The delivery of software services over widely distributed systems provides far more dynamic and flexible ICT solutions for the user than ever before – but to maximise this potential, software development and maintenance has to radically change, something project S-Cube is ensuring. Dr Andreas Metzger explains.

**Working together to create a network of excellence**

**THE rapid evolution** of information and communication technology (ICT) means that opportunities for new ways of computing and interacting are growing apace. One such opportunity is that of developing innovative systems by composing software services available over widely distributed infrastructures, providing utility to the users in a much more dynamic and flexible way than possible today. However, such service-based systems and their corresponding software services require fundamental changes to the way software is developed and maintained.

The use of software services implies that software is no longer owned by its users and that it is no longer running in the place where users are interacting with it. This distributed ownership of the software opens up a whole range of research challenges, including its design, evolution, adaptation and quality assurance. But while many organisations across Europe are investigating some of those very challenges, so far there has been little or no concerted effort to explore challenges that cut across different research disciplines.

This is where the S-Cube project comes in. Coordinated by Paluno (The Ruhr Institute for Software Technology), based at the University of Duisburg-Essen in Germany, “S-Cube, as a European Network of Excellence, brings together researchers from various disciplines and ensures...”
there is a synergy and learning effect,”
said Dr Andreas Metzger, from S-Cube.
“As an example, the software engineering
discipline has acquired a huge body of
knowledge on how to design traditional
software systems.”

However, in the case of service-based
systems much more decisions need to be
taken during the systems’ operation. This
is due to the fact that the distributed
ownership of the software implies that
required information about the software
services might not be available during
design time.

This is where researchers working on
computing infrastructures (such as Grids)
bring in their expertise on how to design
systems that are more dynamic and
autonomous, such as self-adaptive
infrastructures.

“Researchers from the business process
management discipline bring in their
understanding about how complex
networks of organisations can work
and reference library for the Internet of
Services, which is available via the S-
Cube web portal.

“We realised that between the
communities involved in S-Cube we will
not always be able to agree on a common
terminology, so we did not force it but
instead interrelated the various definitions
so that people can translate between the
vocabularies of the various communities.”

To organise the research activities in S-
Cube, the network has defined an
integrated research. “The S-Cube
framework provides a clear separation of
concerns and thus allows handling the
complexity involved in aligning and
integrating research activities of diverse
disciplines. Specifically, the framework
provides a clear distinction between
service technology provided at different
layers of a service-based system and
cross-cutting principles and methods to
utilise that technology in an integrated
fashion.

The basic motivation for S-Cube
is to create a network of excellence
that will bring together researchers from
various communities and
ensure there is a synergy and
learning effect between these
various communities”

“...A very positive sign that shows the
potential for S-Cube,”
explains Dr Metzger.

“...there is a synergy and learning effect,”
said Prof. Michael Papazoglou.

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To align the different disciplines and to
cross-pollinate already existing yet disparate
research strands, S-Cube pursues dedicated
integration activities within the project,
not least to acknowledge and understand the
differences in language and terminology used by the different scientific
disciplines.

“What we did in S-Cube to address the
diversity in terminology was to define and
continuously update the S-Cube knowledge
model. This is an on-line encyclopaedia
and reference library for the Internet of
Services, which is available via the S-
Cube web portal.

“For example, in the ‘Quality Definition,
Negotiation and Assurance’ building block of
the framework, we investigate the novel
facilities to predict a potential failure of a
software service.

“This allows for an adaptation of the
service-based system before a failure of a
service can impact on the system’s quality.
To predict such failures different quality
characteristics need to be measured and
correlated across the technology layers.”

S-Cube has just entered the second half
of its four-year funding period. “Driven
by S-Cube’s research challenges and
fostered by its research framework,
researchers from various disciplines are
now pursuing joint research activities and
are intensively talking to each other.

A very positive sign that shows the

Contact (for further inquiries)
Name: Dr. Andreas Metzger
Telephone number: +49-201-183-4650
Email address: andreas.metzger@paluno.uni-
due.de

E-Mail: andreas.metzger@paluno.uni-
due.de
The increased pressure that the medical (Multimodal MIDAS project) said Dr Metzger.

utilising computing resources per use,“ dynamicity, as it allows allocating and

In addition to software that is provided as a service, processing and storage facilities will be made available as a service. This adds another level of flexibility and
dynamicity, as it allows allocating and utilising computing resources per use,” said Dr Metzger.

S-Cube’s Integrated Research Framework

"So there is yet another dimension of shared ownership that has another potentially huge impact on research. The new ICT work-programme under the European Commission’s Seventh Framework Programme is addressing these cloud computing issues and so this will also be a very interesting and relevant subject for S-Cube researchers to study beyond the scope and life-time of S-Cube." ★

At a glance
Project Information
Project Title: S-Cube: The Software Services and Systems Network

Project Objective:
S-Cube will create a unified, multidisciplinary, vibrant research community and will define a broader research vision and perspective to shape the “Internet of Services”. Thereby, S-Cube will enable Europe to lead the software services revolution and help in building the foundations for our future interactive society.

Project Duration and Timing:
48 Months, running from 01.03.2008 to 29.02.2012

Project Funding:
Funded by the European Community’s Seventh Framework Programme FP7/2007-2013 under the programme “Service and Software Architectures, Infrastructures and Engineering”

Amount: approx. 8.5 million EUR

Project Members:
Univ. of Duisburg-Essen / Paluno – Ruhr Institute for Software Technology (DE), Tilburg Univ. (NL), City Univ. London (UK), CNR (IT), FBK (IT), INRIA (FR), Lero (IE), PIJIT (PL), Politecnico di Milano (IT), MTA SZTAKI (HU), Vienna Univ. of Technology (AT), Univ. Claude Bernard Lyon (FR), Univ. of Crete (GR), Univ. di Pisa (IT), Univ. Europénne de Bretagne / Univ. de Bretagne-Sud (FR), Univ. L’Aquila (IT), Univ. of Groningen (NL), Univ. of Innsbruck / Semantic Technology Institute (AT), Univ. of Manchester (UK), Univ. of Ménster (DE), Univ. of Southampton / IT Innovation (UK), Univ. Politecènica de Catalunya (ES) Univ. Políticènica de Catalunya (ES)

successful alignment of the various communities is conferences and workshops

A prominent example is the ICSOC/ ServiceWave conference series, which has attracted great interest from research and industry. ServiceWave has been launched in 2008 by S-Cube jointly with several European Technology Platforms and EU projects to serve as a European forum addressing software services and ICT technologies.

Each second year ServiceWave is collocated with the International Conference on Service-Oriented Computing (ICSOC) and thereby also attracts many participants outside Europe.

The challenges of cloud computing are now testing out the S-Cube team as they try to look ahead to a future which is changing so quickly in the present. “In addition to software that is provided as a service, processing and storage facilities will be made available as a service. This adds another level of flexibility and
dynamicity, as it allows allocating and utilising computing resources per use,” said Dr Metzger.

The project’s primary goal is the development of complete and intelligent integrated solutions for our future interactive society.

Project Members:
CETIC (BE), Dortmund Univ. of Technology (DE), Karlsruhe Institute of Technology (DE), SINTEF (NO), South East Europ. Research Centre (GR), Tsinghua Univ. (CN), Univ. de Sevilla (ES), Univ. della Svizzera Italiana (CH), Univ. di Pisa (IT), Univ. Europénne de Bretagne / Univ. de Bretagne-Sud (FR), Univ. L’Aquila (IT), Univ. of Groningen (NL), Univ. of Innsbruck / Semantic Technology Institute (AT), Univ. of Manchester (UK), Univ. of Ménster (DE), Univ. of Southampton / IT Innovation (UK), Univ. Politécènica de Catalunya (ES) Univ. Políticènica de Catalunya (ES)