PROJECT REPORT — PROGRESS & EVALUATION
Covering period 1 April to 30 September 2002

KUN, all

November 1, 2002

AMETIST DELIVERABLE 0.1.1

Project acronym: AMETIST
Project full title: Advanced Methods for Timed Systems
Project no.: IST-2001-35304
Project Co-ordinator: Frits Vaandrager
Project Start Date: 1 April 02
Duration: 36 months
Project home page: `http://ametist.cs.utwente.nl/`

1 Introduction

The kick-off meeting of the project took place on April 4-5 in Grenoble, just a few days after the formal start of the project. Several of the AMETIST partners knew each other already from the previous VHS project (KUN, AAU, Uni DO, VERIMAG, WIS), but still at the start of the project for each participant there were many new faces. The kick-off meeting was used to get to know each other, to learn about each others work and interests, and also for presentation of the four industrial case studies. The second project meeting was organized on September 19-20 in Twente. By that time all partners had succeeded to hire the necessary people to work on the project. During the Twente meeting initial results on the industrial case studies were presented, as well as technical work in the workpackages on Modelling, and Analysis & Tools. We refer to the project webpage for more information on the program and participants of both project meetings. As a result of the two project meetings several collaborations between partners were initiated and/or intensified, both centering around case studies as well a on modelling, analysis and tools, and a number of research visits between partners took place.

2 Work Progress Overview

Below, we give a brief and rather incomplete impression of the work that took place in the various workpackages.

WP0

The work during the first six months aimed at setting up the communication infrastructure (mail aliases, project website,..), defining clearly tasks and responsibilities within the project, and setting up procedures for publications, travel, management of budget, etc.

WP1

Model classification AAU worked on classifying various extensions of timed automata with respect to decidability and expressiveness. The extensions considered allows more general guards and more general updates than traditional timed automata. From a tool implementation point of view this work contains important (though negative) results for timed automata allowing guards on clock-differences.

Quantitative Modelling Notions of abstraction and refinement for Markov Decision Processes (MDP) has been identified and used as basis for the tool RAPTURE allowing (CSP-like) networks of MDPs to be analysed in an iterative manner. In each iteration an abstraction induced by a partitioning of the complete state-space is considered. The abstraction induces a smaller numerical problem and may be sufficiently accurate that a desired threshold probability may be guaranteed.

Scheduling and Planning A translation from PDDL3 to UPPAAL has been given and implemented (in collaboration with Henning Dierks, Oldenborg) and preliminary applications on a small number examples has been carried out.

Control Synthesis Work on extended existing optimal reachability methods for priced timed automata to settings with both controllable and uncontrollable events is under investigation.

WP2

Abstraction, compositionality and Structure Exploitation Methods utilizing abstraction in quantitative analysis of Markov Decision Processes has been established and implemented in the tool RAPTURE.

Identification of cyclic patterns in timed automata models permitting acceleration during analysis has been given. The acceleration method has been investigated using UPPAAL on timed automata models being combinations of scheduled controller programs as well as their real-time environment. The huge variation in timing constants in these mixed models make acceleration (or similar methods) necessary in order that model checking is feasible.

State Space Representation New datastructures for organising the forward state-space exploration in UPPAAL has been designed and implemented. The datastructures include unification of the so-called Passed and Waiting list as well as sharing of common parts of symbolic states.

Significant effort in implementing and experimenting with a parallel and distributed version of UPPAAL has been made.

Significant effort on extending UPPAAL with C-code has been made during the summer. A first release is expected to appear before the end of the year.

Tool Integration Work on definition and implementation of an XML format for networks of timed automata has beed made in the context of UPPAAL. The format may serve as a starting point for interaction between the various methods and prototype tools made in the project.

WP3

Within this workpackage, preliminary descriptions of the four industrial case studies have been produced:

- Smart Card Personalization System, provided by partner Cynernétix, Deliverables 3.1.1 [1].
- Real-time Memory Management in Radar Sensor Equipment, provided by partner Terma, Deliverable 3.2.1 [3].
- Real-time Service Allocation for Car Periphery Supervision, provided by partner Bosch, Deliverable 3.3.1 [4].
- Value Chain Optimization, provided by partner Axxom, Deliverable 3.4.1 [5].

In addition, initial modeling and analysis results for three of the case studies were obtained:

- **Smart Card Personalization** CYRdescribed and analysed the algorithm of their smard card machine and the production constraints in terms of time and defective cards rate. The first goal was to demonstrate that the intuitive super-single mode was optimal regarded to the batch mode. For that matter, a tool named Design/CPN was used to model the system following the coloured Petri Net method. As the model became too complex, it was then decided to consider a simplied system without defective cards. KUN build a simple discrete model of the system using the SMV model checker and managed to synthesize the super-single mode schedule and prove its optimality.
- **Real-time Memory Management in Radar Sensor Equipment** Preliminary models and analyses in UPPAAL and the BDD-based tool visualSTATE have been carried out by AAU.
- **Sypply chain management** Uni DOfocussed on this case study and related modeling questions. Since mathematical programming is a well known modeling and solution approach in many domains it was decided to try it first. Two different mixed-integer linear programming models were formulated, which are able to solve the job-shop scheduling problem from Axxom. The aim was to investigate whether this approach is appropriate and how large the problems to be solved can be. Another point is to compare this approach with others.

WP4

Dissemination and Use Plan As part of this workpackage, a Dissemination and Use Plan was written, see Deliverable 4 [6].

Workshops A successful workshop on theory and practice of timed systems (TPTS) was organized by VERIMAG shortly after the beginning of the project. The workshop brought together representatives from different industries (Ilog, Intel) as well as different scientific communities (verification, optimization, operating systems) and was attended by more than 50 persons. For more details on the workshop we refer to AMETIST Deliverable 4.1.1 [2].

Contacts with related projects Contacts were established with the related EU projects CC, Hybridge, and Omega. This was facilitated by the fact that AMETIST partners participate in each of these projects.

Website Angelika Mader and Tomas Krilavicius from UT realized and managed the AMETIST website `http://ametist.cs.utwente.nl/`. A first version of the website was completed on May 1, and proposed to the EU as Deliverable 4.4.

Publications A large number of publications was produced. We refer to the AMETIST website for details.

3 Conclusions

After six months, the project is fully in line with its objectives. Scientific/technical progress has been made in the different workpackages according to schedule. In Workpackage 3 the project is actually ahead of schedule: apart from the preliminary descriptions of the case studies, also initial modelling and analysis results were obtained. Seven deliverables (4.4, 3.1.1, 3.2.1, 3.3.1, 3.4.1, 4, 4.1.1) were produced according to plan. No difficulties worth mentioning were encountered at the management and co-ordination level.

References

[1] Sarah Albert. Cybernetix case study – informal description. Technical report, Cybernétix - LIF, 2002. Available from World Wide Web: `http;//www.cmi.univ-mrs.fr/~niebert/docs/cyx.pdf`.

[2] AMETIST. Ametist workshop, April 2002. Available from World Wide Web: `http://ametist.cs.utwente.nl/INTERNAL/PUBLICATIONS/del4.1.1.pdf`. Deliverable 4.1.1 from the IST project AMETIST.

[3] T. Hune and G. Behrmann. Modelling and analysing a memory interface, April 2002. Available from World Wide Web: `http://ametist.cs.utwente.nl/RESEARCH/TERMA/terma.ps`. Deliverable 3.2.1 from the IST project AMETIST.

[4] S. Kowalewski and M. Rittel. Real-time service allocation for car periphery supervision, September 2002. Available from World Wide Web: `http://ametist.cs.utwente.nl/RESEARCH/AMETIST_CPSPrelimDescription_1_0.pdf`. Deliverable 3.3.1 from the IST project AMETIST.

[5] S. Loeschmann and D. Ludewig. Case study 4: Detailed description of the model of a lacquer production. Available from World Wide Web: `http://ametist.cs.utwente.nl/INTERNAL/PUBLICATIONS/DELIVERABLES/del3.4.1.pdf`. Deliverable 3.4.1 from the IST project AMETIST.

[6] O. Maler. Dissemination and use plan, October 2002. Available from World Wide Web: `http://ametist.cs.utwente.nl/INTERNAL/PUBLICATIONS/del4.pdf`. Deliverable 4 from the IST project AMETIST.