

# Addressing the challenges of Beyond 3G service delivery: the SPICE service platform

*Christophe Cordier (France Telecom), François Carrez (Alcatel CIT), Herma Van Kranenburg (Telematica Instituut), Carlo Licciardi (Telecom Italia Labs); Jan Van der Meer (Ericsson), Antonietta Spedalieri (Telefonica I+D), Jean-Pierre Le Rouzic (France Telecom)*

## 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 facilitate and quicken (context-aware) application development.

Operators – such as 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.

In this paper we present our research on a Service Platform in B3G environment. We sketch the key issues of such a Service Platform. Current technological solutions are discussed and the specific SPICE approach to address these challenges is described.

## I. 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 the good availability of broadband radio technologies, the business of mobile services has not yet taken off 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;
- 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 main fields of research in SPICE are covered.

## II. SPICE objectives

**SPICE** (Service Platform for Innovative Communication Environment) 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: 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, devices through personalisation & 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 3<sup>rd</sup> 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 borders.
- **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.

### III. SPICE architectural framework

#### a) Technical objectives

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 and direct access 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 3<sup>rd</sup> 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. Service and information brokering (including content provision) does not cross the service platform and domain borders.

#### b) Technical approach and innovations

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 3<sup>rd</sup> 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. 3<sup>rd</sup> parties), and allow flexible distribution of business roles.
- Advanced business models and enhancement of existing ones for global use.

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 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** so 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 different interests that easily can implicate legal conflicts.

#### IV. Middleware and service enablers

##### a) Technical approach

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.

##### b) State of the Art and Innovation

Whereas existing **component frameworks** are intended for individual platform technologies, the SPICE approach will allow for development of components that can be used in a multi-platform and multi-operator environment.

With respect to **semantic resource acquisition** existing technology patterns identify solutions for sharing and aggregation of resources. These current

technologies have focused on issues related to synchronous/asynchronous behavior, scalability, and configurability (e.g. SLP, CORBA, DNS, P2P). These patterns have not considered cross-domain issues such as the use of multiple types of semantic meta-data in order to enable new semantic-based service creation. Existing description technologies, such as RDF, RDF-S, OWL, and OWL-S, specified technology for annotated resources using semantic meta-data. These technologies have not been tailored for the needs of future telecommunication service descriptions. Enabling an innovative SPICE semantic resource acquisition technology, by infusion of *semantic-based description meta-data to current acquisition technology*, will benefit both SPICE service creation and service execution environment. This innovation will be realized using a method of extending existing concept vocabulary and ontology technologies, to enable semantically enhanced resources to be realised, for use by new acquisition technology patterns.

In **service roaming**, currently the home domain of a roaming end-user handles service execution on service platforms. In SPICE the developed Service Roaming capability will allow for partial or complete (depending on available capabilities) roaming of services, where service execution takes place on the SPICE service platform near the current location of the end-user.

In **brokering and mediation** innovations will apply to various aspects. First of all, current solutions for mediation functions between customers and service providers are, in general, proprietary solutions, implemented on a single system and not integrated in a "horizontal" service platform. Moreover, such in-a-box "Brokers" are mainly focused on the support of information based services, where the service providers play the role of content providers. SPICE will integrate the mediation functions in the context of an open "component-based" service platform, and integrated with its middleware and service enablers. In addition, the mediation functions will be considered as well for communication services and for combined communication/information services. Second, W3C, OSA/Parlay, WebServices Interoperability Organisation and Liberty Alliance have all developed solutions allowing the exposure of interfaces to services. However, each of these bodies has based its solution on a static approach where integration and exposure are not linked to contextual data. These solutions do not take into account the capabilities of the entities that consume the interfaces exposed. Typically, the accessing protocol capability is not taken into account. And no solution addresses the privacy preferences of users when user data is exposed to services through exposure mechanisms. We in SPICE will develop a technical solution where new components will be integrated and exposed through the Service

Platform depending on contextual parameters and needs. The project will bring new solutions to allow a custom access to exposed interfaces depending of the capabilities of the accessing entity. On-demand, the platform will be able to expose the interfaces through different protocols, and with different associated qualities of services. Furthermore, solutions to control user privacy rules before allowing any application to access any user data will be developed

## V. Distributed Communication Sphere Management

### a) Technical approach

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 potentially contain:

- All terminals, personal gateways and associated devices that can participate in and contribute to a person's connectivity and communication means. This includes well known pieces of equipment such as mobile phones, PDA's, laptops but also emerging ones like communicating objects, car embedded terminals, smart clothes etcetera
- All available communication technologies and channels. Depending on their characteristics they will be used for different aspects of the communication.
- The communication environment, including people, groups, resources, devices (e.g. printers) and the available and relevant (according to the user's context) pieces of information.

The DCS is subject to frequent changes as the user moves. This basic feature implies that communication devices may be only temporally 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 optimisation 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. As an illustration of this Telco platform-centric approach, let us just consider that it might happen that an audio and video communication taking place between different people at work involves different terminals from the user's DCS e.g. the mobile phone for audio and the user's professional laptop screen for video (it could be a TV-set if the user is staying at home). Beyond terminals, this communication act also involves both fixed and mobile connectivities both of them being handled by a unique operator (e.g. 3G and DSL). Determining which parts of the DCS will be optimally used according to the user's context and preferences is the objective of the DCS management activity, and innovations aimed at will be further described hereafter.

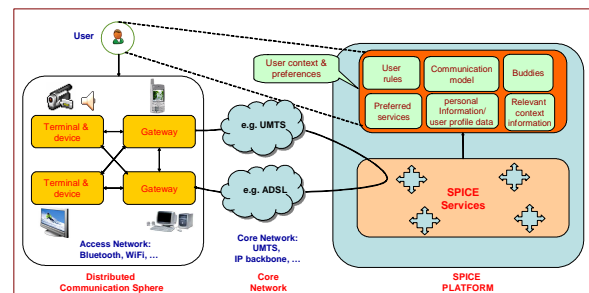


Figure 1: DCS and its abstraction (Model)

### b) State of the Art and Innovation

The principle of "Multi-terminal, Multi-access Distributed Communication Sphere" (DCS) sets the foundation for heterogeneous and rich communication environment. A number of technical issues will be worked out by the SPICE project as described below with focus on state of the art and SPICE innovations aimed at.

Today, terminal desktops (welcome screens) are basically configured by the manufacturer and offer only low personalisation capability. The only dynamic information users can get relates to notifications such as new message, call in absence etcetera. Our innovations for the **dynamic desktop** will allow the user to set-up shortcuts (icons) to services, presence information, resources etc... in order to fully personalise their own portal to the digital world. According to the user's context; the content of these shortcuts will change accordingly (e.g. a weather forecast service instance is not the same in Europe as in Japan, the closest pizza restaurant or color printer all change over time, friends status as well).

Existing approaches for **multi-modality** mainly refer to modalities (encompassed in slave devices) which are available in the vicinity of master devices. We will propose a service/access provider approach to the handling of communication multi-modalities in such a way that terminals or devices that do not know each other can participate to a service or communication as distinct parts of the user's DCS.

According to the service invoked, the user's rules and preferences, the most appropriate combination of modalities will be elected. The project will also define ontology for the publishing of such communication modalities.

Whereas today people are basically dealing with one terminal at one time and the need for user rules is not that crucial, the Distributed Communication Sphere will be composed of a number of devices with their own capabilities, calling for user assistance. Therefore, **user rules** will be developed that allow users to set-up conditional and context-driven priorities as well as rules for handling the diverse communication and using modalities. The project will set-up a dedicated ontology and construction language for dealing with such user rules.

Currently **user equipment management** can partly be done by end users. The range of features that can be altered is rather limited though, examples are the customisation of Windows desktops or mobile phone features like ring tones or display-schemes. More complex management tasks are usually in the hands of administrators. Highly adaptive terminal environments, effectively exploiting locally available devices, operator services and local and remote resources in a dynamic fashion will be developed.

**Automatic Device Configuration** solution exists, that is capable of requesting device capabilities restricted to mobile terminals based on IMEI identification. The project will bring new solutions to deal with a more diverse variety of devices such as laptop, PDA, TV-set.

## VI. Intelligent service enablers

The intelligent service enablers are aimed at enriching the SPICE service platform with intelligent personal information and knowledge provisioning. Such functionalities allow a service – in a multi-domain environment - to access and meaningfully interpret the end-user's situation and to behave accordingly.

### a) Technical approach

We will investigate key functions and mechanisms needed in adaptive, mobile middleware that support ubiquitous, attentive and context aware distributed computing. Our intelligent enablers retrieve and process information from heterogeneous context, user profile, and service profile sources. The information is processed with advanced context-based reasoning methods targeting at plausible and usable results. Scalable access mechanisms will be addressed as well as exchange of information between platforms and domains. Prediction techniques, mechanisms anticipating (foreseeable) changes, and integration mechanisms will be studied yielding pro-active service enablers and extending the services with intelligence. These

anticipatory service enablers allow for alertness and responsiveness to changes in the environment, proactively triggering mobile services in advance to changes having actually occurred. These approaches are grouped as following:

- **Personal Information Management** is focussing on service platform provisioning of relevant and meaningful information and services based on user profile management and matching and profiling techniques.
- **Distributed context information interpretation.** This enabler will incorporate advanced inference engines that are able to use dynamic context information, user profiles, and application-specific knowledge in order to infer relevant knowledge for either service provider, application or the end-user.
- **Attentiveness.** This enabler will provide mechanisms that notify services of events (such as location or network-QoS changes) that are relevant for them, and that can be specified by the service itself.

### b) State of the Art and Innovation

In providing **profiling** mechanisms existing approaches include collaborative filtering and statistical based mechanisms like Bayesian networks. Such existing techniques have been used for a long time by service providers to analyse their customer base. Examples are Amazon with click stream analysis and categorisation of subscribers as commonly applied by telecom operators. These techniques are very application-specific, and their results cannot be used easily by other services and applications. In our approach we will have profiling support as a generic component, and user profiles associated with different usage situations will be available. To overcome the shortcomings of existing profiling techniques, they will be combined with additional approaches like rule-based reasoning and conflict resolution.

**Context awareness** is being used by many applications to adapt service behaviour accordingly, such as to changing user's location. Rightfully interpreting that information however, still is a huge challenge. For starters, by capturing context digitally, it is altered and its own context is removed. Furthermore, sometimes essential information is missing. Often superfluous information is present, and sometimes even contradicting. Examples are a user-location: this can be deduced from a GSM network cell or binding with a Wi-Fi access point (with a known position and access range) or via a Bluetooth discovery on a device the person is carrying, or via an RFID discovery on an identity card (employer security system with known positions of the RFID sensors/readers); or via a GPS receiver the person is carrying. Common approaches in context processing do not deal with e.g. superfluous

information: the first available information of e.g. available access network is often used out of pragmatic perspective, leading to coincidental network choices based on solicitation order of networks (such as is the case when IPv6 is used).

We will use (1) additional contextual information and (2) quality parameters, such as reliability indicators and freshness of the information to make a more appropriate selection fitting to the services needs. In dealing with the various heterogeneous contextual and knowledge sources we will use a generic Context Management Framework (CMF) of which an essential approach is hierarchic ordering of such sources (described in [2]) allowing each Context-Source component to call upon the interface of other Context-Source components. The CMF approach enables processing and exchange of **heterogeneous context** information that is **distributed** in context domains, over administrative domains and is stemming from different protocol layers (e.g. from application layer or network layer). The contextual information originating from any of the Context-Source components is provided to applications, services and other Context-Sources via a uniform interface which hides the details of the underlying context-sensing and – interpreting mechanisms. Furthermore in our approach we look at context-awareness as much broader than awareness of identity and location. Our framework will facilitate any service to inject business rules within an “engine”, in such a way that the engine applies these rules to a set of available information (including the contextual information, but not only) in order to infer business knowledge. Aware of the relativity of information, induced by the data collection and by the interpretation processes, we will focus on **knowledge usability** not on its correctness.

Classically, intelligence in application is handled in a reactive way. Changes are tracked and notified to applications that behave accordingly. Examples of these are a simple context-aware reminder, event-driven notifications services and planning and personalisation based on learning mechanisms. We will propose solutions that enable services and applications to **proactively** anticipate changes in the environment. This means that potential relevant changes foreseen to occur during a given activity will be anticipated on and that related solutions will be provided by the service or application before the problem has actually been raised to the user. Use will be made of activity modelling and monitoring in combination with reasoning methods in order to provide alternative and/or prioritised alternatives and to ensure that only the relevant triggers to services are generated. Further additional context information will be incorporated and prediction techniques will be used.

## VII. 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 really important 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 of 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 various network elements and on user devices (software upgrade on a terminal). It is also important at this stage to minimise the user’s manipulations as far as terminal configuration is concerned, especially if more than one terminal are 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.

### a) Technical approach

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 environment 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 modeled 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.

#### **b) State of the Art and Innovation**

Nowadays **Service Creation Environments** are closed environments that can be used on a single vertical platform. Creation of services in a multi-platform environment is very painful, and integration is always very time consuming. We will implement tools for easy design of services over heterogeneous platforms. To do that 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.

Currently some standard languages such as BPEL (Business Process Execution Language) allow to describe service composition as a workflow. This approach is getting more and more used to compose web services, but it is not suitable for composing web services with telco services, due to the poor asynchronous support. Our **Service Description Language** for composition will be capable of describing in an easy way composite and integrated IT/telco services taking into account semantic information associated with the elementary services. The language shall be easily generated by the Service Creation Tool in a graphical way, and shall 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. Our approach is a **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 elements 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 chain from service idea to service usage, overcoming today's lack of integration in the process of creation, deployment, provisioning. The platform will therefore include the support for integrated delivery of services, including mechanisms 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.

## VIII. Service Access Control and Trust Management

### a) Objectives

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 on several SP belonging to a circle of trust.
  - The delegation of use of terminal or 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.

### b) Technical approach

2. **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 is addressed with Liberty Alliance or similar proposals.
  - New works will address the delegation that can be used for multimodal or shared terminals.
3. **AAA** will enable the access and the accounting to Spice component.
  - The composition of services makes it very difficult to associate rights to services that are recursively imbricated.
  - Authorisation must be dealt 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.

4. 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.
5. 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).

## IX. Information and Content delivery

### a) Technical objectives

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.

#### b) State of the Art and Innovation

Nowadays **media and the related metadata** are treated as separate items although the processing of the media is described in accompanying documents. Therefore, the preparation of content is done manually and so it is time- and cost-consuming. The project will develop and implement tools for an easy handling of content by describing media and metadata as an entity with the metadata controlling the behaviour of the media.

Today **content** is played out in a certain device **and its usage** is more controlled by the characteristics of this device than by the user. A user friendly handling of content is not strongly enough supported in today's technical environment. This means that the user has to select a quality, hoping that he has the codecs available, and so on. These hurdles prevent rapid multimedia service deployment. The project aims at linking the content to the user and not to a certain device. The adaptation processes that are necessary to transport, protect and display the content are hidden from the user and will be controlled by the service environment without bothering the user with technical details.

Multimedia content nowadays is distributed in a controlled environment having specified and adjusted edge conditions as the content representation format, its delivery channel and its presentation device. In such a way quality of service (QoS) can be guaranteed taking into account the legal and technical constraints of the several participants contributing to a multimedia service. For multimedia services in an IP-based environment only the "Best effort" approach is used without a possibility of interaction between the network and the application. The SPICE approach will **link the content and network domains**: Quality requirements will be signalled from the application level to the network and the network has to give some kind of feedback to the application whether these requirements can be fulfilled or not for a content-aware end-to-end delivery. The process must be performed dynamically and influence the delivery strategy of the application.

Currently, **seamless service provisioning across networks** is not possible. e.g. a TV program

watched via the home wireless LAN that is streamed via the public network cannot seamlessly be continued over the UMTS network. The project will work on metadata and standardized support services that allow users to maintain the same channel via various (not necessarily related) access networks.

## X. Experiencing SPICE

The demonstration of the SPICE project results will be achieved keeping in mind the main objective which is to ensure economical and technical viability of the proposed solution. It will use several scenarios, the roles of which are to illustrate the impact of SPICE on the European citizen, its impact on the service providers and telecommunication operators and the ability to work across various business domains, heterogeneous networks, environments and terminals. This will also provide insight on the new business models implied by the changes for all the stakeholders in the value chain and on the adequacy of the user's experience with their needs and expectations. It is also interesting to notice that the scenario-driven approach followed by the SPICE project will allow to feature parts of the original scenarios used during all phases of the project during the final demonstration. These scenarios (intelligent-portal, e-tourism and e-emergency) have been carefully designed to illustrate all the concepts and features developed and implemented during the project.

In order to align the fundamentals of the SPICE project to the basic needs of the European society, there needs to be validation of the experience. In this activity real users from different societal fields (focus groups) provide feedback based on a visit to SPICE services. Feedback will be retrieved from users and actors by putting them in a context that is as close as possible to the real one. This kind of 'testing-by-a-real-user' evaluates both the ease-of-use as the practical benefits for the different types of users/actors.

## XI. Conclusions

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.

## **XII. References**

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