

*O<sup>3</sup>neida Workgroup*  
*„Execution Models of IEC 61499 Function Block Applications“*

## Meeting Minutes

The meeting took place at Automation and Control Institute (ACIN), Vienna University of Technology, on July 24<sup>th</sup> 2007, 6:30 pm.

### ***Participants***

- Antonio Valentini, O<sup>3</sup>neida
- Valeriy Vyatkin, The University of Auckland
- Julien Chouinard, ICS Triplex / ISAGraph
- Tuan Dang, EDF
- Olivier Pasteur, EDF
- Frans Weehuizen, Massey University
- Martin Hirsch, University Halle
- Luca Ferrarini, Politecnico di Milano
- Carlos Insaurralde, Tampere University of Technology
- Nils Hagge, Siemens
- Thomas Strasser, Profactor
- Gerhard Ebenhofer, Profactor
- Alois Zoitl, Vienna University of Technology
- Christoph Sünder, Vienna University of Technology

The following topics have been discussed:

### ***Welcome***

Christoph Sünder warmly welcomed all participants to this first meeting of the O<sup>3</sup>neida Workgroup. Further he gave a short introduction to the meeting place, the Automation and Control Institute.

Afterwards, each participant introduced himself roughly.

### ***Presentation of contributions to the INDIN 2007 Special Session***

The working group has been founded during lunch at the ETFA'06 conference. The defined targets have been described by Valeriy Vyatkin in his announcement about the working group as follows:

- Collection of information: collect published and unpublished materials on execution modes of function blocks
  - FTP server at ACIN was set up
  - Some material can be found there (VV, MC, CS, AZ, TS)
- Classify problems
  - Different topics have been considered for the Special Session at INDIN 2007
- Develop compliance profile structure
  - open

- Propose solutions addressing the problems
  - Partly applied within the SS contributions
- Vote for the most appropriate solutions and release compliance profile drafts for assessment by industrial partners
  - open
- Release version one of the compliance profile
  - open
- Revise and update the compliance profile
  - open

We had a brief introduction on the topics of the different papers listed below:

## **A Device and Resource Execution Model for IEC 61499 Control Devices (presented by Alois Zoitl)**

- Open execution issues
  - Device Execution Model
  - Resource Execution Model
  - Only implicit definitions
    - Open to conflicting interpretations
  - Already implementations with different execution behavior existing
- Additional important point
  - Real-time constrained execution
  - Assigning execution context to IEC 61499 elements

## **Execution Models for the IEC 61499 elements Composite Function Block and Subapplication (presented by Christoph Sünder)**

- How CFBs and Sub-Apps should be executed?
- CFBs
  - Definition in the standard is very weak
  - Execution control by events
  - 2 different ideas
    - Composite FB as an entity
    - Composite FB as a transparent container
- Sub-Apps
  - Different meanings in the standard
  - 2 different ideas
    - Sub-Apps as executable model → similar to CFB as transparent container
    - Just for simplification of the engineering → no executable model

## **Modeling and Clarifying the Execution of IEC 61499 Function Blocks Using XNet (presented by Nils Hagge)**

- Problem
  - Textual specification of execution semantics may be (and is!) ambiguous, imprecise, incomplete and/or even contradictory
- Proposed solution
  - Specify execution semantics using a (semi-)formalism
  - XNet provides 3 main elements
    - resource
    - events
    - handlers

- Behavior is well-defined
- Mappings to code patterns exist

### **Sequential Axiomatic Model for Execution of Basic Function Blocks in IEC 61499 (presented by Valeriy Vyatkin)**

- Execution model for BFBs
- Imprecise definition of the execution of BFBs in the standard
- Found 6 postulates for the execution of BFBs
- One can build an execution model for BFBs

### **Alternatives for Execution Semantics of IEC 61499 (presented by Valeriy Vyatkin)**

- Discusses also the execution semantics of BFBs
- Additional to the sequential hypothesis also a parallel execution is mentioned

### **Defining IEC 61499 Compliance Profiles using UML and OCL (presented by Alois Zoitl)**

- How to set-up a CP using UML and OCL
- Enhancing the (formal) definition of a CP

### **Enhanced IEC 61499 Device Management Execution and Usage for Downtimeless Reconfiguration (presented by Thomas Strasser)**

- Paper deals with enhanced reconfiguration services for IEC 61499 application reconfiguration
- IEC 61499 defines a basic set of commands for the management
- Current research work on downtimeless systems has shown that there are some further commands necessary
  - Structure of management commands
  - Different categories
    - Structural services
    - Execution control services
    - State interaction services
    - Query services
    - Library services
  - These services are not in contradiction to the standard. They provide a more detailed and enlarged set of commands.

### **Synchronous Execution of IEC 61499 Function Blocks Using Esterel (presented by Valeriy Vyatkin)**

- FB Execution possibilities
  - Sequential
  - Parallel
    - Synchronous
    - Asynchronous
  - Fixed order
- Huge amount of technology dealing with synchronous execution for dependable, embedded systems
  - There exists a language for synchronous programming → Esterel
  - The paper describes how to use Esterel to model the execution of IEC 61499.

## ***Discussion round***

In the following a short excerpt of the discussion about the open topics and further activities is given.

Christoph Sünder

- Are the problems clearly stated?
  - How to clarify?
  - Subdivision of problems?
- Do we agree about the proposed solution?
  - Are there different solutions possible?
- Do we need to address further problems not mentioned up to now?
  - Clearly state these problems!

Luca Ferrarini

- Can we review the goal of this WG?
- We have not the power to change the standard itself!
- Summarize all the problems of IEC 61499 that are known
- Separate the semantics from the implementations
- Give ideas how to solve this problems
- Use a formal specification for the description of FB semantics
- Have another WG related to IEC 61508!?
- The WG wants to clarify some misunderstanding parts of the IEC 61499 standard
- Write down the problems
  - Real needs of automation systems from the industrial point of view (paper 1)
  - Proceed also with the original point of view of the O3NEIDA WG (paper 2)

Julien Chouinard

- We have 200.000 runtimes running in industrial applications which serves as the basis for the IEC 61499 product
- Queuing of events
  - We have an unstable system when using queuing of events
  - Queuing of events is not supported in the ISaGRAF implementation
- Formal testing
  - Our execution environment is safe, no formal validation is necessary
- Scanned based approach
- Industrial application example
  - About 30 different applications running in one Device (I am not sure if I got this right)
- Focusing on the industrial application and implementation
  - We need to have determinism and reliability
- We hope that our product is interoperable with products from other vendors and vice versa
- TÜV Reinland said that ISaGRAF V5.0 is full compliant to IEC 61499
- ECC is implemented as SFC
  - SFC is well known and a kind of a state machine
- In 5 years no automation product will be sold if it is not SIL 3 compliant
- IEC 61499, IEC 61131, IEC 61508, EDDL, FDT/DTM ... have to work together
  - Don't see IEC 61499 as a stand-alone product
- IEC 61499 are being implemented by customers
- IEC 61508 has major impact on R&D divisions in automation companies
- Automation system has to be fault tolerant

- Safety requirements have to be met
- Use BBS as discussion forum for further WG discussion and information exchange
  - BBS discussion form
  - Creation of a knowledge base
- CP on communication networks
- Our SW is almost available for any platform

Valeriy Vyatkin

- Define collaboration rules between WG members
- How to write down the problems?
  - Which procedure is necessary/suitable?
- How to move forward

Antonio Valentini

- How to interact with IEC standardization WGs?
- Feedback from WG members is necessary!
- O3NEIDA web-site have to be updated with the link to the O3NEIDA BBS discussion form hosted by ICS Triplex
- Link: <http://205.150.126.252/Scripts/ikonboard.pl>

Alois Zoitl

- Each member found loop-wholes in the standard
- How we should/can proceed?

### ***Roadmap for further activities / Summary***

It is a clear target of the workgroup to provide compliance profiles on the different topics of the standard IEC 61499. A large amount of work has been done in the different papers for the INDIN Special Session. The most important work topic is to discuss the different approaches and to come up with a first draft version of a compliance profile.

We want to use the BBS system as a forum for these discussions. There is also to have a moderator for different topics, and we think it is extremely important to have one person for each track who actively acts as such a moderator. The structure of the forum will be formed during the discussion.

We have suggested the following first structure of possible tracks

- Execution Models
  - Publication (Luca Ferrarini)
    - Summarization of INDIN07 related WG papers
- Open problems arising from the use of the standard
  - Demands from industry (solution providers)
  - Demands from the academia
  - Demands from the end-users
- Communication (Frans Weehuizen)
  - CIP communication

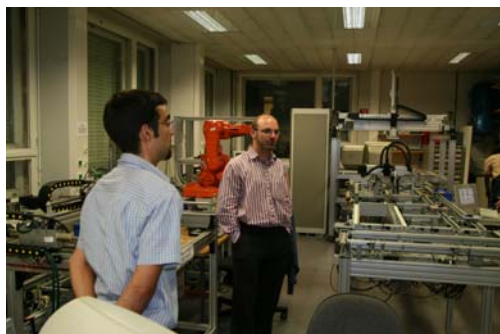
We have defined, that we want to have a first draft of a compliance profile according to the discussion in the BBS in 3 months from now (this means the end of October).

The BBS forum is available via <http://205.150.126.252/Scripts/ikonboard.pl>.  
Additionally, the BBS forum will be made available as a link in the O<sup>3</sup>neida webpage.

## *ToDo's*

ICSTriplex	Maintenance of the BBS forum (basic IT)
Antonio Valentini	BBS forum link on O <sup>3</sup> neida webpage
Luca Ferrarini	Moderation of the Publication track
Frans Weehuizen	Moderation of the Communication track
Paper authors	Insertion of the problems and proposed solutions mentioned in the SS paper
ALL	Discussion on the topics of the BBS forum
ALL	Insertion of necessary new topics into the BBS forum

## *Impressions from the O<sup>3</sup>neida WG meeting*



Best regards from Vienna,  
ALOIS and CHRISTOPH.