

AN INTRODUCTION TO PERFORMANCE MODELING AND ANALYSIS

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Performance modeling and analysis provide an important means to ensure the cost-effective design and engineering of communications and computer systems, as well as services based on such systems. Appropriate use of performance modeling and analysis techniques can provide quantitative insight into system performance that would otherwise be difficult, expensive, or even impossible to obtain.

Background

Performance modeling and analysis are especially useful during the early design phase because they allow quick and inexpensive comparisons of a myriad of design alternatives. The use of these techniques throughout the design, development, and deployment phase of products and services provides an invaluable complement to prototyping and actual system evaluation.

The discipline represents a unique blend of art and science. It makes extensive use of a variety of sophisticated technical concepts such as applied probability, stochastic processes, queueing theory, scheduling theory, control theory, and optimization theory. At the same time, an analyst must be able to extract from a real system the essence of its performance and incorporate this into an abstract mathematical or simulation model that will provide the needed quantification of relevant performance measures. This ability, which may well be the most important ingredient in the successful use of performance modeling and analysis, calls for skills that are hard to teach. The skills often develop only after extensive experience and practice.

In This Issue

The papers in this issue of the *AT&T Technical Journal* illustrate the significant role of performance modeling in improving the development process for new products. The papers are largely concerned with new communication, computer, and data systems. Most of the papers combine, in varying degrees, the development of new methodologies and their application to particular systems.

The first paper, by Weiss and Mitra, provides a new approach to transient analysis, motivated by the Datakit® virtual circuit switch.

The new approach is based on an asymptotic analysis. Asymptotic analyses have proved fruitful in previous studies of other problems, including the provision of a significant improvement of computational requirements for queueing network analysis.

The next three papers, by Luan and Lucantoni, by Kumar, and by Cole, analyze aspects of data networks that use link-access procedures for D channel (LAPD) frame relay, a new protocol concept that facilitates high-speed data transport through a simpler protocol functionality in the network.

The paper by Luan and Lucantoni deals with the combination of flow control and bandwidth management. It is shown that a customer can choose an appropriate window size to optimize successful throughput.

The next two papers concern analyses of data network virtual circuits. Kumar's paper analyzes the performance of several architectures that provide SNA™/SDLC services over permanent virtual circuits in a frame relay data network. (SNA is a trademark of IBM Corporation.) The paper concerns itself primarily with end-to-end delay. Cole's paper also deals with end-to-end delays in frame relay networks. It models the 3270 Binary Synchronous Communication (BSC) multipoint circuits over private line frame relay networks.

The next paper, by Karanam, Sriram, and Bowker, gives a performance evaluation of variable-bit-rate packetized voice signals. Variable bit rate is a method to control overloads gracefully by decreasing bit rates in overload, as opposed to dropping packets. The paper shows that, by a combination of analysis and subjective voice quality testing, this technique controls overloads effectively with minimal effect on voice quality.

The papers by Hać and Johnson, by Ramamurthy, and by Barkley and Schimmel, are concerned with various aspects of computer systems. The first paper discusses and simulates a load balancing policy in a distributed system. The paper was motivated by the LOCUS distributed file system.

The second paper provides an analytical model for a single processor interactive computer system running under the UNIX® operating system. The model is a closed multichain, multiclass priority queueing network.

The third paper, also about the UNIX operating system, complements analytical work on the system (of which Ramamurthy's paper is an example) by providing a measurement tool. Specifically, it supports timing and tracing of UNIX software at the user and kernel levels.

The final paper in this issue, by Astmann and Kaufman, describes the modeling of a PBX. Begun early in the development process, the modeling brought about design enhancements. The model was validated and updated during the subsequent laboratory measurement phase.

Collectively, the papers in this issue provide a sampling of the broad spectrum of ongoing activity in performance modeling and analysis at AT&T. They underscore the company's commitment to excellence in the performance of its products and services.

Biographies (continued)
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