ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

TIK Institut für Technische Informatik und Kommunikationsnetze

Semester Thesis Proposal

Modular Performance Analysis of Large-scale Distributed Embedded Systems

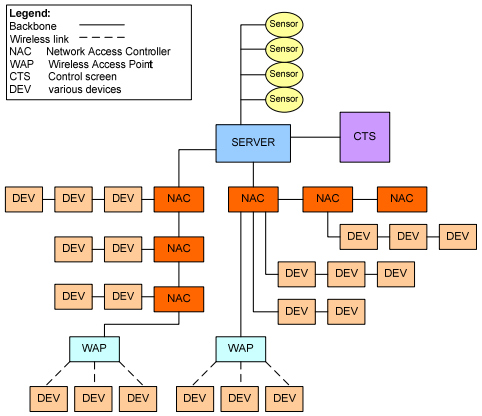
Background

The Computer Engineering and Networks Laboratory of ETH successfully conducts research in the area of performance analysis of distributed real-time embedded systems. The main result is a modular formalism for system-level performance analysis, denoted as Real-Time Calculus (RTC) [1]. The RTC permits to analytically bound worst-case event latencies and buffer requirements in distributed systems with heterogeneous processing and communication components. The methodology has been implemented in the RTC Toolbox [2], a Matlab/Java-based tool for performance analysis of distributed embedded systems.

Task

The RTC Toolbox has been applied successfully for the analysis of medium-scale distributed embedded systems, mostly in academic case studies. There is, however, little experience with the analysis of large-scale industrial systems. First attempts show that the application of the RTC analysis method to large-scale systems is not trivial, as several issues have to be taken into account. They concern mostly limited memory and time for the analysis as well as artificial complexity due to numerical imprecision.

On the basis of a collaboration with a major player in the aircraft industry, the European Aeronautic Defence and Space Company (EADS), we consider the application of the RTC Toolbox to a heterogeneous aircraft in-cabin communication system (HCS) with more than 200 individual processing and communication components.



In this context we offer a semester thesis that deals with the issues of scaling the RTC analysis to large systems. In particular, the thesis comprises the following four tasks:

1) Automatic model generation

   This step consists in developing a framework that permits the automatic generation of large-scale RTC models (Matlab code). Some results on automatic model generation are already available.

2) Modeling of the HCS

   This step comprises the complete modelling of the HCS specified by EADS. Preliminary results on RTC models for the HCS are available.

3) Approximated Model and Analysis

   The RTC Toolbox adopts a detailed representation of the timing behaviour of event and resource streams in distributed embedded systems. This leads to unpractical time and memory requirements when analyzing complex large-scale systems. A work-around to reduce the complexity of the analysis are simplified data-structures that approximate event and resource streams. Appropriate approximation functions have already been implemented for the RTC Toolbox. In this step the mentioned approximation functions shall be applied in an automatic manner to the model of HCS, finally enabling a practicable performance analysis of the HCS system.

4) Presentation of the analysis results for the HCS and documentation of the work

Kind of work:

20% theory, 30% concept, 50% implementation

Requirements:

- Basic knowledge of the RTC framework
- Strong programming skills (Matlab, Java)

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References:

[1] S. Chakraborty, S. Künzli, and L. Thiele. A general framework for analysing system properties in platform-based embedded system designs. In Proceedings of 6th Design, Automation and Test in Europe (DATE), Munich, Germany, March 2003.

[2] Software Toolbox for Real-Time Calculus: http://www.mpa.ethz.ch