Timing Modelling with AUTOSAR
Current State and Future Directions

Stefan Kuntz
Continental Automotive GmbH

Marie-Agnes Peraldi-Frati, INRIA, CNRS, France
Hans Blom and Daniel Karlsson, Volvo Group Trucks Technology
Co-authors

- Marie-Agnès Peraldi-Frati, INRIA, Nice Sophia-Antipolis, France
- Hans Blom, Volvo Group Trucks Technology, Gothenburg, Sweden
- Daniel Karlsson, Volvo Group Trucks Technology, Gothenburg, Sweden
Overview

- Introduction
- Current State
- Future Directions
- Conclusion
- Questions and Answers
Introduction

• The reflections presented have been primarily conducted in the ITEA TIMMO-2-USE project where the scope are different levels of abstraction.

• Purpose of Timing Modelling:
  – Support the construction of systems that satisfy the given timing requirements
  – Timing analyses of those systems, for example scheduling analysis
Current State - AUTOSAR

• Automotive Open System Architecture (AUTOSAR)
• Scope is implementation level with different views
• Primary focus is software and describes hardware from the software point of view
• Component based architecture
  – Basic Elements: Component, Port and Interfaces, Connectors
  – Application Software Layer
  – Software Infrastructure Layer
  – Basic Software Layer
Current State - AUTOSAR

CSWC_001

CSWC_002

CSWC Composition Software Component

RE Runnable Entity

SWC Software Component

14-Mar-12

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Current State - AUTOSAR Architecture

Interfaces
Components and interfaces view (simplified)

AUTOSAR Software Component
- Interface
- Standard Software

Interfaces:
- VFB & RTE relevant
- RTE relevant
- BSW relevant

Possible interfaces inside Basic Software (which are not specified within AUTOSAR)

Basic Software
- Operating System
- Standardized Interface

ECU-Hardware
- ECU Abstraction
- Standardized Interface
- Microcontroller Abstraction

AUTOSAR Runtime Environment (RTE)
- Standardized Interface
- Standard AUTOSAR Interface
- Services
- Communication

Application Software Component
- AUTOSAR Interface

Actuator Software Component
- AUTOSAR Interface

Sensor Software Component
- AUTOSAR Interface

Application Software Component
- AUTOSAR Interface

Courtesy AUTOSAR Development Partnership
AUTOSAR Timing Extensions (TIMEX):

- Event: Specifies an event and refers to a location in a system where occurrences of such event are observed.
- Event Chain: Specifies a causal relationship between events and their temporal occurrences (stimulus and response).
- Event Triggering Constraints are imposed on events.
- Latency and Synchronization Constraints are imposed on event chains.
Current State - Case Study

Third presentation of this Hot Topic Session: Timing Modelling and Analysis in the Automotive Development Process - An Industrial Case Study
Although AUTOSAR TIMEX already provides a rich set of elements to model timing, there are some deficiencies:

- Traceability
- Probabilistic Timing
- Higher Levels of Abstraction (EAST-ADL)
- Multi-form Timing
- Symbolic Timing Expressions
Future Directions - Traceability

Seamless traceability between timing information on different levels of abstraction and AUTOSAR views

• Supports reasoning about timing requirements and constraints while constructing systems

• Improves the validation of higher level timing requirements while considering specific properties on the implementation level
Future Directions - Probabilistic Timing

Functionalities may tolerate for example infrequent deadline misses, and infrequent data loss, etc.

• Capability to specify probabilistic timing constraints and properties for events and event chains

• Existing methods and tools for timing analyses must be adapted accordingly

Second presentation of this Hot Topic Session: Challenges and New Trends in Probabilistic Timing Analysis
The scope of AUTOSAR is implementation: software and hardware architectures

• Decision regarding timing are taken on higher levels of abstraction respectively phases in the development process

• Tracing between such higher levels of abstraction and the implementation level are crucial for a consistent and seamless timing modelling approach

• EAST-ADL already provides the framework supporting such an approach
Future Directions - Multi-form Time

Timing modelling must provide means to express time in any unit – multi-form of time – and not only constant values – expressions

• Not only chronometric [s], but also in any physical measure, like temperature, distance in meters, etc. In engine management systems time is often specified in degrees (crank- and camshaft)
• Time values must be expressed by formulas
• Relation between different multi-form time bases
Conclusion

• AUTOSAR gained momentum in the automotive industry
• Subsequent releases of the AUTOSAR Timing Extensions may follow the presented direction
• Tool Support is key to timing modelling and analysis: Fourth presentation of this Hot Topic Session
Questions and Answers

Thank you very much for your attention!