

NS Simulator for Beginners

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Eitan Altman and Tania Jiménez

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NS Simulator for Beginners

Eitan Altman

INRIA, Sophia Antipolis, France

Tania Jiménez

LIA, University of Avignon, France

SYNTHESIS LECTURES ON COMMUNICATION NETWORKS #10

ABSTRACT

NS-2 is an open-source discrete event network simulator which is widely used by both the research community as well as by the people involved in the standardization protocols of IETF. The goal of this book is twofold: on one hand to learn how to use the NS-2 simulator, and on the other hand, to become acquainted with and to understand the operation of some of the simulated objects using NS-2 simulations. The book is intended to help students, engineers or researchers who need not have much background in programming or who want to learn through simple examples how to analyse some simulated objects using NS-2. Simulations may differ from each other in many aspects: the applications, topologies, parameters of network objects (links, nodes) and protocols used, etc. The first chapter §1 is a general introduction to the book, where the importance of NS-2 as a tool for a good comprehension of networks and protocols is stated. In the next chapters (§4, §5, §6, §7, §8 and §9) we present special topics as TCP, RED, etc., using NS-2 as a tool for better understanding the protocols. We provide in the appendices a review of Random Variables §A and Confidence Intervals §B, as well as a first sketch for using the new NS-3 simulator §C.

KEYWORDS

NS-2 simulator, TCP simulation, simulation traces, network simulation, tcl

To our children Einat and Daniel.

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Preface

The NS-2 simulator covers a very large number of applications, of protocols, of network types, of network elements and of traffic models. We call these “simulated objects”. The goal of this book is twofold: on one hand to learn how to use the NS-2 simulator, and on the other hand, to become acquainted with and to understand the operation of some of the simulated objects using NS-2 simulations. This book provides therefore not only some basics and description of the NS-2 simulator, but also a description of the simulated objects. Finally, we focus on the analysis of the behavior of the simulated objects using NS-2 simulations.

The book is intended to help students, engineers or researchers who need not have much background in programming or who want to learn through simple examples how to analyse some simulated objects using NS-2. For that purpose, we provide a large number of scripts that can be used by the reader so as to start programming immediately. For readers who are interested to learn from examples, we should mention that a very large number of examples are already available in the software package of the NS-2 simulator¹. Other tutorials containing many examples are available electronically: Marc Greis’s tutorial² and the tutorial by Jae Chung and Mark Claypool³.

For a much deeper study of the NS-2 simulator, one should refer to the NS-2 manual which is maintained up-to-date at <http://www.isi.edu/nsnam/ns/>, or to <http://www.nsnam.org/docs/release/manual/singlehtml/index.html> for the NS-3 manual.

We present in this book many simple (but hopefully useful) scenarios for simulations. Simulations may differ from each other in many aspects: the applications, topologies, parameters of network objects (links, nodes) and protocols used, etc. We do not aim at being exhaustive; instead, we present what we consider to be “typical” examples. If one needs a more exhaustive description of NS-2, one may find it very useful to consult the manual. An alternative simple way to know about other possibilities for choosing network elements, network protocols or their parameters, application parameters, etc., is to look directly at the library files that define them⁴. For example, the definitions of mobile nodes could be found in the file *ns-mobilenode.tcl*, those describing queueing disciplines and parameters in the file *ns-queue.tcl*, etc. Default parameters can be found at the file *ns-default.tcl*. Note: to know which default object is related to which command, one may need to check the file *ns-lib.tcl* as we shall see in an example in Section 2.2.

The book is organized in 10 chapters and 3 appendices. The first chapter §1 is a general introduction to the book, where the importance of NS-2 as a tool for a good comprehension of networks

¹It typically appears in the directory ns-2/tcl/ex, where directory “ns-2” could have other longer names that depend on the NS-2 release, e.g. “ns-2.34”

²<http://www.isi.edu/nsnam/ns/tutorial/index.html>

³<http://nile.wpi.edu/NS/>

⁴[ns-allinone-2.34/ns-2.34/tcl/lib](#)

and protocols is stated. This chapter also offers a small introduction to the Tcl programming. The chapter §2 give the information that allows one to create a first simple NS-2 script. Chapter §3 is about tracing in NS-2 and how to exploit the traces. In the next chapters (§4, §5, §6, §7, §8 and §9) we present special topics as TCP, RED, etc., using NS-2 as a tool for better understanding the protocols. In the last chapter §10 we briefly explain how to add new classes to the NS-2 architecture. We provide in the appendices a review of Random Variables §A and Confidence Intervals §B, as well as a first sketch for using the new NS-3 simulator §C.

For the last ten years, we have been using the first edition of this book in our courses on simulations. We had written it for our students in ULA (University de Los Andes), Mérida, Venezuela, and have reused this material in courses given in the University of Nice Sophia-Antipolis. Our goal has been not only to learn how to simulate, but also to teach networking by simulating the network protocols. We hope that this book, along with the many programs that are available for free download, will be helpful and useful for students, researchers and engineers.

Eitan Altman and Tania Jiménez
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