



# Position Paper on Future Internet Usage Areas

## Setting the Context and the Requirements

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### 1. Introduction

The National and Kapodistrian University of Athens (NKUA) is the largest academic organisation in Greece in terms of academic staff and under-graduate and post graduate students. NKUA provides a complete educational framework integrating a vast number of educational areas (including applied sciences, human sciences, medical, legal and financial, etc).

This paper is providing NKUA's on the envisaged usage areas and their requirements on the Future Internet providing NKUA's priorities and identifying corresponding requirements in terms of needed functionalities and the experimentation facilities. The 5 vertical usage areas selected by the FI PPP programme are: (1) Utilities and Environment, (2) eHealth, (3) Smart Energy Grid, (4) Transport, Mobility and Logistics, and (5) Content management. Section 2 identifies NKUA's priorities on the Usage Areas, Section 3 presents the required functionality, Section 4 outlines the experimentation environment, and Section 5 presents NKUA's profile and role in the development in FI PPP.

### 2. Usage Areas Identification

In this section, NKUA proposes a prioritised list of appropriate use cases with a reference to the identified Usage Areas, based also on NKUA's team expertise, application areas and scope. In this context:

- **Content Management** is proposed as the Usage Area of the **highest priority** of large scale experimentation. Content stands at a **higher abstraction** level between the infrastructure (hardware and software platforms) and the means (application and services) for providing **user value**. In this sense, an **integrated approach for content management** will have to cope with the **increasing heterogeneity** of the network and device interfaces, the underlying resources, as well as the personalisation related semantic data and knowledge. Additionally, such an integrated approach will enable **seamless dynamic roles swap**: roles such as content owner/provider, content aggregator and content user will be ever re-allocating among the involved stakeholders; this also implies the need for **open and flexible interfacing** infrastructures, resources, stakeholders, value, and corresponding metadata.
- **Smart Energy Grid**: the concept of energy efficiency spans among systems, networks, infrastructures and services. This makes the notion of smart energy, a "horizontal" usage area penetrating the rest usage areas and promising a powerful and efficient tool for energy generation/provisioning and consumption management and control. NKUA is working on a **innovative paradigm** that considers the **convolution of the communication networks and the energy distribution networks** in a system self-evolvement towards multiple purposes energy aware systems putting in scene additional requirements for **self-adaptability, dependability** and **scalability** [1].
- **Transport, Mobility and Logistics**: the notion of **smart cities** is of considerable importance for the quality of living; it is also of major interest as having to deal with a huge heterogeneity of requirements based on different needs of users, communities, groups, etc. thus outlining corresponding need for large scale experimentation. Moreover, such usage areas will have to address **additional technical issues** reflecting **different areas**: Extending the notion of smart cities to **smart regions** further increases heterogeneity: e.g. **smart (small) islands**. University Campuses could provide a small scale experimentation area to pave the way for gradual addressing transport issues within smart cities. In addition, this notion concerns the combination of **advanced traffic and route management** mechanisms that will produce respective content and services to the end-users/consumers. The cooperation of the **end-user and the infrastructure** is foreseen to promote social networking aspects and the optimization of the system functions. Such concept can be coupled with the smart-cities concepts or can be viewed as an extension of existing location-based services platforms/systems.
- **Utilities and Environment**: this notion embraces the provision, emergence and deployment of **end-to-end services** for the users focusing on the **smart cities concept**. The efficient



deployment and management of these services calls for solutions that will realize the monitoring and control of the arising solutions and interactions. M2M technology embraces as a key solution for **edge devices' communication** and **network integration**. NKUA will leverage on the outcomes and solution in the **Smart Energy Grid and Smart Cities notions** utilizing **M2M technologies** so as to work on the application of the concepts in a large-scale real-time environment domain (Smart Energy Grid test environment, Pan-European Global Mobility guidance system) by envisaging three main aspects: a) definition of key scenarios, b) deployment of defined mechanisms and solutions and c) possible exploitation of bringing-in the university as part of the end-users community.

### 3. Required Functionalities and Core Platform

The prioritised usage areas could rely on a common set of generic capabilities, which, in turn, could be broken down to more specific functionality. Such generic capabilities include:

- High autonomicity and Self-x capabilities for more efficient management of resources (i.e. energy efficiency),
- Cooperation capabilities for addressing more complex problems solving (e.g., dependability, etc),
- Personalisation capabilities related to resource allocation and service and application deployment and provisioning,
- Adaptation and fine-grained customisation capabilities for optimised resource usage and allocation and dynamic configuration of the supporting infrastructure.
- Evolvability, extensibility, scalability.

The above presented set of generic capabilities may be supported by more specific functionalities as included in the initial set of common enablers in reference to the Core Platform:

- Event / Data aggregation, transformation, correlation and Filtering, and Data / Data classification
- Entities Naming Resolution (applicable to services, things, devices, nodes, resources, ...),
- Service and content repositories management and aggregation; Service composition, brokering and execution,
- Content/Service indexing, searching and discovery,
- Dynamic adaptability of services / content,
- Application Communication Infrastructure,
- Situation awareness, Context, Identity and knowledge management and sharing,
- Generic rating/context aware co-evaluation, charging, billing,
- Conceptualization Repository,
- Provision of shared Infrastructure (communication, computing, storage, cognition) as a Service,
- Real time data monitoring and analysis/servers,
- Resources virtualisation, and dynamic resources customisation/adaptation,
- Dynamic configuration of the infrastructure
- User feedback loop for the cooperation between user – infrastructure,
- Energy-efficiency functionality and management schemes,
- Reinforcing learning capabilities on user social networking,
- Security and accessibility in produced user information/content,
- Scalability related functionalities for efficient administration of increased end-user number.

### 4. Experimentation Environment

An evolutionary approach could be considered for the prototyping environment building on existing infrastructures at national and European level. National initiatives on experimentation related to the



presented areas would be able to bring out more specific requirements and characteristics according to each member state particular characteristics.

Next, experimentation at European level will work on clarifying/integrating the requirements emerged during national trials and will also elaborate on homogenisation, and bringing up issues resulted from the large scale and the combination of multiple contexts into one experimentation environment. Moreover, the nationally tested capabilities and features are expected to be cross-challenged for evaluating their actual scope and range.

Moreover, this will advance cooperation between mere testbeds coming from industry and universities. For the specific usage area use cases that are related to smart energy, FIRE-like energy initiatives could be designed and evaluated (i.e. smart energy grid test environment).

As regards the experimentation activities, it should be noted that NKUA team will leverage on its involvement in the FIRE initiative. NKUA being the coordinator for FP7 Self-NET project has cooperated with PanLab on developing and testing specific use-cases for experimentation. Using OCTOPUS testbed infrastructure (PANLAB member), NKUA has worked on experimenting on Self-management schemes for techniques coverage and capacity optimization. In addition, NKUA will exploit multiple software and hardware platforms for reconfigurable and cognitive systems and location based-services from EU projects (e.g. LIAISON, E2R I & II, E3, MOBIVAS for experimentation and testing activities).

## 5. NKUA Profile and Role

The advancements in software engineering impacting communication technologies have recently led to the revelation of the need for a synthetic research approach in the area of software engineering and its applications in mobile services, pervasive and ubiquitous computing, reconfigurable systems, autonomic computing and communications. Autonomic and Self-Managing Networks is emerging as a significant strategic and holistic approach to the design of object oriented, computer-based systems and communications. SCA-Networks is a new and pioneering Lab focusing on software based autonomic and reconfigurable systems in the Dept. of Informatics and Telecommunications, which belongs to the School of Sciences of the National and Kapodistrian University of Athens. The SCA-Networks Lab (Self-Configuring Autonomic Networks) will operate under the supervision of the Lecturer Nancy Alonistioti and is a spin off lab of CNL. SCAN members have wide expertise in technical and project management, system design, reconfigurable and cognitive systems, autonomic and mobile computing, mobile applications and services. Over the past decade, UoA researchers have been actively involved in International projects, funded by the European Commission (ACTS WAND, RAINBOW, IST FP5 WINE, MOBIVAS, EURO-CITI, VIDEO-GATEWAY, BROADWAY, POLOS, ANWIRE, IST FP6 E2R I & II, LIAISON, CASCADAS, ANA, BIONETS, ICT FP7 E3, Self-NET) and a vast number of National Initiative projects. UoA researchers have undertaken project and technical management roles (e.g., MOBIVAS, Self-NET, E2RI, E2RII). SCAN and CNL researchers have been actively striving for wide-area dissemination of its research results through interaction with UMTS Forum, 3GPP, DMTF, MEXE Forum and with EU DG INFSO for event organisation and meeting hosting activities.

Based on strong experience and know how on technical areas that are horizontal to the (proposed) usage areas NKUA could work on

- Technical Use cases definition for extracting both application and functional requirements: setting functional requirements would lead to architectural and interface specification; on the other hand application requirements include application deployment, composition and personalisation.
- Cohesion mechanisms and evaluation metrics for architecture/platform capabilities fine tuning and optimization during the system lifecycle.
- Business cases viability could be also exploited.
- Test scenarios definition for both national and european experimentation and elaborating on the proprietary testbed for initial evaluation of envisaged functionality and features.

## 6. References

- [1] Alonistioti, N. et al, Towards Self-Adaptable, Scalable, Dependable and Energy Efficient Networks: The Self-Growing Concept submitted to UBICOMM 2010.