Centrum voor Wiskunde en Informatica

CooPer
"Coordination with Performance Guarantees"

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Abstract

The *component connector* emerges as a powerful concept for coordination of multiple activities in a large-scale distributed processing environment. Coordination models and languages serve as means to formally specify and implement component connectors.

Compositional coordination models and languages, such as Reo, offer the additional benefit of allowing one to build *complex* component connectors out of simpler ones, and as such provide a powerful means to build large-scale distributed applications.

Perceivable Quality of Service (QoS) degradation represents a key issue in large-scale distributed applications running in an environment where resources (bandwidth, CPU power) may become scarce. This raises the question about component connectors that offer *guarantees* in order to satisfy users' end-to-end QoS requirements.

Motivated by this, the *CooPer* project aims to develop coordination models and tools for specification and implementation of complex connectors with QoS guarantees. This will enable us to control the end-to-end QoS of applications in large-scale distributed processing environments.

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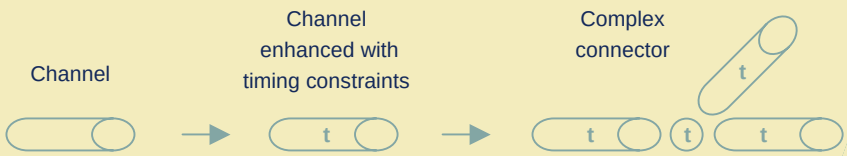
Goals

To this end, we plan to:

- develop and validate *quantitative models* for the basic connectors that constitute the atomic building blocks of complex ones;
- develop a *compositional QoS calculus* that relates the relevant performance metrics at the application layer, the connector layer, and the basic connector layer;
- use these models to develop and implement *QoS control mechanisms* to efficiently react to observed QoS degradation.

Intuition

We take an existing compositional circuit-based approach to building connectors (Reo) and enhance it with QoS capabilities (e.g., timing constraints – *t*) in a **theoretically-sound** and **practical** manner.



Approach

We outline our approach with the following research questions:

- What compositional coordination model will allow us to *specify* QoS at **different layers** and to reason about the **relation of QoS between** different layers (*mapping*)?
- What *computational* model can we implement in a coordination middleware to **enforce the specified QoS** in a large-scale distributed environment?
- What *software architecture* implements the computational model in such a way that the coordination middleware can facilitate **large-scale** applications to achieve their QoS requirements in a **heterogeneous** distributed environment comprised of **low-cost** hardware and software components?
- What quantitative QoS models of **basic connector** implementations given by the coordination middleware, provide the necessary basic framework for dynamic *assessment* of QoS?
- What quantitative QoS model of the implementation of the **composition operators** given by the coordination middleware, provide the necessary framework for dynamic *assessment* of QoS of a compositionally-constructed application?