

## Modeling and Analysis of Computer Networks in a Graphical Workstation Environment

October 26th, 1988

Alvin M. Blum, Robert F. Gordon and Edward A. MacNair

IBM Thomas J. Watson Research Center  
Yorktown Heights, NY 10598

Kurtiss J. Gordon and James F. Kurose

Department of Computer and Information Science  
University of Massachusetts  
Amherst, Mass. 01003

**Modeling and Analysis of Computer Networks  
in a Graphical Workstation Environment**

Alvin M. Blum, Robert F. Gordon and Edward A. MacNair  
IBM Thomas J. Watson Research Center  
Yorktown Heights, New York 10598

Kurtiss J. Gordon and James F. Kurose  
Department of Computer and Information Science  
University of Massachusetts  
Amherst, Mass. 01003

**ABSTRACT**

Queueing networks are important as performance models of systems where performance is principally affected by contention for resources. Such systems include computer systems, communication networks, office systems and manufacturing lines. In order to effectively use queueing networks as performance models, appropriate software is necessary for definition of the networks to be solved, for solution of the networks (by simulation and/or numerical methods) and for examination of the performance measures obtained.

The RESEARCH Queueing Package Modeling Environment (RESQME) is a graphical workstation environment for iteratively constructing, running and analyzing models of resource contention systems. It is built on top of the RESEARCH Queueing Package (RESQ) which provides the functionality to evaluate extended queueing networks.

In this paper we describe its use in modeling computer networks. A model of a long haul network which routes messages around a loop is used with several different protocols. A local area network with a token ring is also discussed.

**Alvin M. Blum**

Mr. Blum joined IBM in 1961 in the Data Systems Division in White Plains, New York where he developed several early simulation models for performance analysis of information Systems. In 1962 he moved to the IBM Advanced Systems Development Division Laboratory in Yorktown Heights, New York where his work included the modelling and performance evaluation of computer systems and networks, data base systems, transportation systems, and graphics systems, as well as computer architecture emulation and simulation language development. In 1976 he transferred to the Data Processing Marketing Group in White Plains where he developed algorithms and methodology for the statistical analysis of software problems and performance. In 1982 he began his current assignment with Modelling and Analysis, Software Systems Group at the IBM T. J. Watson Research center where he is doing work on further development of the Research Queuing Package (RESQ), graphics interfaces, and a statistical and data analysis graphics package (GRASTAT).

Mr. Blum received a B.B.A degree in 1955 from the City College of New York and an M.S. degree in mathematics from the Courant Institute of Mathematical Sciences at New York University in 1966. Mr. Blum is a member of the Mathematical Association of America.

Robert F. Gordon

IBM Research Division, Yorktown Heights, New York

Dr. Gordon is a research staff member in the modeling and analysis software systems group at the IBM Thomas J. Watson Research Center. He received a B.S. in mathematics and physics from the City College of New York in 1964, an M.S. in mathematics from Carnegie Institute of Technology in 1965 and Ph.D. in mathematics from Carnegie-Mellon University in 1969. From 1968 to 1974, he was Manager of Mathematics and Programming for Hoffmann-La Roche, Inc., where he developed mathematical models for marketing, production planning and distribution. From 1974 to 1983, Dr. Gordon was Director of Information Management Services at Avis, where he headed the operations research, timesharing systems, and systems and programming groups. Dr. Gordon is an adjunct professor at Hofstra University. He is a member of Phi Beta Kappa, Sigma Xi and ORSA.

Edward A. MacNair

IBM Research Division, Yorktown Heights, New York

Mr. MacNair joined IBM in 1965. He is a Research Staff Member in the Computer Science Department at the IBM Thomas J. Watson Research Center. He is currently in the Modeling and Analysis Software Systems group developing modeling programs to solve extended queuing networks. He received a B.A. degree in Mathematics in 1965, from Hofstra University and an M.S. degree in Operations Research in 1972, from New York University. He is currently a Ph.D. student at Columbia University in the Industrial Engineering and Operations Research Department. Mr. MacNair is a member of the Association for Computing Machinery and the Operations Research Society of America.

Kurtiss J. Gordon

University of Massachusetts, Amherst, Massachusetts

Dr. Gordon received his B.S. in Physics from Antioch College in 1964, his M.A. and Ph.D. in Astronomy from the University of Michigan in 1966 and 1969, and his M.S.E.C.E. in Computer Systems from the University of Massachusetts in 1985. Until 1984, he taught in the Five-College Astronomy Department. Currently, he is a Senior Postdoctoral Research Associate in the Department of Computer and Information Science at the University of Massachusetts in Amherst. Dr. Gordon's interests include the display and interpretation of large bodies of data, modeling and performance evaluation, and graphical user interfaces. He is a member of the American Astronomical Society, Sigma Xi, ACM, and IEEE.

James F. Kurose

University of Massachusetts, Amherst, Massachusetts

Dr. Kurose received a BA degree in Physics from Wesleyan University in Middletown, Conn. in 1978 and an MS and PhD degree in Computer Science from Columbia University in 1980 and 1984, respectively. Since 1984, he has been an Assistant Professor in the Department of Computer and Information Science at the University of Massachusetts, Amherst, MA., where he currently leads several research efforts in the areas of computer communication networks, distributed systems, and modeling and performance evaluation. He has also been associated with the performance modeling methodology group at the IBM T.J. Watson Research Center as a consultant since 1980 and has served as a consultant for various other companies as well. Professor Kurose is a member of Phi Beta Kappa, Sigma Xi, IEEE, and ACM and the IEEE Technical Committees on Computer Communications, Distributed Systems, and Computer-Aided Modeling of Communication Systems.