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Application of UML for Modeling Urban Traffic System Using Producer Consumer Theory to Generate Process Algebra Model

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ABSTRACT

UML is widely used as an industry standard for modeling any system. In this paper will be dealing with simple UML diagrams and show that low it can be transformed into process algebra models specially designated to model urban traffic systems. The model capture functionality at the level of mesoscopic as well as microscopic level and it is merged with process algebra's producer consumer theory. The model is also formalized using Process algebra equations. This paper focuses on complex situational activity diagrams enhancing the expressivity by refining at the abstraction levels. Performance requirement is annotated by the UML profile for schedulability performance and time.

INTRODUCTION

There are number of information processing methodologies (Rao, Teran, & Savard, 2004) used in modeling Urban Traffic flow but unfortunately they are not able to model the Traffic flow completely. We would like to suggest a methodology by using UML (Buchholz, 2000) which will help in easily building Macroscopic, mesoscopic and microscopic models (Aalast & Van Hee, 2002; Darbari, 2003). The modeling methodology which we will be following can be divided into two sub classifications.

Decision Model and Physical model. The decision model contains various functionalities and Control Algorithms (Galup, Dattero, & Quan, 2004; Jitpaiboon & Kalaian, 2005) and Physical model contains operational details.

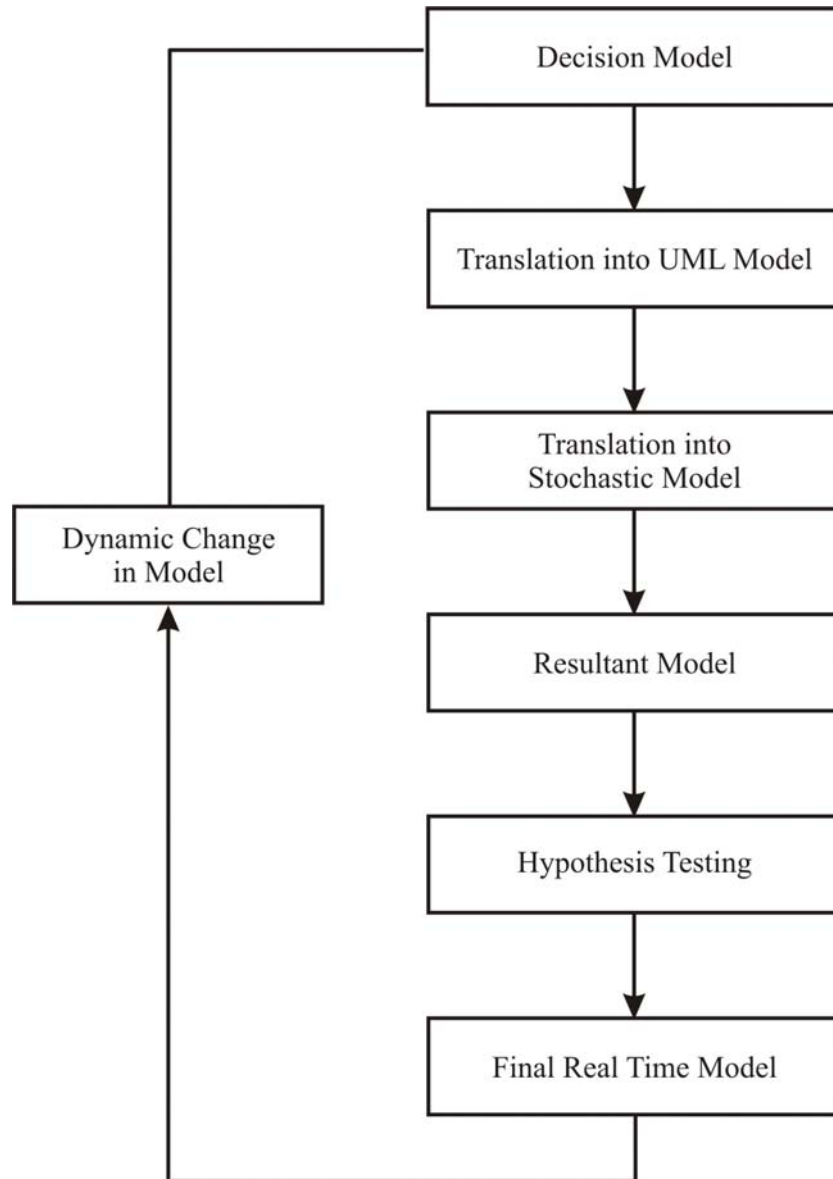


Figure 1: Diagram of the Entire Modeling Process.

GENERATION OF DECISION MODEL USING UML

Decision Models are based on average signal timings. They are particularly useful for signal system timing design software because they provide efficient procedures for formulating objective functions used in optimization logic.

In the past decade, many decision models have incorporated more details to account for actuated signals and coordination between them.

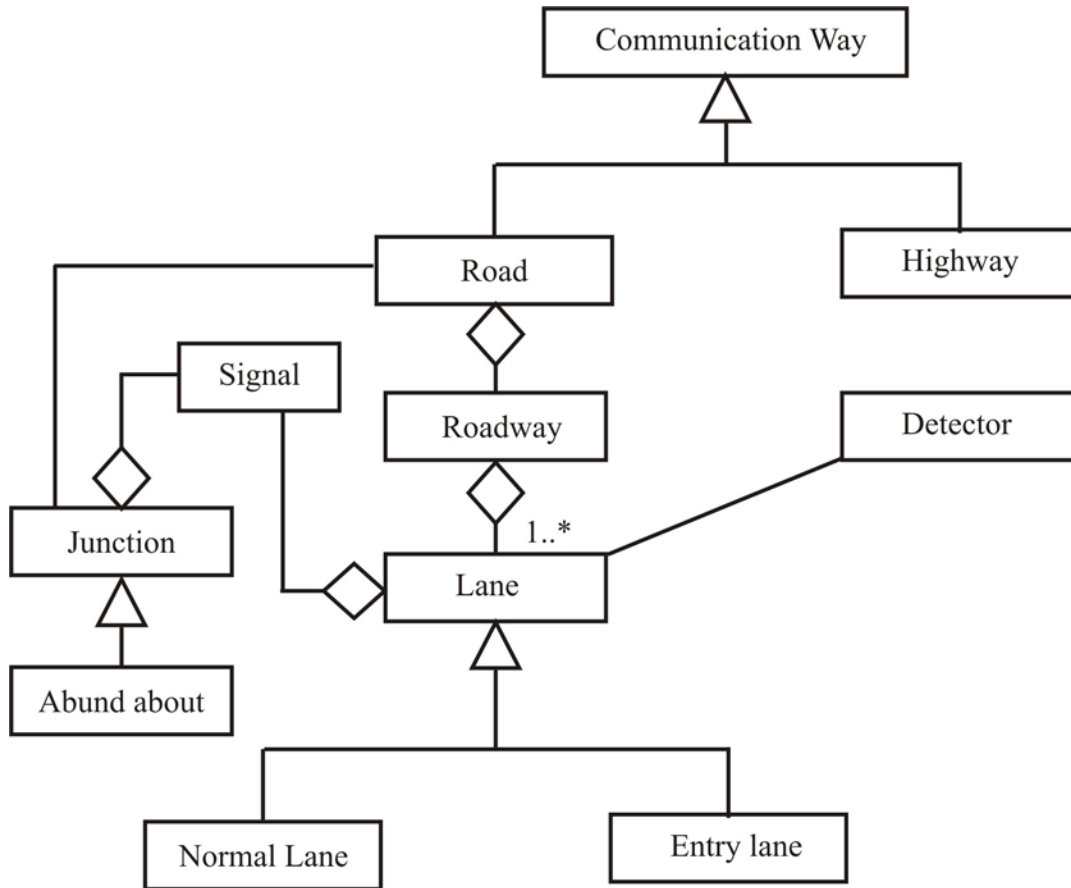


Figure 2: Class Diagram of UTS.

We can have the basic class diagram (Tari, 2000) being converted into producer consumer methodology.

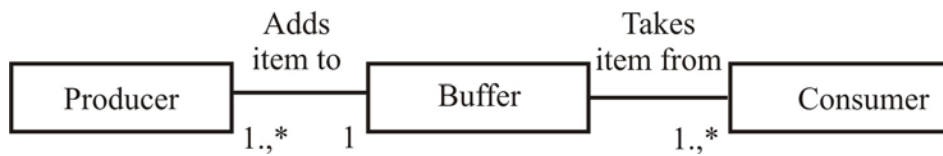


Figure 3: Class diagram for producer Consumer.

Converting the Class diagram in Figure 2 in Producer Consumer methodology we can have.

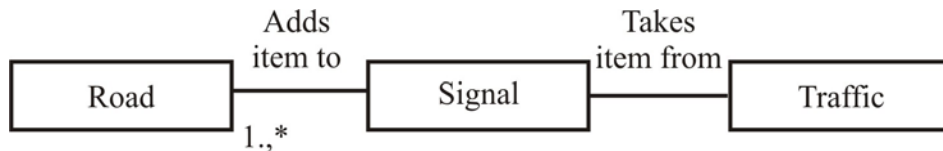


Figure 4: Basic Producer Consumer interpretation of UTS.

We can generate collaboration/ State diagram for UTS in Producer consumer mode.

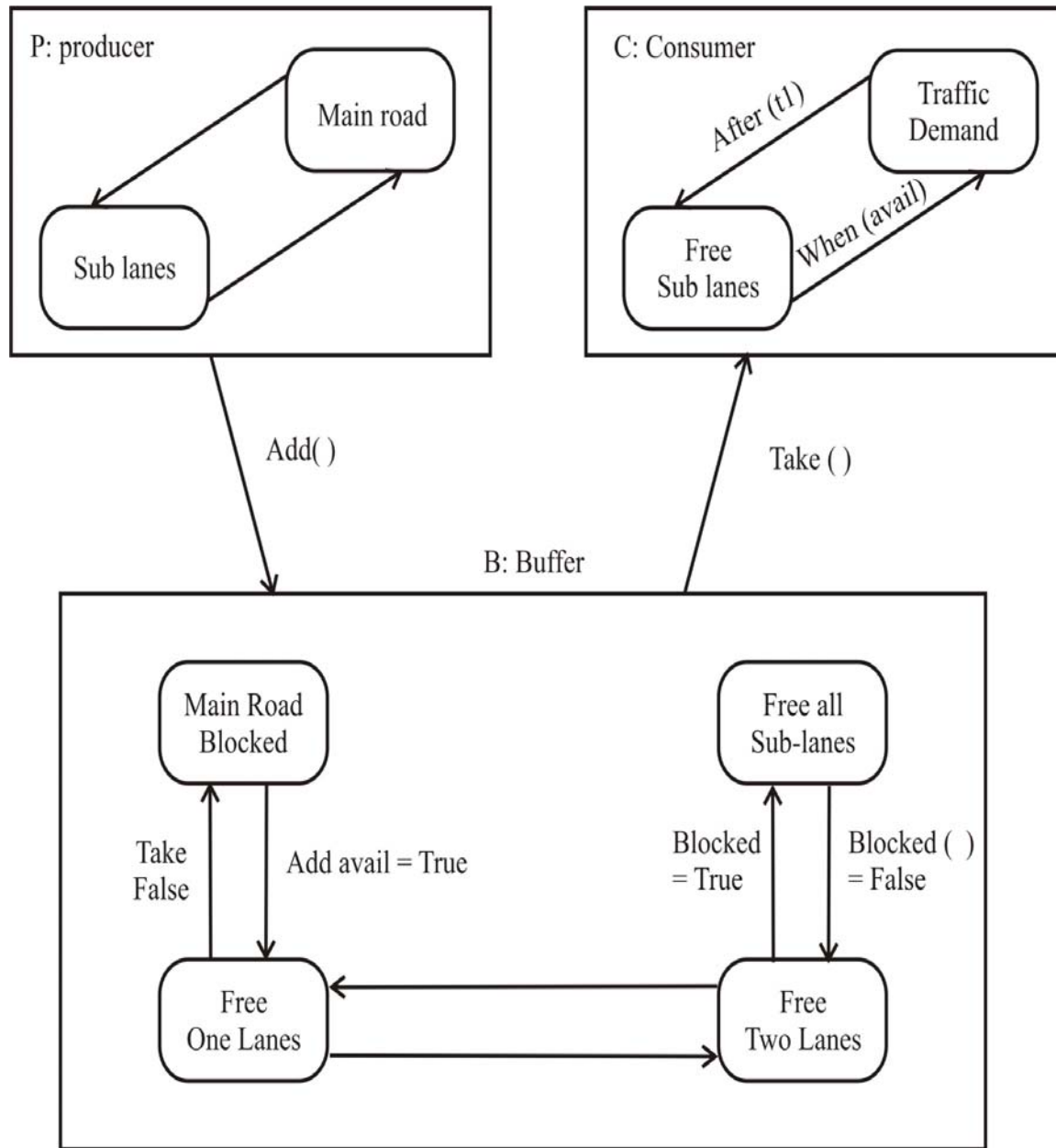


Figure 5: Combined Collaboration State Diagram for producing/ Consumer of UTS.

The basic diagram for producer/Consumer of the combined collaboration/State Diagram.

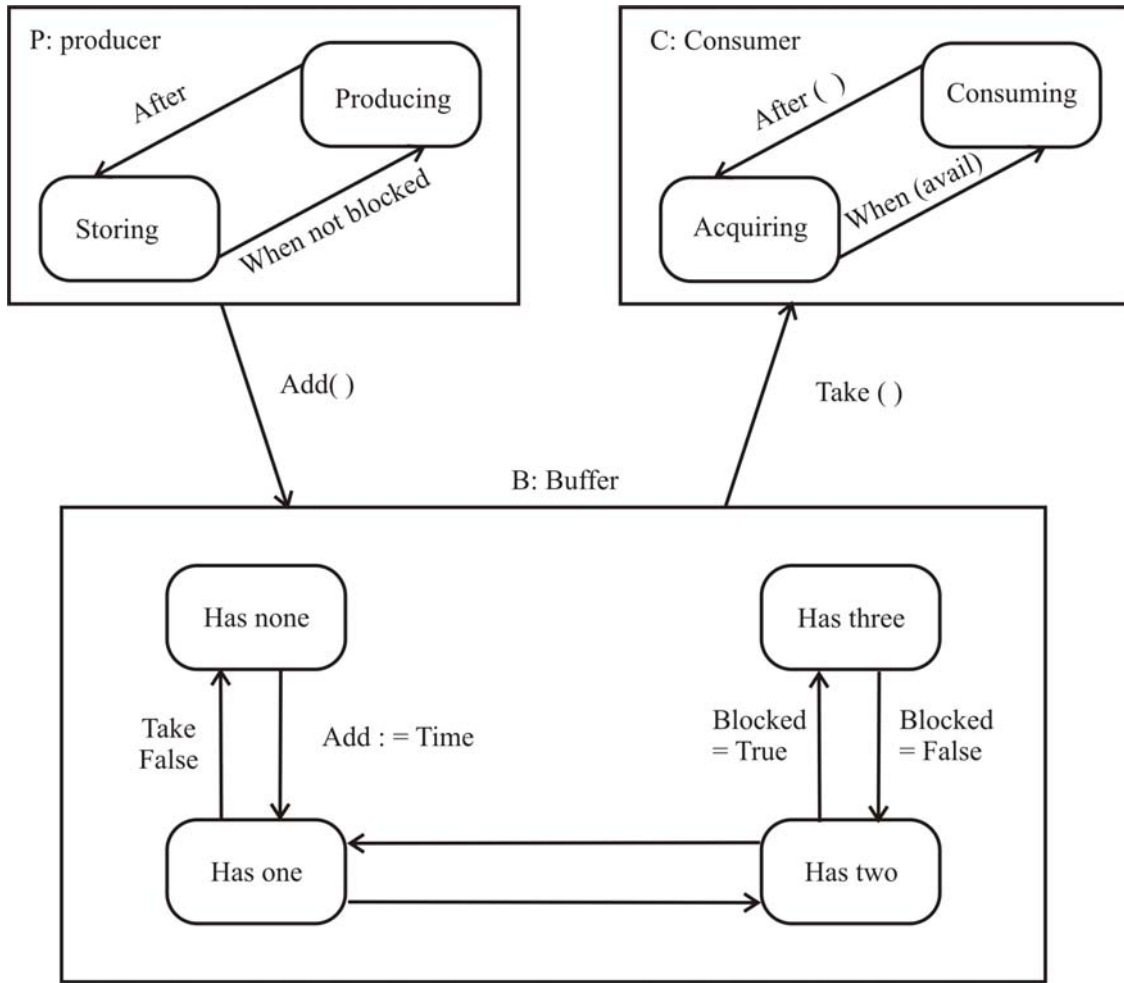


Figure 6: Combined Collaboration State Diagram for producer/ Consumer of UTS.

GENERATING A PROCESS ALGEBRA MODEL OF UTS

Generation of a process algebra Model (Hilston,1997) from the UML (Ashley, Meehan, & Carr,2005) model concentrates on the combined collaboration and state chart diagram shown in Figure 6.

The transition from producer to blocked requires the completion of the produce action which let us twice t1. In PEPA (Gilmore, 2002) terms this translates to a rate of 2/t1. The transition from blocked to producer requires completion of the passive action add.

Communication way def (Main Road, 1/t1).

Blocked def (add, T). Communication way Traffic flow def (Free lanes 1/t2). Halted

Halted def (take T). Traffic Flow.

The Buffer is a simple counting process, which will not allow a take action if it has zero substances and will not allow an add if it has all the free sub lanes with it.

The decision to define rates for add and take only in the buffer is arbitrary and in a real example they might be defined in the other processes as well or instead.

Main Road Blocked def (add 1/3) Sublane 1



Sub lane and Overflow def (add 1/3). Sublane + (take 1/4). Main Road Blocked.

Sublane 2 Overflow def (add 1/3).

All Sublane + (take , 1/4) Sublane 1.

All Sublane def (add 1/3) (take, 1/4) sublane 2, Overflow.

To complete the model we must combine the separate processes using the PEPA cooperation. We will now build a model by first combining the producer with buffer, forcing them to cooperate in add action. It can be represented as :

Prod Cons def (Producer  Buffer)  Consumer.

Mainroad Traffic (Free Sublanes  Buffer)  Traffic flow.

Once the producer (Mainroad) enters the blocked state and send its add message, it cannot proceed until that message has been received by the buffer. The direction of message passing implies that it is the buffer which supports the operations add () and take () , which is partial justification of our decision to define their rates entirely in term of the capabilities of the buffer. UML plays a vital role in giving the diagrammatical representation first and then converting it into producer consumer representation.

CONCLUSION AND FUTURE SCOPE

In this paper we have shown the conversion of Urban Traffic Road Network annotated into UML model and then later on converted these models into process algebra PEPA. The extension of the work can be in the direction of signal light and traffic diversion gateways which should automatically become active in case of Traffic congestion. Next aim will be to develop a simulation model which could cover all the UML modeling diagrams to develop and simulate real time Traffic modeler with Multi-Agent systems. We will try to simulate Multi Agent Process Algebra Models by incorporation of intelligent cooperation algorithm dedicated to urban traffic system. It will enhance its ability to coordinate and optimize the traffic signal control networks.

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