

THESIS OVERVIEW

Started: 01.10.2012 **Defended: 03.12.2015** NNT : 2015SACLL004

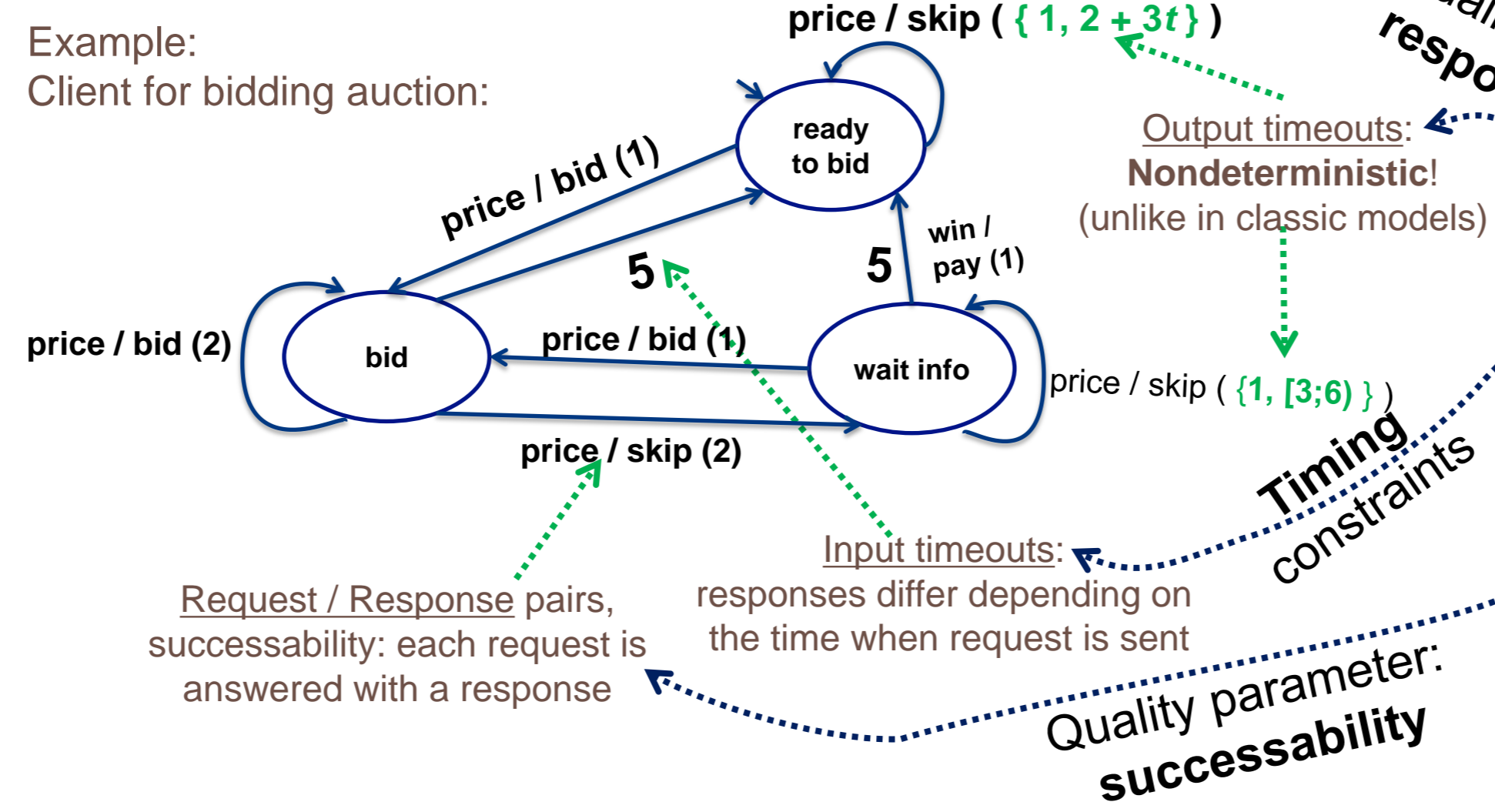
Objectives:

- Propose a finite state model capable of **integrating functional, quality and safety requirements** for complex services.
- Define a composition** for the proposed model for describing communicative behavior of complex services.
- Develop methods for effective **optimal component selection** based on proposed model.

Parties prenantes

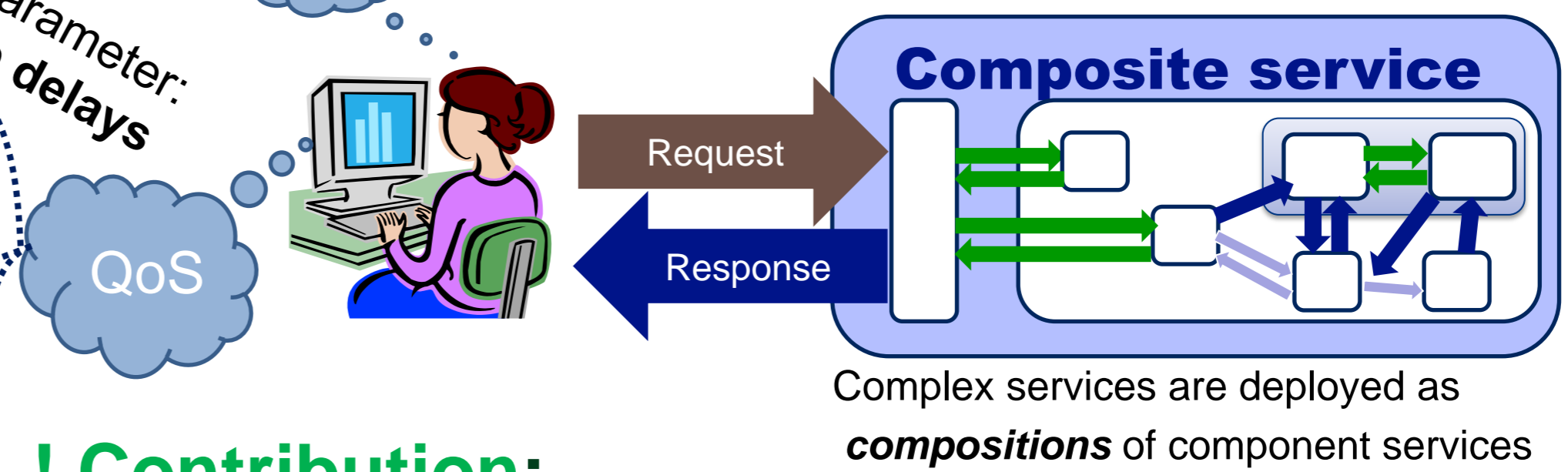


Finite State Machine with Timeouts



Service-oriented architecture

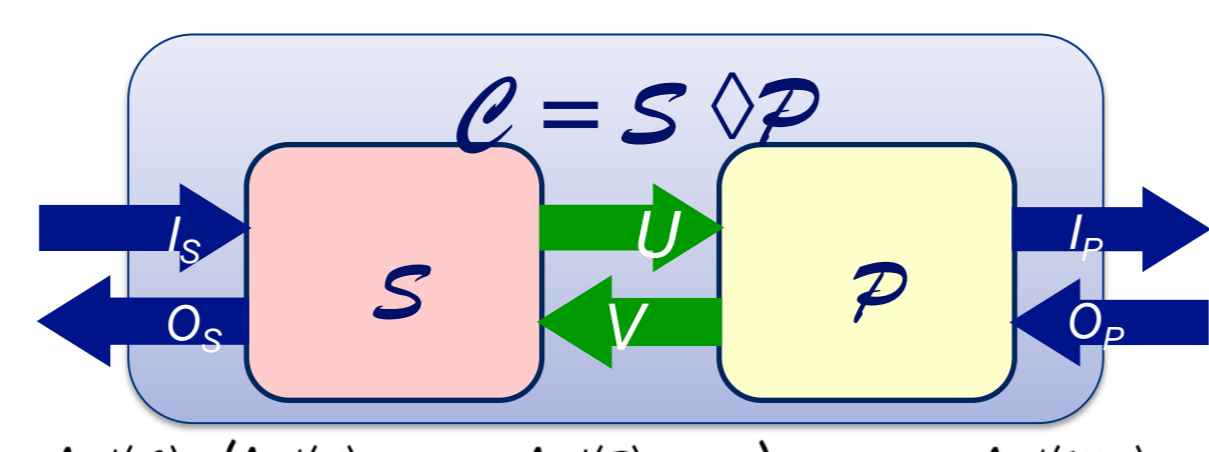
Service – a self-contained unit of functionality, logically representing a repeatable business activity with a specified outcome (by The Open Group SOA Working Group)



! Contribution:

We propose the **time-nondeterministic** extension of the model of an FSM with Timeouts (TFSM). This extension allows us to describe component services with nondeterministic behavior, and to derive the composition of nondeterministic component services.

Parallel composition



$Aut(C) = (Aut(S)_{I_S \cup O_S} \cap Aut(P)_{I_P \cup O_P})_{I_C \cup O_C} \cap Aut(\mathcal{M}_C)$

extend: component S is not affected by external communications of P
joint behavior of components
hide all internal communications, keep time and externals
TFSM part + assumption of "slow environment": next input is applied after an output to the previous

Binary composition can be extended to multiple-component case due to associative nature of parallel composition operator.

COMPOSE

VERIFY

! Contribution:

Checking the **conformance** between models with real values of time variable is a complex issue. Hence, we prove that two given TFMSs are conforming if and only if they are conforming w.r.t. **integer time instances**.

Questions to answer:

? Whether the parallel composition of given components satisfies given functional and quality requirements, while providing safe communication between components?

Safety-awareness

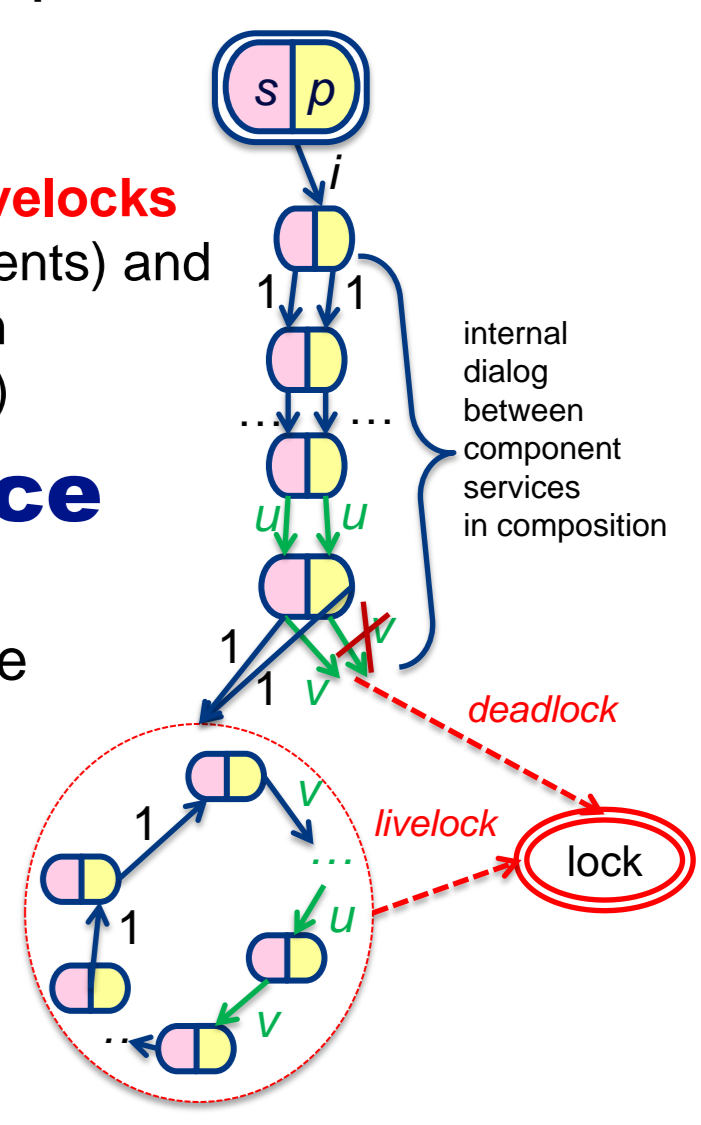
We have proposed explicit detection of **livelocks** (infinite internal dialogs between components) and **deadlocks** (when internal dialog between component services cannot be continued)

Functional conformance

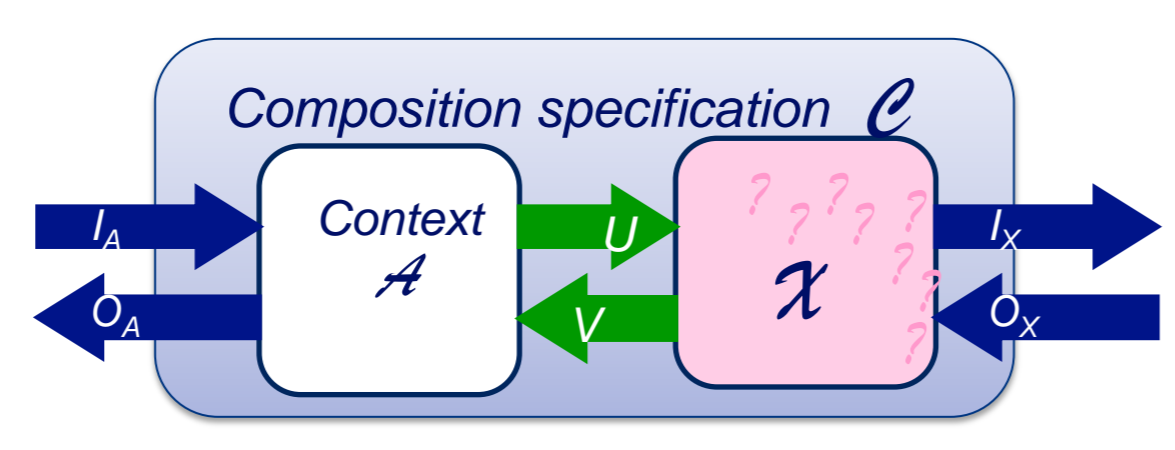
We adapt trace-based conformance relations between TFMSs (equivalence and trace inclusion)

Quality restrictions

Check that composition has output delays within specified intervals



Solve equation



$A \Delta X \sim C \Rightarrow \text{Solution} \subseteq A \Delta (C \cap \mathcal{M}_C)$

context: joint behavior of all other components
parallel composition
conformance relation
specification, or set of requirements
component under optimization

! Contribution:

We have proposed a method for **deriving** the largest solution containing **all permissible component service behaviors**, based on solving TFMS parallel equation.

! Contribution:

We have proposed a method for **minimization of the set of requirements** for service compositions given over finite number of scenarios: the method is based on comparing which parts of the component under optimization are involved in satisfying or violating each required scenario.

OPTIMIZE

SELECT

Questions to answer:

? Whether it is possible to **optimize** some of the components to ensure that composition meets quality restrictions?

- ...no livelocks and deadlocks? (**safety requirements**)
- ... optimal delays? (**quality requirements**)

! Contribution:

We have proposed algorithms to **extract** restricted solutions with **required properties**:

- minimizing the **size** of the component service;
- choosing optimal **output delays** (max / min);
- minimizing** the amount of **changes** in given component to derive an optimal one;
- ensuring safety** of the chosen solutions.

Directions for future work

- Multi-stimuli composition
- Timeout functions for other quality parameters
- Integration of developed methods with service discovery

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Partenaires



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- Kondratyeva O., Kushik N., Cavalli A., Yevtushenko N. Using Finite State Models for Quality Evaluation at Web Service Development Steps. International Journal on Service Computing (IJSC), ISSN 2330-4472, 2013. Issue 1(1), pp. 1-12.
- Kondratyeva O., Yevtushenko N., Cavalli A., Solving parallel equations for Finite State Machines with Timeouts. Proceedings of the Institute for System Programming. 2014. Volume 26 (Issue 6), P. 85-98 (peer-review journal, in Russian)
- Kondratyeva O., Yevtushenko N., Cavalli A., Parallel composition of nondeterministic Finite State Machines with Timeouts. Tomsk State University Journal of Control and Computer Science. 2014. Volume 2 (Issue 27). P. 73-81. (peer-review journal, in Russian)
- Kondratyeva O., Kushik N., Cavalli A., Yevtushenko N. Evaluating Quality of Web Services: a Short Survey / Proceedings of the IEEE 20th International Conference on Web Services (ICWS 2013), July 2013. – pp. 587-594. (rank A conference)
- Kondratyeva O., Kushik N., Cavalli A., Yevtushenko N. Evaluating Web Service Quality using Finite State Models / Proceedings of the 13th International Conference on Quality Software (QSIC 2013), July 2013. – pp. 95-102.

Presentation of results:

- Poster presentation at La Journée Futur & Ruptures (l'Institut Mines-Télécom), the best poster award, January 2014
- International Conference on Web Services (ICWS 2013), 27 June – 2 July 2013, Santa Clara, California, USA (rank A conference)
- First Franco-Russian Seminar on Software Verification, Testing, and Quality Estimation, November 2014, Paris, France
- 10th International Summer School on Training And Research On Testing (TAROT 2014), 30 June – 04 July 2014, Porto, Portugal
- Tarragona International Summer School on Trends in Computing (SSTIC 2014), 07 July – 11 July 2014, Tarragona, Spain
- Concours "Ma Thèse en 180 secondes", 07 April 2014, Université Evry Val d'Essonne, Evry, France