Extensions of normal OOA methods and techniques for distributed Real-Time Systems

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Extended abstract

Despite the fact that there are several Object Oriented Analysis (OOA) methods there is no method which fits the needs for the specification of distributed real-time systems in the same way as for example the Booch method [Boo93] or Object Modelling Technique (OMT) [RBP+91] do for traditional business applications.

The main reason can be found in the used techniques. They do not cover the necessary features a technique must have to be used for distributed real-time systems. Nearly all methods use finite automata or a simple extension like Statecharts [Har87]. For the normal environment where these methods are used it was of minor importance to handle synchronisation, real concurrency, non-determinism etc. But even there one can find an increasing demand for such concepts of better specifications for the problems encountered in larger companies with branches in different locations. Distributed real-time systems are of increasing importance to commercial application areas.

Currently there is no real method for the specification of distributed real-time systems. Usually there is only a set of techniques which can be used in a very technical way to specify the requirements. They are normally based on temporal logic (see e.g. [CM88]). A description of how to use these techniques is not given. Furthermore these techniques are too complicated to be used in the commercial fields.

To solve the problem of specification of distributed real-time systems we propose to use Coloured Petri Nets with their known advantages in combination with object-oriented analysis and design to get synergetic effects. In [BM93a] and [BM93b] we have shown how to model object oriented concepts with Petri Nets without a specific (object oriented) inscription language. These can be used to model Object-Diagrams (OD) (see e.g. [RBP+91]) and cover therefore also Entity-Relationship-Diagrams (ERD) [Che76]. Here the approach of [BM93b] has been extended by introducing abbreviations for the replacement of these techniques by nets.

In [FM93] and [Fri95] the replacement of data flow diagrams by Petri Nets has been described by presenting a formal definition. Using this definition, nets can be applied to the specification of systems for which it is necessary to simulate the specification or to perform formal analysis. This was not possible with data flow diagrams. In [Fri95] the replacement of statecharts by Petri Nets is also shown by a formal replacement. Combining the two results we gain the possibility to use Petri Nets instead of data flow diagrams and statecharts in combination with the Structured Analysis (SA) approach [You89] or with the OOA approach. Here we concentrate on the latter.

By the foundation of the methods with the formal based technique of Petri Nets we gain the necessary concepts to handle specific problems in the area of distributed real-time systems. The paper shows how to modify and extend the technique Petri Nets to fit the additional problems of this kind of application. Furthermore by covering all different views of a system it is therefore possible to describe how object oriented methods like [RBP+91] and [Boo93] have to be modified for distributed real-time system specification. The mapping of problems of concurrency, distribution of tasks (objects) and synchronisation to Petri Nets are explained and discussed.

Keywords: Object-Oriented Analysis, High Level Petri Nets, Specification, Distributed Real-time Systems, Concurrency

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