



## Mission of TClouds:

- › To develop an advanced cloud infrastructure that can deliver computing and storage that achieves a new level of security, privacy, and resilience yet is cost-efficient, simple, and scalable.
- › To change the perceptions of cloud computing by demonstrating the prototype infrastructure in socially significant application areas: energy and healthcare.

## Motivation:

State-of-the-art cloud computing enables seamless access to services and global availability of information, but inherent risks severely limit the application of this technology.

In a cloud environment, pertinent data is accessed via information and communications technology (ICT) using remote hardware instead of being stored only on a local server or computer. The benefits of increased storage at reduced cost allow information to be made readily available.

However, the current cloud computing model comes with perceived risks concerning resilience and privacy. There are three fundamental trends in ICT whose risks mutually reinforce each other:

- › the push towards an Internet of Services - most services are provided on the web as a platform;
- › cost pressures drive a migration of ICT into so-called Infrastructure clouds;
- › growing importance of ICT as the critical “nervous system” for socially relevant “smart” infrastructures – such as healthcare, energy, environmental monitoring, or mobility.

Protecting data and services in the cloud is important to governments, organizations and enterprises across all industries, including healthcare, energy utilities, and banking. Thus, the perceived security and dependability risks of cloud computing are limiting its application.

The TClouds project targets cloud computing security and minimization of the widespread concerns about the security of personal data by putting its focus on privacy protection in cross-border infrastructures and on ensuring resilience against failures and attacks.

## Objectives:

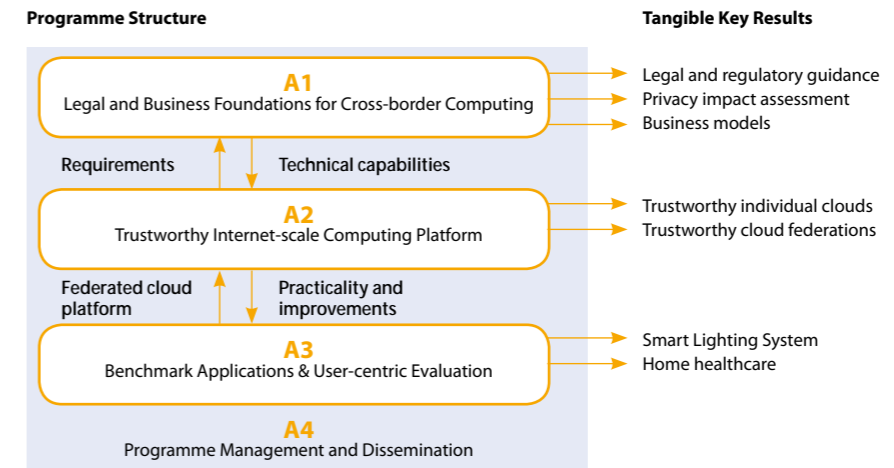
Trustworthy Clouds (TClouds) aims to build a prototype Internet-scale ICT infrastructure which allows virtualized computing, network, and storage resources over the Internet to provide scalability and cost-efficiency. The following objectives contribute to achieving the overall goal:

- › Identifying and addressing the legal and business implications and opportunities of a widespread use of infrastructure clouds, contributing to building a regulatory framework for enabling resilient and privacy-enhanced cross-border infrastructure clouds.
- › Defining an architecture and prototype for securing infrastructure clouds by providing security enhancements that can be deployed on top of commodity infrastructure clouds (as a cloud-of-clouds) and assessing the resilience and privacy benefits of security extensions of existing clouds.
- › Providing resilient middleware for adaptive security on the cloud-of-clouds. The TClouds platform will provide tolerance and adaptability to mitigate security incidents and unstable operating conditions for a range of applications running on such clouds-of-clouds.

To demonstrate TClouds, scientists will prototype two scenarios involving critical IT-systems:

- › A smart lighting control system with Portugal’s leading energy and solution providers Energias de Portugal and EFACEC. TClouds will exhibit a public-infrastructure solution as part of the smart grid and show how to migrate it to a secure cloud. This increases the resilience against hardware failures, adds privacy protection and protects from hacker attacks and other security problems.
- › A patient-centric home healthcare service with San Raffaele Hospital in Milano, Italy: TClouds will demonstrate a cloud-supported solution that supports multiple different actors and remotely monitors, diagnoses and assists patients outside a hospital setting. The service respects security and privacy requirements and regulations governing patient data.

## Stages of the TClouds project



## Key concepts:

**Federation of independent providers** enables an ecosystem of independent providers to guarantee that the overall system does not depend on any individual provider.

**Flexible trust models** determine who among the different players to trust and which mechanisms to use.

**User-centric security and privacy policies** define individual security and privacy preferences.

**Open interfaces** provide interoperability between different clouds and seamless migration of workloads while maintaining the security constraints given.

**Scalable security mechanism** emphasizes that a mechanism must be scalable and transparent as well as resilient to handle failures of the underlying virtual infrastructures.

## Project Results:

- › An infrastructure cloud security architecture with well-defined abstractions and standardised interfaces that allow loosely coupled components to provide adaptive and scalable resilience and privacy.
- › Novel resilient protocols, cloud security mechanisms, management components, and selected open source implementations.
- › Proof-of-concept prototypes that evaluate our results in experiments, in conjunction with and validated by key stakeholders represented by the Advisory Board and others.

## Technical Approach:

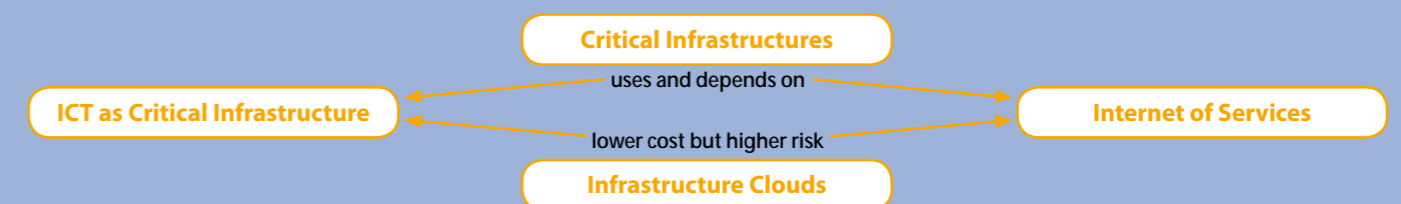
The work plan of TClouds encompasses four independently managed Activities and twelve tightly integrated Work Packages.

**Activity A1: Legal and Business Foundations for Cross-border Computing**  
A1 is responsible for legal and regulatory guidance, the privacy impact assessment for cross-border clouds, and viable business models for cloud providers.

**Activity A2: Trustworthy Internet-scale Computing Platform**  
A2 is responsible for the TClouds platform. This platform includes trustworthy individual clouds that are based either on extending commodity clouds or on strengthening cloud operation software.

**Activity A3: Benchmark Application & User-centric Evaluation**  
A3 is responsible for delivering the Smart Lighting and Home Healthcare cloud scenarios as well as self-evaluation and self-improvement through end-user and expert feedback.

**Activity A4: Programme Management and Dissemination**  
A4 is responsible for wide and effective dissemination as well as the proper programme management that ensures timely and high-quality delivery of all results while mitigating emerging conflicts.



## Contact:

### Project Coordinator

Dr. Klaus-Michael Koch  
 Technikon Forschungs- und Planungsgesellschaft mbH  
 Burgplatz 3a  
 9500 Villach  
 Austria

Tel.: +43 4242 233 55 – 0  
 Fax: +43 4242 233 55 – 77  
 E-mail: [coordination@tclouds-project.eu](mailto:coordination@tclouds-project.eu)  
 Web: [www.tclouds-project.eu](http://www.tclouds-project.eu)

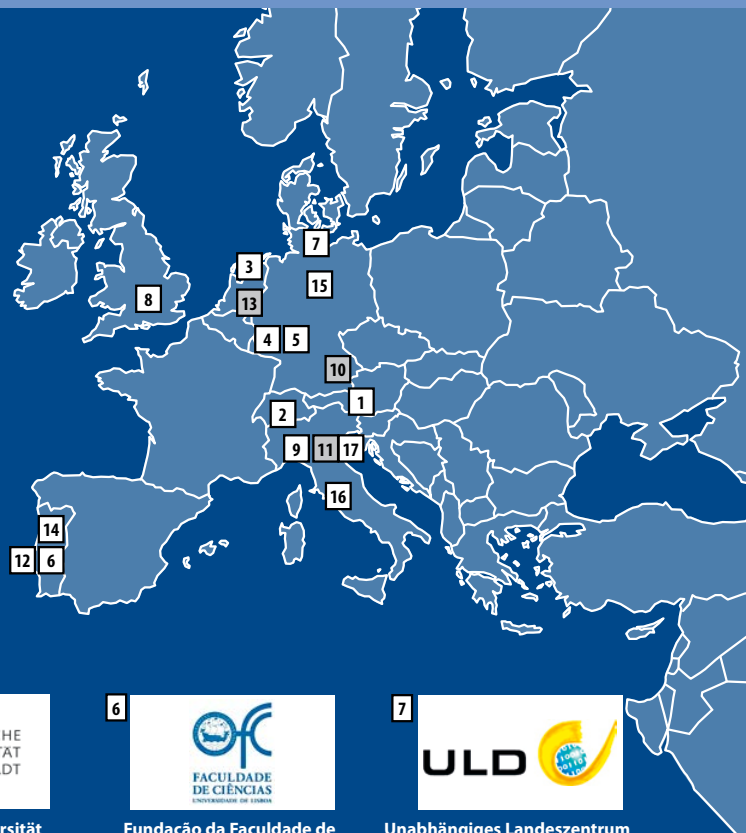
### Technical Leader

Dr. Christian Cachin  
 IBM Research GmbH  
 Säumerstraße 4  
 8803 Rüschlikon  
 Switzerland

Tel.: +41 44 724-8989  
 E-mail: [cca@zurich.ibm.com](mailto:cca@zurich.ibm.com)  
 Web: [www.zurich.ibm.com/~cca](http://www.zurich.ibm.com/~cca)

## Consortium

The consortium currently consists of 14 partners from 7 different countries (greyed background identifies former members): reputable universities and recognised companies from six European Union member states (Austria, Netherlands, Germany, Portugal, Italy and the United Kingdom) plus Switzerland. All partners are experts in their field. This partnership of experienced professionals is anticipated to result in a successful project.



**1**  
 Technikon Forschungs- und Planungsgesellschaft mbH (Villach/Austria)



**2**  
 IBM Research GmbH (Zurich/Switzerland)



**3**  
 Philips Electronics Nederland B.V. (Amsterdam/Netherlands)



**4**  
 Sirrix Aktiengesellschaft (Homburg/Saar/Germany)



**5**  
 Technische Universität Darmstadt (Darmstadt/Germany)



**6**  
 Fundação da Faculdade de Ciências da Universidade de Lisboa (Lisbon/Portugal)



**7**  
 Unabhängiges Landeszentrum für Datenschutz Schleswig-Holstein (Kiel/Germany)



**8**  
 The Chancellor, Master and Scholars of the University of Oxford (Oxford/United Kingdom)



**9**  
 Politecnico di Torino (Torino/Italy)



**10**  
 Friedrich-Alexander-Universität Erlangen-Nürnberg (Erlangen/Germany)  
 Project Exit Date: March 30, 2012



**11**  
 Fondazione Centro San Raffaele del Monte Tabor (Milan/Italy)  
 Project Exit Date: May 10, 2012



**12**  
 Energias de Portugal (Lisbon/Portugal)



**13**  
 Universiteit Maastricht-Merit (Maastricht/Netherlands)  
 Project Exit Date: April 30, 2012



**14**  
 EFACEC Engenharia e Sistemas, S.A. (Maia/Portugal)



**15**  
 Technische Universität Braunschweig (Braunschweig/Germany),  
 Project Entry Date: April 1, 2012



**16**  
 INNOVA SpA (Rome/Italy),  
 Project Entry Date: June 1, 2012



**17**  
 Fondazione Centro San Raffaele (Milan/Italy),  
 Project Entry Date: May 11, 2012