DynAdapt 2016

		France ~ I3S	Norway ~ SINTEF
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1. Short description of the scientific project

Nowadays, software systems are leveraging upon an aggregation of dedicated solutions, which leads to the design of large scale, distributed, dynamic systems. The need to evolve and update such systems after delivery is often inevitable, for example, due to changes in the requirements, maintenance, or needs for advancing the quality of services such as scalability and performances. Dynamically adaptive systems (DAS) have emerged to cope with this challenge by enabling the continuous design and adaptation of complex software systems. DAS facilitates handling short-term changes in the execution environment as well as long-term changes in the system requirements. In order to facilitate reasoning, simulation and enactment of adaptation actions, DAS typically rely on a runtime model that provides an abstract representation of the running system. These models are often based on a predefined and fixed set of concepts that describe the current system's hardware infrastructure and services. However, with the recent advances in the miniaturization of computer hardware, these infrastructures and services can dynamically evolve due to arbitrary node mobility or failures. **An interesting challenge is thus to provide support for the dynamic modification of these runtime models on the basis of the appearance or disappearance of devices and services.** A particular focus will be given to the integration of such new devices and services within the runtime model on the basis of their similarities at a semantic level (e.g., a newly accessible smartphone can be integrated and considered as a display within the runtime model).

2. Is the collaboration between the research teams new?

This proposal aims to formalise the irregular contacts that exist between the two partners. Nicolas Ferry (SINTEF) was a member of the I3S laboratory during his PhD studies (2008-2011) with Stéphane Lavirotte as main advisor. Arnor Solberg visited I3S several times and performed lectures in the software engineering course at University of Nice. In addition, I3S and SINTEF have been involved together in the proposal writing of several EU projects. **These irregular contacts comfort us in the fact that there is a real need to start a sustainable collaboration between SINTEF and I3S.**

3. What is the purpose of the exchange and what will be done during the visits?

Objectives of the collaboration
Our long-term goal is to establish a sustainable collaboration between the two participating laboratories. The objective of the proposed AURORA collaboration is to bootstrap such a sustainable collaboration with the submission of a EU proposal at the end of the AURORA contract. From a

scientific point of view, the objective of this collaboration is combined our research effort on the design and management of DAS. This will be handled according to two axis:

O1: Case study definition and development. The two laboratories are using disjoint case studies applied to different domains to assess their own tools. It is necessary to exchange these case studies and to confront these tools to new domains with software developed by others.

O2: Initial tool chain to support DAS development and management. Both laboratories provide tools that support different aspects in the design and management of DAS. It is necessary to identify how these tools and techniques are complementary and can be integrated. This tool chain will serve as a baseline for the submission of a H2020 proposal.

Main types of activities

According to the previously described objectives, we propose activities involving exchanges of both permanent staff and PhD candidates. We want to strengthen both teams through this project, seen as a mutual sharing media between them.

Intensive research workshop. Such workshops are important to trigger research discussions (whiteboard brainstorming) as well as technical work realisation (code camp). Part of the workshop time will be used to present the obtained results, and these presentations will be open to the public (e.g., MSc and PhD candidates) to ensure the dissemination of the joint research efforts.

Mutual visits of faculty and researchers. Short-term visits (typically 2-3 days) will be used to *(i)* strengthen point-to-point collaboration between a restricted set of persons with respect to the tool chain and *(ii)* to prepare the following up of this project by identifying and developing future programs to ensure the sustainability of the started effort beyond the lifetime of this collaboration.

Joint supervision of engineer interns and master students. Both I3S (through the Polytech Nice – Sophia school of engineering and the University of Nice) and SINTEF (through the NTNU and the University of Oslo) are involved in students supervision (MSc or engineers). We will use this project to foster new collaborations using this topic as the core of the proposed topics.

Expected results for the project

R1: Common case study. The two partners have developed their own case studies from different domains and motivating different research challenges. We aim to leverage these case studies and design a common case study that captures the relevant requirements. **This case study will serve as a candidate to motivate and illustrate the research challenges for a future EU proposal.** This result address objective O1.

R2: Assessed Tool chain for Building DAS offering dynamic discovery support. This results address objective O2. **This tool chain will be the foundation of a EU proposal we plan to submit after the end of the AURORA contract to pursue this collaboration on a long-term perspective.**

R3: Roadmap for further collaborative research. In order to build a sustainable collaboration between the two laboratories, including through EU funding, **a long-term and concrete roadmap will be defined for research activities, workshops, publications and projects activities.**

Research agenda & Prospective planning

The proposed agenda is organised around 2 periods (P1 & P2). During the first period (P1), the main goals are for each partner to show the status of their own tool, and to use the different meetings to build the tool chain (result R1), using the two existing case studies. Then, the second period (P2) will

focus on the assessment of the built tool chain as well as the formalisation of the common case study (result R2), based on the experience gained during P1. The last part of P2 will involve senior staff to prepare the writing of a EU proposal to transform this punctual collaboration into a sustainable collaboration, substantially funded by the EU Commission.

Tab 4 – Prospective travel planning between January (01.16) and December (12.16).

Type		Date	Goals	Potential Travellers
P1	Kick-off **Workshop** *@Nice*	01.16 3 days	Tools demonstrations, Presentations of the case studies, "Brainstorming" to start the project	Nicolas Ferry, Arnor Solberg,
	Visit *@Oslo*	02.16 2 days	Presentation of the tool chain status, Follow up of the case studies	Jean-Yves Tigli, Gérald Rocher
	Visit *@Nice*	03.16 2 days	Presentation of the tool chain status, Follow up of the case studies	Nicolas Ferry, Jakob Høgenes
P2	Mid-term **Workshop** @Oslo	05.16 2 days	Assessment of the obtained results, Formalisation of the shared case study, "Brainstorming" for EU project proposals	Stéphane Lavirotte, Gérald Rocher
	Visit *@Nice*	07.16 2 days	Presentation of the tool chain status, Follow up on the EU project proposals	Nicolas Ferry, Ida Maria Haugstveit
	Visit *@Oslo*	09.16 2 days	Identification of perspectives, Writing workshop for EU proposals	Jean-Yves Tigli, Stéphane Lavirotte, Gérald Rocher
	Visit *@Nice*	11.16 3 days	Assessment of final results, Writing workshop for EU proposals	Arnor Solberg, Nicolas Ferry

Estimated Budget

We use the following cost estimation for each travel, per traveller:

- French partner:
  - Trip: 400 euros *(average price for Norwegian / SAS flights)*
  - Accommodation: 140 euros *(considering standard diet cost and hotel prices in Oslo)*
- Norwegian partner:
  - Trip: 3.000 Kr *(average price for Norwegian / SAS flights)*
  - Accommodation: 1.800 Kr *(considering standard diet cost and hotel prices in Nice)*

Tab 5 – Estimated Budget.

Planned Travel	I3S (FR)	SINTEF (NO)
Kick-off Workshop *@Nice*	-	2 participants, 3 days 2x3.000 + 2x3x1.800 =16.800Kr
Visit *@Oslo*	2 participant, 2 days 2x400 + 2x2x140 = 960 €	-
Visit *@Nice*	-	2 participant, 2 days 2x3.000 + 2x2x1.800 =13.200 Kr
Mid-term Workshop *@Oslo*	2 participants, 2 days 2x400 + 2x2x140 = 960€	-
Visit *@Nice*	-	2 participant, 2 days 2x3.000 + 2x2x1.800 =13.200 Kr
Visit *@Oslo*	3 participant, 2 days 3x400 + 3x2x140 = 1900€	-

Visit @*Nice*	-	2 participant, 2 days 2x3.000 + 2x2x1.800 =13.200 Kr	
Total	**3.820 €**	**56.400 Kr**	

4. Do the research teams have any plans of collaboration in the frame of H2020, or other European programs?

The intention of this AURORA project is to combine ours experience and tooling in the design of DAS (SINTEF) and in dynamic discovery (I3S)**, and to transform them it into a pivot to co-organise our research efforts based on our pre-existing results** and thus to build a sustainable collaboration focusing on addressing the research challenge previously described.

The main objective of the proposed collaboration is thus to bootstrap such a sustainable collaboration with the submission of a EU proposal at the end of the contract targeting ICT 1.1 – Smart Cyber Physical Systems.

5. Who will participate in the exchange?

Relevance of the collaboration & Team complementarity

The two laboratories involved in this proposal are considered by their peers as centres of excellence. The two partners regularly publish their results in top-ranked conferences and journals, and push an important research effort into contractual research (*e.g.*, European Commission, *ANR*, *Forskningsrådet*). **The domains addressed by the two partners are disjoint**. I3S targets pervasive and Ambient Intelligent Systems and has acquired a research-based expertise in middleware supporting dynamic discovery and integration of new devices and services. SINTEF provides research-based expertise in model-driven software engineering, with particular focus on the application of model-driven techniques and methods to support the design of DAS in the domains of cloud computing and sensor networks. As **the two partners focus on empirical and applied research**, they also publish as open-source software several pieces of software to assess their researches.

We list in Table 1 the list of personnel (permanent staff and PhD candidates) involved in this effort.

Tab 1 - Key Personnel from both partners involved in the proposal *(project leaders in bold).*

Affiliation	Name	Position	Research areas
I3S (FR)	Dr Jean-Yves Tigli	Associate Professor	Adaptive systems, Context-awareness, Semantic Web of Things
	Dr Stéphane Lavirotte	Associate Professor	Adaptive systems, Ambient Intelligent Systems, Context-awareness
	Gérald Rocher	PhD Student	Semantic Web of Things
SINTEF (NO)	Ida Maria Haugstveit	Junior Research scientist	Human computer interactions,
	Dr Nicolas Ferry	Junior Research Scientist	Adaptive Systems, Models@Run-time, Cyber-Physical Systems, Cloud-Computing
	Dr Arnor Solberg	Senior Research Scientist	Adaptive Systems, Model-Driven Engineering, Models@Run-time, Cloud Computing
	Jakob Høgenes	Junior Master of Science and potential PhD candidate	Adaptive systems, Control-theory

Description of the partnership

French Partner: I3S as a long experience in the design of adaptive middleware [1], [2] with a particular experience on adaptation to dynamic services discovery (associated to devices). Stéphane Lavirotte and Jean-Yves Tigli are now introducing semantics technics to compensate the limits of type matching in software engineering with the more flexible concept of similarities at a semantic level. The recent results in this research topic [3] comfort us in the fact that there is an exciting potential in terms of advanced research initiating a sustainable collaboration between the two research groups.

Tab 2 - Key Publications for I3S (bolded authors are I3S members involved in this proposal).

[1]	**Jean-Yves Tigli, Stéphane Lavirotte**, Gaëtan Rey, Nicolas Ferry, Vincent Hourdin, Sana Fathallah, Christophe Vergoni et Michel Riveill. « Aspects of Assembly: from Theory to Performance ». LNCS Transactions on Aspect-Oriented Software Development (TAOSD), volume 7271, 2012. ISSN 1864-3027 (Print) 1864-3035
[2]	**Stéphane Lavirotte,** Gaëtan Rey, **Gérald Rocher et Jean-Yves Tigli**. "A Generic Service Oriented Software Platform to Design Ambient Intelligent Systems" in proceedings of the International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp/ISWC'15 Adjunct), September 7-11, 2015 in Osaka, Japon,
[3]	**Gérald Rocher, Jean-Yves Tigli, Stéphane Lavirotte**, Rahma Daikhi, "Run-Time knowledge model enrichment in SWoT", to appear in 5th the proceedings of the International Conference of Internet of Things, October 26–28, 2015 in Seoul, S. Korea.

Norwegian Partner: SINTEF has pioneered a novel software engineering approach to support the design of DAS called models@runtime and plays a leading role in this community. SINTEF has developed several open-source tools implementing models@runtime and in particular: (i) DiVAML [5] (since 2009) for the design of DAS in the large, which is currently extended with the ability to manage at runtime the behaviour of the DAS [4], and (ii) CloudMF [6] (since 2013) to support the dynamic deployment and management of cloud-based applications. These tools are used in several EU projects (e.g., Broker@Cloud, MODAClouds, PaaSage) that aim at building self-adaptive platforms by SINTEF and other partners (e.g., Softeam, Polytecnico di Milano, INRIA etc.). SINTEF has also developed the SensApp platform, a service-oriented application for storing and exploiting large data sets collected from sensors and devices. SensApp has been used as a case study in several projects as a platform that can be dynamically adapted.

Tab 3 - Key Publications for SINTEF (bolded authors are SINTEF members involved in this proposal).

[4]	Hui Song, Xiaodong Zhang, **Nicolas Ferry,** Franck Chauvel, **Arnor Solberg**, Gang Huang, "Modelling Adaptation Policies as Domain-Specific Constraints",in proceedings of the 17th International Conference on Model Driven Engineering Languages and Systems, ACM/IEEE, Valencia, Spain, September 28 - October 3, 2014
[5]	Brice Morin, Olivier Barais, Jean-Marc Jézéquel, Franck Fleurey, **Arnor Solberg**: Models@ Run.time to Support Dynamic Adaptation. IEEE Computer 42(10): 44-51 (2009)
[6]	**Nicolas Ferry,** Alessandro Rossini, Franck Chauvel, Brice Morin, **Arnor Solberg**, "Towards model-driven provisioning, deployment,monitoring, and adaptation of multi-cloud systems" in proceedings of the 6th IEEE CLOUD 2013 international conference, application and industry track, IEEE, Santa Clara, USA, June 27-July 2 2013