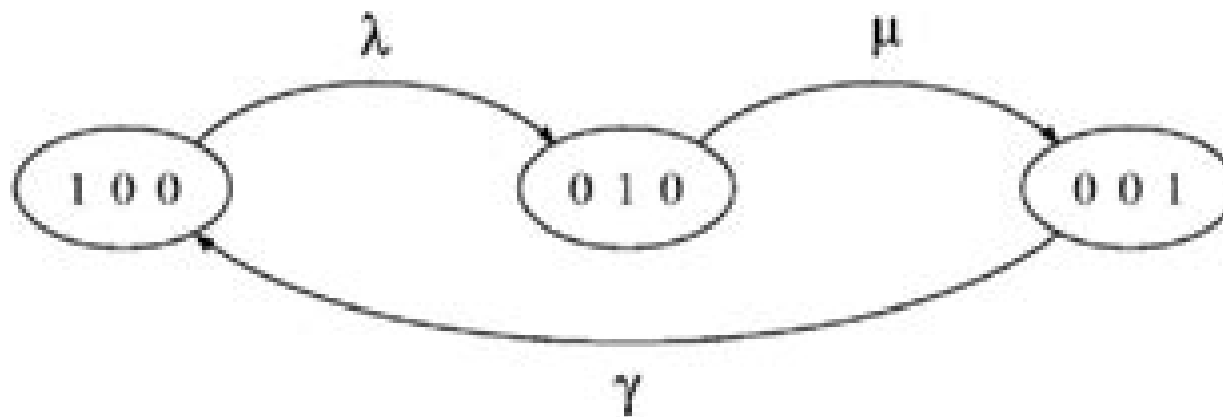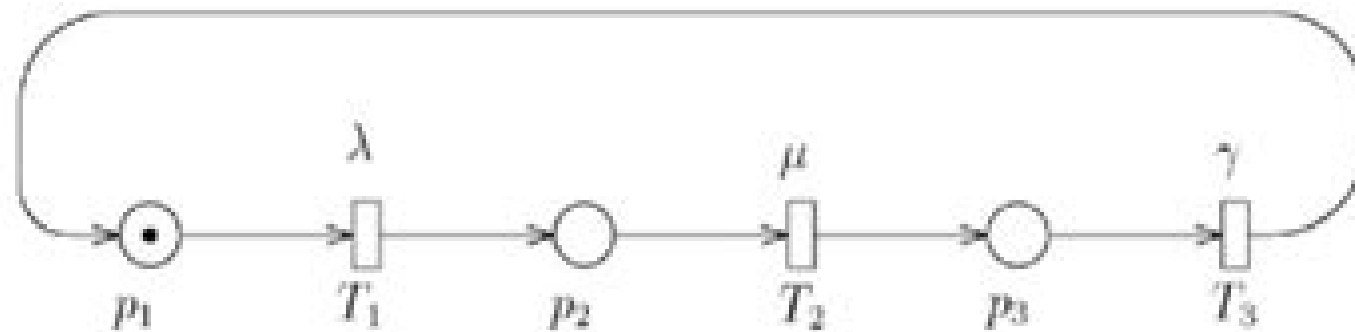# Stochastic Petri Nets ...

Stochastic Petri Nets

Thomas G. Robertazzi

Stochastic Petri Nets:

   Modelling with Generalized Stochastic Petri Nets M. Ajmone Marsan,1995-12-12 World renowned leaders in the field provide an accessible introduction to the use of Generalized Stochastic Petri Nets GSPNs for the performance analysis of diverse distributed systems Divided into two parts it begins with a summary of the major results in GSPN theory The second section is devoted entirely to application examples which demonstrate how GSPN methodology can be used in different arenas A simple version of the software tool used to analyse GSPN models is included with the book and a concise manual for its use is presented in the later chapters   **Stochastic Petri Nets** Falko Bause,Pieter S. Kritzinger,1996 Any engineer who is responsible for the design and development of discrete systems such as embedded software for control or telecommunication systems knows that the most important quality of the final product is that it be functionally correct Once assured that the system behaves correctly it is also important that it be efficient in that its running cost is minimal or is optimum in whatever quanititive measure is chosen Stochastic Petri nets have been developes over the last decade with exactly these objectives in mind This book is an introduction to Stochastic Petri nets and arose out of a desire by the authors to collect all one needs to understand Stochastic Petri net theory in one volume The intention of this book is not to give an overview of several or all Stochastic Petri net models appearing in the literature but to stress a combined view of functional and performance analysis in the context of some Stochastic Petri net models The book contains a reference to several Stochastic Petri net tools which are available to help the reader apply the theory contained in this volume USP F r sicher funktionierende DV Systeme   **Stochastic Petri Nets** Peter J. Haas,2006-04-10 Written by a leading researcher this book presents an introduction to Stochastic Petri Nets covering the modeling power of the proposed SPN model the stability conditions and the simulation methods Its unique and well written approach provides a timely and important addition to the literature Appeals to a wide range of researchers in engineering computer science mathematics and OR   *Modelling with Generalized Stochastic Petri Nets* Marco Ajmone Marsan,2002   *Stochastic Petri Nets for Wireless Networks* Lei Lei,Chuang Lin,Zhangdui Zhong,2015-04-08 This SpringerBrief presents research in the application of Stochastic Petri Nets SPN to the performance evaluation of wireless networks under bursty traffic It covers typical Quality of Service performance metrics such as mean throughput average delay and packet dropping probability Along with an introduction of SPN basics the authors introduce the key motivation and challenges of using SPN to analyze the resource sharing performance in wireless networks The authors explain two powerful modeling techniques that treat the well known state space explosion problem model decomposition and iteration and model aggregation using stochastic high level petri nets The first technique assists in performance analysis of opportunistic scheduling Device to Device communications with full frequency reuse and partial frequency reuse The second technique is used to formulate a wireless channel mode for cross layer performance analysis in OFDM system Stochastic Petri Nets for Wireless Networks reveals useful insights for the design of radio resource

management algorithms and a new line of thinking for the performance evaluation of future wireless networks This material is valuable as a reference for researchers and professionals working in wireless networks and for advanced level students studying wireless technologies in electrical engineering or computer science   **Stochastic Petri Nets** Peter J. Haas,2004 Stochastic Petri nets have proven to be a useful tool for modelling and performance analysis of complex discrete event stochastic systems such as those in telecommunications manufacturing transportation This monograph centres on techniques for the modelling and computer simulation of such systems   Enhancing Stochastic Petri Nets with Reconfigurability Samir Tigane,Laid Kahloul,Abdelhamid Mellouk,2025-07-29 This book explores the world of reconfigurable stochastic Petri nets RSPNs a powerful method for modeling and verifying complex dynamic and reconfigurable systems As modern discrete event systems become increasingly flexible requiring structural adaptability at runtime classical Petri nets are proving insufficient This book presents innovative extensions to Petri nets offering enhanced modeling capabilities for reconfigurable systems while ensuring efficient verification Through a structured approach this book introduces reconfigurable generalized stochastic Petri nets RecGSPNs an advanced framework that integrates reconfigurability while preserving crucial system properties such as liveness boundedness and deadlock freedom This book systematically explores modeling techniques including stochastic reward nets and dynamic topology transformations demonstrating their effectiveness through quantitative and qualitative analyses By addressing challenges in state space explosion and computational complexity this book provides essential methodologies for researchers and practitioners working on reconfigurable systems and serves as a valuable resource for those working in network security manufacturing systems and distributed computing where dynamic reconfigurations are essential   **Superposition of Generalized Stochastic Petri Nets and Its Impact on Performance Analysis** Peter Kemper,1997   Combination of Queueing Networks and Generalized Stochastic Petri Nets Matthias Becker,2000   **Discrete Deterministic and Stochastic Petri Nets** National Aeronautics and Space Administration (NASA),2018-07-02 Petri nets augmented with timing specifications gained a wide acceptance in the area of performance and reliability evaluation of complex systems exhibiting concurrency synchronization and conflicts The state space of time extended Petri nets is mapped onto its basic underlying stochastic process which can be shown to be Markovian under the assumption of exponentially distributed firing times The integration of exponentially and non exponentially distributed timing is still one of the major problems for the analysis and was first attacked for continuous time Petri nets at the cost of structural or analytical restrictions We propose a discrete deterministic and stochastic Petri net DDSPN formalism with no imposed structural or analytical restrictions where transitions can fire either in zero time or according to arbitrary firing times that can be represented as the time to absorption in a finite absorbing discrete time Markov chain DTMC Exponentially distributed firing times are then approximated arbitrarily well by geometric distributions Deterministic firing times are a special case of the geometric distribution The underlying stochastic process of a DDSPN is then also a DTMC from which the

transient and stationary solution can be obtained by standard techniques A comprehensive algorithm and some state space reduction techniques for the analysis of DDSPNs are presented comprising the automatic detection of conflicts and confusions which removes a major obstacle for the analysis of discrete time models Zijal Robert and Ciardo Gianfranco Langley Research Center NAS1 19480 DFG 1257 7 1 Analysis of Phase-Type Stochastic Petri Nets with Discrete and Continuous Timing National Aeronautics and Space Administration (NASA),2018-05-29 The Petri net formalism is useful in studying many discrete state discrete event systems exhibiting concurrency synchronization and other complex behavior As a bipartite graph the net can conveniently capture salient aspects of the system As a mathematical tool the net can specify an analyzable state space Indeed one can reason about certain qualitative properties from state occupancies and how they arise the sequence of events leading there By introducing deterministic or random delays the model is forced to sojourn in states some amount of time giving rise to an underlying stochastic process one that can be specified in a compact way and capable of providing quantitative probabilistic measures We formalize a new non Markovian extension to the Petri net that captures both discrete and continuous timing in the same model The approach affords efficient stationary analysis in most cases and efficient transient analysis under certain restrictions Moreover this new formalism has the added benefit in modeling fidelity stemming from the simultaneous capture of discrete and continuous time events as opposed to capturing only one and approximating the other We show how the underlying stochastic process which is non Markovian can be resolved into simpler Markovian problems that enjoy efficient solutions Solution algorithms are provided that can be easily programmed Jones Robert L and Goode Plesent W Technical Monitor Langley Research CenterPETRI NETS MARKOV PROCESSES SYNCHRONISM ALGORITHMS *Timed Petri Nets* Jiacun Wang,2012-12-06 Driven by the request for increased productivity flexibility and competitiveness modern civilization increasingly has created high performance discrete event dynamic systems DEDSs These systems exhibit concurrent sequential competitive activities among their components They are often complex and large in scale and necessarily flexible and thus highly capital intensive Examples of systems are manufacturing systems communication networks traffic and logistic systems and military command and control systems Modeling and performance evaluation play a vital role in the design and operation of such high performance DEDSs and thus have received widespread attention from researchers over the past two decades One methodology resulting from this effort is based on timed Petri nets and related graphical and mathematical tools The popularity that Petri nets have been gaining in modeling of DEDSs is due to their powerful representational ability of concurrency and synchronization however these properties of DEDSs cannot be expressed easily in traditional formalisms developed for analysis of classical systems with sequential behaviors This book introduces the theories and applications of timed Petri nets systematically Moreover it also presents many practical applications in addition to theoretical developments together with the latest research results and industrial applications of timed Petri nets Timed Petri Nets Theory and Application is intended for use by researchers and

practitioners in the area of Discrete Event Dynamic Systems *Stochastic Petri Nets* Gérard FLORIN,1991 **Estimation Methods for Stochastic Petri Nets Based on Standardized Time Series** International Business Machines Corporation. Research Division,Peter J. Haas,1996 Abstract When a computer manufacturing telecommunication or transportation system is modeled as a stochastic Petri net many long run performance characteristics of interest can be represented as time average limits of the underlying marking process For nets with generally distributed firing times such limits typically cannot be computed analytically or numerically but must be estimated using simulation We provide conditions on the clock setting distributions and new marking probabilities of a stochastic Petri net under which the output process of the simulation obeys a multivariate functional central limit theorem It then follows from results of Glynn and Iglehart that strongly consistent point estimates and asymptotic confidence intervals for time average limits can be obtained using methods based on standardized time series In particlar the method of batch means with the number of batches fixed is applicable Moreover the methods of Mu oz and Glynn can be used to obtain point estimates and confidence intervals for ratios of time average limits All of these estimation methods apply to stochastic Petri nets for which the regenerative method for analysis of simulation output is not applicable Why Many Non-safe Stochastic Petri Nets are Non-product Form Networks Thomas G. Robertazzi,1991 *Extended Stochastic Petri Nets* Joanne Bechta Dugan,1984 An Extended Stochastic Petri Net ESPN model useful for modeling systems which exhibit concurrent asynchronous or nondeterministic behavior is developed Applications demonstrating the flexibility of the model for a variety of system modeling applications are presented Analytic techniques for the representation of a class of ESPNs as Markov or semi Markov processes are discussed as is the simulation of more general models Finally DEEP the Duke ESPN Evaluation Package is previewed Author Stochastic Petri Net Models: Simultaneous Transition Firing P. J. Haas,G. S. Shedler,1990 Abstract Stochastic Petri nets with timed and immediate transitions have at least the modelling power of generalized semi Markov processes and provide a general framework for discrete event simulations on a countable state space In this context the marking assignment of token counts to the places of the net corresponds to the state of the underlying stochastic process of the simulation The firing of a transition corresponds to the occurrence of an event so that a marking change occurs when one or more transitions fire simultaneously This paper focuses on stochastic Petri nets in which transitions can fire simultaneously **Markovian Stochastic Petri Nets** Peter Jerome Haas,Gerald S. Shedler,1989 Abstract Stochastic Petri nets are particularly well suited to representation of concurrency synchronization and communication We show that the marking process of a stochastic Petri net is a time homogeneous continuous time Markov chain with countable state space provided that the clock associated with the firing of each timed transition is always set according to a fixed exponential distribution The result rests on a representation of the conditional distribution of the vector of clock readings given the partial history of the process We also investigate the modelling power of Markovian stochastic Petri nets The main result is that for any possibly non Markovian

finite state generalized semi Markov process with exponential clock setting distributions there exists a Markovian stochastic Petri net with deterministic transitions and unit speeds having a marking process with the same finite dimensional distributions   Stochastic Petri Nets Peter J Haas,2002-06-27   High-level Petri Nets Kurt Jensen,Grzegorz Rozenberg,2012-12-06 High level Petri nets are now widely used in both theoretical analysis and practical modelling of concurrent systems The main reason for the success of this class of net models is that they make it possible to obtain much more succinct and manageable de scriptions than can be obtained by means of low level Petri nets while on the other hand they still offer a wide range of analysis methods and tools The step from low level nets to high level nets can be compared to the step from assembly languages to modem programming languages with an elaborated type concept In low level nets there is only one kind of token and this means that the state of a place is described by an integer and in many cases even by a boolean value In high level nets each token can carry complex information which e g may describe the entire state of a process or a data base Today most practical applications of Petri nets use one of the different kinds of high level nets A considerable body of knowledge exists about high level Petri nets this includes theoretical foundations analysis methods and many applications Unfortunately the papers on high level Petri nets have been scattered throughout various journals and collections As a result much of this knowledge is not readily available to people who may be interested in using high level nets

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