

Net-Based Analysis of Event Processing Networks – The Fast Flower Delivery Case

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Abstract. Event processing networks emerged as a paradigm to implement applications that interact with distributed, loosely coupled components. Such a network consists of event producers, event consumers, and event processing agents that implement the application logic. Event processing networks are typically intended to process an extensive amount of events. Hence, there is a need for performance and scalability evaluation at design time. In this paper, we take up the challenge of modelling event processing networks using coloured Petri nets. We outline how this type of system is modelled and illustrate the formalisation with the widely used showcase of the Fast Flower Delivery Application (FFDA). Further, we report on the validation of the obtained coloured Petri net with an implementation of the FFDA in the ETALIS framework. Finally, we show how the net of the FFDA is employed for analysis with CPN-Tools.

1 Introduction

Complex event processing is a paradigm that builds on concepts from database technology enhanced with dynamic processing capabilities. So-called event processing networks (EPNs) [1] are at the centre of complex event processing systems. The overall system behaviour of such a network is decomposed into a set of *event producers* that generate events. Those are processed by *event processing agents* who create further events that are relevant to *event consumers*. Often, event producers can also be event consumers, such that EPNs are not simply a complex kind of event-condition-action pipeline, but rather a cybernetic system that observes events in the real-world and, based thereon, coordinates action.

There exists a plethora of approaches for implementing event processing networks and dealing with its intrinsic challenges [2]. A general problem in this context, though, is to analyse the overall behaviour of an EPN. Yet, there is currently no generally accepted formal model for complex event processing. The potential of utilising coloured Petri nets to this end stems from their capability of specifying concurrency in an explicit manner with support for typing of events. Indeed, this merit has been recognized already for active database systems [3], which promote rule-based processing in a non-distributed environment.

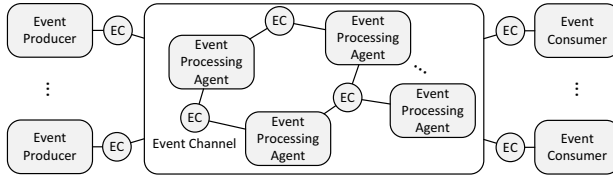


Fig. 1. Schematic representation of an event processing network

In this paper, we investigate the application of coloured Petri nets for specifying and analysing EPNs. We turn to the case of the Fast Flower Delivery Application (FFDA) [1]. This real-world case is promoted by the Event Processing Technical Society¹ and has become a de-facto benchmark for demonstrating the capabilities of event processing systems. Our contribution is the mapping of concepts from EPNs to coloured Petri nets with a discussion of design choices. Further, we report on the validation of the coloured Petri net obtained for the FFDA with its implementation in ETALIS, an open-source event processing engine. Finally, we demonstrate the merits of analysis and simulation capabilities for this domain, thereby contributing to the formal foundations of EPNs and opening this emerging field for Petri net analysis.

The paper is structured as follows. Section 2 introduces the main concepts of event processing networks. Section 3 sketches the Fast Flower Delivery Application. Section 4 defines the coloured Petri net model for this application case. Section 5 is devoted to the validation of this model with the implementation of the application in ETALIS. Section 6 summarises findings from analysing the Petri net. Section 7 discusses related work and Section 8 concludes the paper.

2 Background: Complex Event Processing

Following [1], Section 2.1 presents the essentials of event processing networks (EPNs) and Section 2.2 outlines event pattern detection.

2.1 Event Processing Networks

Event types and events. An event is a happening of interest, an ‘occurrence within a particular system or domain’ [1]. Events are typed and an event type is a specification for a set of events with related semantics and structure. A common model for events is attribute-based, i.e., each event has a set of (required or optional) attributes organised as key-value pairs. For instance, an event of type ‘delivery request’ may be characterised by a number of attributes and values, such as ‘pickup = 24.09.12’ and ‘time = 3 days’.

Event producers and consumers. An EPN, as illustrated in Fig. 1, consists of event producers and event consumers. Event producers emit events, eventually

¹ <http://www.ep-ts.com>