into the architecture work. Three innovative - user and service provider oriented - **service scenarios**, taking into account the work on requirements, will be elaborated, and related requirements derived. Requirements will be grouped around scenarios that further relate them to the architecture and service aspects, and facilitate the project research, design and implementation efforts. Since the SPICE architecture will accommodate different types of **business models**, a set of viable business models underpinning the overall SPICE architecture will be researched and designed. An essential feature of these business models is that they will have to be sustainable for various actors in various roles, and shall include service providers, application developers, content providers, internet service providers, manufacturers, operators, business and residential users. This activity will also focus on **legal and regulation implications** of SPICE as a service platform that will be dealing with data and information that is traceable to individuals. SPICE will provide an open framework to many actors and players in the service value chain, and thus there will be a need to carefully analyse the different business and the legal framework regulating the different actors of the value chain.

b. Middleware and service enablers

Currently service execution platforms are aimed for a specific platform technology and framework. SPICE will provide a component framework, which allows for the development of components that can be used in a multi-platform and multi-operator environment. This will be achieved by the introduction of specified interfaces that describe how components must be published, discovered, executed and managed. To support the development of new, and wrapping of existing, components or services a Cookbook is provided that describes the requirements of the SPICE platform towards the components. Examples (recipes) including wrapper implementations are provided with the Cookbook. The middleware provides component publication and discovery functions, which are capable of taking dynamic behaviour, scalability and configuration. This is achieved through infusion of semantic-based description meta-data into existing acquisition technology. The SPICE service creation and execution environment will both discover and access the components through this acquisition function.
When end-users currently move outside their home domain standard supplementary services continue to function, individualized or add-on service execution however degrades to a lower or non-functioning level. The SPICE middleware provides an interface to other SPICE service platforms which

allows for partly or complete service roaming. Thus when an end-user visits another domain the actual service roams also to the domain for execution, excluding components which cannot, or are not allowed, to execute elsewhere.
Finally the middleware provides for the correct on-line or off-line charging of combined service components provided by several component owners.

c. Intelligent service enablers

The intelligent service enablers aim at enriching the services with context awareness functionality by providing service platform solutions for user profile and context information management and anticipatory / attentive middleware functionality. The context-aware functions encompass multi-domain context gathering, user profiling, combining those and extracting knowledge from these, and access provisioning to this derived knowledge on the situation of mobile end-users. Mechanisms anticipating changes, as foreseeable location updates, and integration mechanisms will be studied yielding pro-active service enablers and extending the services with intelligence.
On the one hand the SPICE enablers provide relevant knowledge and contextual information concerning the end-user and his situation – via the "*personal information enablers*" and the "*knowledge information enablers*" respectively. On the other hand they incorporate this information in intelligent service support mechanisms – via the "*attentive service enablers*". The integrated solutions ("*intelligent service enablers*") enable a rapid development of applications that can give their users meaningful, personalized and anticipatory access to services, applications and communication means at the right moment.

Our research approach towards the personal information enablers is twofold:

User profile management for service personalisation: Mechanisms and functions necessary to manage profiles and handle possible conflicting profile-subsets and semantics – in a secure manner, respecting user-privacy - will be investigated. Multiple user profiles will be defined that can be associated with different service usage situations based e.g. on available devices, on location, on time.

Semantic description of personal data: Based on the different aspects of the user profile an optimal ontology structure will be researched and derived that is needed to describe the semantics of user profiles and will assist in making the information available to any service.

For the knowledge information enablers we conduct research on:

Intelligent context interpretation and knowledge inferring: This service platform functionality allows any service (either hosted in the platform or using this capability through the service presentation layer) to infer entailed information ('knowledge') from available information such as user's personal information and past behaviour, and the user's context. "Useful" knowledge will be prioritised instead of "correct" knowledge. Inference engines, capable of processing business policies, user-defined preferences and application specific needs, will be specified and implemented, and policies for avoiding conflicts in decisions making defined.

Scalable context information discovery and knowledge distribution: Scalable access and discovery mechanisms aiming at simple and flexible information retrieval and a model for exchanging information between service platforms will be studied and extended upon. Use will be made of the privacy management enabler to determine what knowledge information is accessible for who with what access rights.

The approach for attentive service enablers splits into the following:

Pro-active services: Investigation of mechanisms anticipating upcoming changes such as foreseeable resource changes: service adaptation or push alternative recommendations before the changes have occurred. Use will be made of activity modelling and reasoning to ensure that only the relevant triggers are generated.

Integration mechanisms and extending services with intelligence: Mechanisms for incorporating intelligence into services will be studied for known service enablers like session establishment, session mobility, presence, group management, and others. For instance IMS services can be flexible extended with location and presence information but also with a privacy related access policies.

d. Service creation and life-cycle management

The differentiation and the competition between telecommunication operators is

mainly based on innovation, attractive and easy use of new services towards customers, as well as the ability to quickly adapt services to the requirements of the market and of the customers (customisation). It is therefore critical to make use of tools that simplify creation and deployment of services (by reducing the service delivery time), and also tools that allow customers to fit services to their own needs. The utmost idea is that customers themselves create their own services or even that the telco service platform automatically creates the services following requirements and needs expressed by customers.
The starting point to define a service creation environment (SCE) is to analyse the service life cycle, composed by the following phases:

- Ideation: it is usually handled by the service provider marketing, following a phase of user needs analysis. It ends with the definition of service requirements. Ideally the service can be prototyped quickly using the graphical tools available from the SCE for the concept validation.
- Development: requirements are translated in service logic by means of programming language (owner or standard), and also through IDE (Integrated Development Environment), SDK (Software Development Kit) or graphical programming environments.
- Simulation and testing: after being developed the service is tested in a simulated environment to verify the right implementation and to identify potential interactions with existing services.
- Deployment: during this phase the service previously created and tested in a protected environment is deployed in the network. Deployment includes also the client deployment and a subsequent configuration phase of end-user devices. Note that service logics can be allocated on a various network elements and on user devices (software upgrade on a terminal). It is also important at this stage to minimize the user's manipulations as far as terminal configuration is concerned, especially if more than one terminal is concerned with this configuration.
- Provisioning: the service is available for subscribed users (also implicit ones). This phase can be ended with the service advertising to users.

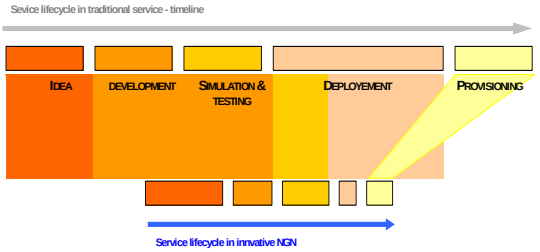

Figure 2 - Reduction of a service life cycle

The objective of the Service Creation environment (SCE) is to decrease the overall delivery time from the service idea to the final service usage. It is therefore really relevant to study new paradigms for the distributed deployment of logics on application servers, network servers and on end-user devices, in order to simplify the procedure and to speed up the execution.
The SCE must provide high level features that allow to reuse efficiently the huge catalogue of existing high-level or more basic building-blocks existing either at the telco platform side (legacy, call control features, presence, IMS services) or directly through the internet, like web-services for instance. To enforce the accuracy of the building block reuse and composition process, all the blocks will be associated with semantic descriptions complying to defined service ontologies. Since all these bricks provide a number of nice and rich capabilities, it is foreseen that providing new services will consist of combining, orchestrating or putting control over elementary service components, network features and third party services, taking also into account other sources of information such as user's profile and preferences, context etc. Service execution and service creation environments are somehow coupled, i.e. both of these environments speak the same language, the "Service Composition Language".
The SPICE service execution engine supports the execution of event-based service logics that span different application platforms and network (fixed and mobile). The engine is modelled following the emerging JAIN Service Logic Execution Environment (Jain SLEE) framework and J2EE, and can be easily connected to different application platforms, legacy system, IMS and network elements via "Resource Adaptors". Resource Adaptors to different external platforms and elements have been already developed.

The "Service Creation and Life-cycle Management" activity within SPICE will address all the aspects related to service

delivery, from service idea to service usage. All the phases of service lifecycle will be addressed: creation through easy to use and graphical tools, fast delivery to the users, environment for service execution and easy service integration. Last but not least this activity will target the important aspect of automatic service composition or in other words of the automatic service developer, an engine which will understand user needs and request (through extraction of semantic information) and will be able to build on-the-fly the service and make it usable.

We will focus on:

- **Service Creation Environment tools** for easy design of services over heterogeneous platforms will be implemented. To this end it will define a language for service description based on emerging languages such as OWL-s WSMO or WSDL-S that will be submitted to the standards.
- **Service Description Language** for composition: to define a service description language that can describe in an easy way composite and integrated IT/telco services taking into account semantic information associated with the elementary services. The language should be easily generated by the Service Creation Tool in a graphical way, and should be executed on the execution engine, allowing composition of elementary components. The service description language will allow to describe also non-functional aspects of the service.
- **Multi-platform Service execution Environment**: The execution environment will be based on emerging standards such as JAIN SLEE and J2EE, will cope with resources heterogeneity and will ease the composition of elementary service element in more complex services. The project will aim at enhancing interoperability between the two environments. On the J2EE side existing standard engines (process & event) will be extended to cope with Telco constraints. On the JAIN SLEE side the integration with Web-based technologies (e.g. Web Services) will be investigated. Also, extensions to the JAIN SLEE architecture specification will be defined to support: service creation and scripting, reuse of basic service components, distributed service execution. The new Service Execution Environment will be designed to increase the co-operation and integration of service logic in the platform and terminal configuration application.
- **Service Delivery**: SPICE will deliver a system to improve all the service delivery chain from service idea to service usage. The platform will therefore include the support for integrated delivery of services, including mechanism for intelligent (i.e. user's preferences and context sensitive) notification of service existence to users and related invocation patterns.
- **Automatic composition**: SPICE will build Automatic composition engine that would enable automatic service creation (no need for a service designer) and will be based on extension of existing ontology and semantic description languages to telco and Integrated services, taking also into account the semantic orchestration aspects.

e. Service Access Control and Trust Management

i. Objectives

SPICE introduces a model where services are rapidly created and deployed through an open access to basic components and services. Those basic components include network resources, like location and presence information, which through the SPICE platform will be easily integrated by service providers. The SPICE services and basic components will be available to any actor, being either third parties or end-users, from any domain. Access will be controlled with an integrated support for respecting end-user's privacy.

SPICE will ease the emergence of new business models, between Telcos, Users and Service Providers, where Telcos will act as SPICE platforms owners and provide an access to internal components to Service Providers. The latter will then act as "Third Parties" from the Telcos' point of view, while users will consume the services in a controlled manner.

SPICE will consequently provide mechanisms to manage the business and technical relationships with Third Parties, by managing both Service Level Agreements and User Privacy preferences.

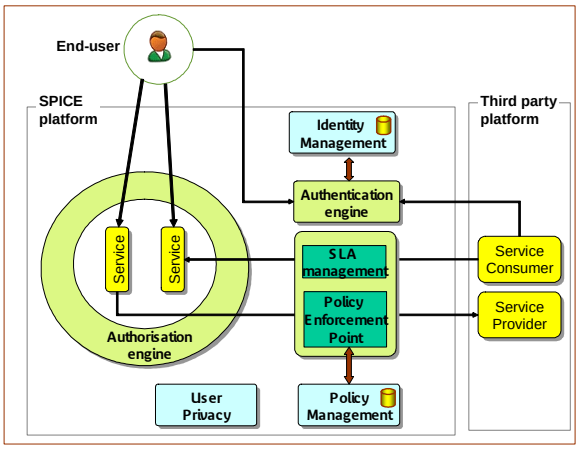

Figure 3: SPICE Platform open and controlled environment

The SPICE project focuses on all aspects relating to the service platform access control for users and third party service providers.

- The identity management will enable without re-authentication:
  - The multi-modal use of terminal.
  - The navigation between several Service Providers belonging to a circle of trust.
  - The delegation of the use of a terminal or a network line.
- The services and service components/enablers accessed by users and third party service providers will be authenticated, authorized and accounted.
- In addition, users will be able to implement privacy policies to protect their sensitive data while accessing 3rd party services.
- The "framework" will guarantee the internal Spice component and 3rd party providers to access services and service components according to the SLA and other policies conditions.

ii. Technical approach

Identity Management is about creation, modification and revocation of identities. It deals also with some properties of identities like the groups to which this identity belongs.

- One of the main problems is the secure assignment of a secret to a principal upon identity creation. This is addressed with GBA or another method to derive a secret to be bonded to an identity from an existing secret
- Another problem is that a user may have different identities that he/she uses in different contexts. This will be addressed with the use of Liberty Alliance specifications or similar proposals.
- New work will also address the delegation that can be used for multimodal or shared terminals.

AAA will enable access and accounting related to a Spice component.

- The composition of services makes it very difficult to associate rights to services that are recursively imbricated.
- Authorisation must be dealt with at access control and also for SLA negotiation, as end-users and 3rd party service providers are actors that could be the same in some business models (e.g., terminal applications accessing web services to access some service enabler).
- Accounting is difficult in a context of services that are recursively imbricated.
- Accounting is difficult in a context of negotiated SLA.

Currently there is no solution to manage **user privacy** in a device or network independent manner. The project will propose a system that allows a user to define privacy preferences for their personal data, in terms of which entity can access them and under which condition.

A **Service Exposure Layer** for **secure and controlled access** to service components will be provided. The issues to be considered are related to the security in the access, the handling of Service Level Agreement conditions (e.g., through some policy framework). One example of solution could be an enhanced version of OMA Policy Execution Enforcement Management (PEEM).

f. Information and Content delivery

This activity within SPICE is mainly concerned with the preparation and delivery of multimedia content (abbreviated as content throughout the rest of this section), and with supporting information that facilitate the access to such content, or protect it in case of copyrighted content. Under the term of multimedia, we refer to different types of content, such as text, images, graphics, video and audio. This content can be formatted in several ways for delivery over various networks to several end devices.

Content is accompanied by several types of information that is used for both the description of the content and its usage in a given context. Often this information is also referred to as **metadata** which means that this information is represented as

supplementary data in a certain format. Content-related information is normally given to the service provider by the content provider. It contains user-related information for a content retrieval and does not or only little need to be changed while being transported through the several steps of a value added chain. The content provider plays a vital role in the value added chain because his requirements set the initial conditions for the process control. On the other hand, context-related information is characterized by its ability to change and to adapt to the current situation.

For the service execution in a pan-European environment where the components of services need to be transported through several domains it is highly desirable to manage content and information as a homogenous entity unity with metadata describing and influencing the workflow with respect to content handling. Therefore, this activity will cooperate with other tasks that support multi-modality, pro-activeness, access control, service support and service execution.

The goal of the "Information and Content Delivery" activity within SPICE is to develop and evaluate tools for the usage of services and their contents as well as the tools that are needed for the content delivery in line with the conceptual design of the architecture framework including in his structure a Digital Rights Management (DRM) part that takes into account the necessity for copyrighted content to be protected and, at the same time, easily accessed by end user.

IV. Conclusion

Building on significant advances in IT technologies, the SPICE platform will support multiple heterogeneous execution platforms allowing for new, innovative services to be spread across different operator domains and over different countries realizing a variety of business models.

For end-users, operators and service providers, the SPICE project will turn today's confusing heterogeneity into an easily manageable and rich service environment by exploiting the diversity of device capabilities and fostering service adoption. The SPICE approach will broaden business opportunities in the communications and associated business sectors.

The SPICE solution will benefit the Service developer community in giving them opportunities for multiple sales or royalties from service components; it will benefit network and service operators in that the cost of generating, deploying and operating new services will be reduced; and it will benefit the society and the user community in that socially beneficial and enjoyable services will be widely available at an affordable cost level.

The SPICE Service Platform and open service architecture with innovative enablers for tailored mobile applications will facilitate easy (and fast) creation and deployment of mobile services by SME's, non-professional users and service providers. Using SPICE platform, overcoming the difficulty of the technical process required, this allows for a growth of value-added services and increased pan-European mobile service business.

End-users get meaningful access to personalised services anytime, anyplace and content services will be adapted to their communication sphere, access technology and personal situation. As such this pushes innovative mobile services and opens industrial opportunities for the European market.

On a European level, SPICE will leverage the potential of the strong mobile communication industry and its excellent ICT research in the platform area to create new economic growth in the industry.

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