Cloud Computing, Software and Services

Objective 1: Advanced Cloud Infrastructures and Services

Aim

Strengthen the competitive position of the European industry through enhanced technological capabilities in respect of the next paradigm of cloud computing, on a market time horizon beyond 2018 (long term). This would in particular orientate cloud computing research towards new computational and data management models (at both infrastructure and services levels) that respond to the advent of faster and more efficient machines, rising heterogeneity of access devices, mobility, demand for low energy solutions, widespread use of big data, federated clouds and secure multi-actor environments.

Why?

Investing in future clouds should build on European strengths: telecoms, mobile and software applications and services. There is an opportunity to 'leapfrog' the competition by focusing on the next paradigm of cloud technologies. It is also an opportunity to respond to the new requirements that are expected to transform cloud computing as we know it today, including: heterogeneity of resources and devices: Software-defined data centres; internet of things (sensor networks and big data); security; rising demands for better quality of user experience:

What

- **Federated cloud networking:** New technologies (architectures, middleware, end-to-end SLAs, etc.) are needed for cloud networking, interoperation and federation to resolve the problems of heterogeneity of platforms, resource allocation and performance sustainability in multi-tenancy.
- **Automated service composition**: Tools for dynamic reallocation of services to platforms to achieve availability, sustainability, flexibility, elasticity; New techniques for managing big data taking into account integrity and state aspects.
- **Mobile Cloud service development environments:** New tools and service development environments for smart mobility cloud services focusing on security allowing agile development of cloud services, synchronicity, identification, authentication and managing access permissions.

Cloud infrastructures (virtual/physical): cloud networking and virtualisation of data centres, platforms and tools to develop cloud-based services (SaaS, PaaS, IaaS). Activities include the development of advanced tools and mechanisms for the management of distributed, heterogeneous physical computing resources, automatic management of elasticity and storage resources, optimisation of usage of hardware resources, provisioning of virtualised resources according to pre-defined SLAs. New programming models for the distribution, parallelisation and replication addressing the specific features of distributed and dynamic environments. Methods and tools that enable compliance with cloud provisioning business concerns, including policies and QoS.

Objective 2: Innovative tools and methods for software development

Aim

This objective aims at cost reduction and quality improvement breakthroughs in software engineering. Software is pervasive in many products and services, therefore advances in software technology impact on the whole of European industry and on the quality of life of citizens. This should help the EU software industry to be more competitive, especially in the area of large and complex software systems which are critical for industrial and public sector applications. It should also reduce the costs of IT systems and thus allow productivity improvements across the economy.

Why

The key research and innovation challenge is rising complexity. The tools and methods of software engineering have not evolved quickly enough in the last 10 years for coping with the evolution of the demand, and are now insufficient to manage the complexity and the variability of real-life software systems. Current technology of software engineering does not allow simulating and testing realistically the variability of a complex software system. A significant improvement in available tools is needed for software providers to develop and bring to the market innovative software products and services.

Also, software projects may now count upon many (thousands) of contributors (including users) spread across the globe that never meet face to face. This is made possible by widespread Internet connectivity. The innovation potential of this new approach to software development, pioneered by Open Source communities, is enormous: it allows putting the user in the loop, tapping into very large pool of skills and spreading knowledge and technological skills very effectively.

What

The next phase of research on software technology will address two main research challenges:

Tools and methods to manage complexity, system simulation, variability, testing and failure management across the software lifecycle by developing methods and tools for software systems that are:

- Reliable, dependable and resilient (e.g. five nines reliability: 99.999%, 5 minutes downtime per year);
- Able to adapt quickly to changing requirements, capable to scale and be managed automatically;
- Susceptible to realistic simulation and system-wide testing.

Flexible and scalable tools for on-line collaborative software development that:

- Support teams geographically dispersed across different countries and cultures
- Allow on-line collaboration across different platforms and from different technical environments
- Allow easy integration and cooperation with web-based social network tools
- Preserve privacy and security when using the public internet
  Encourage the rapid prototyping of open source applications through early and active involvement of users

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