Two-Level Hybrid Modeling Method for Performance Modeling of Large Public ATM Networks

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Abstract

A modeling and analysis method for performance evaluation of large public ATM networks is proposed. For planning and operation of large high-speed data networks like public ATM networks, it is essential to have a modeling and analysis method that can model the network operation realistically but compute accurate performance measures in an affordable time. Traditional simulation methods and mathematical analysis methods fail to meet such requirements. We thus propose an alternative approach, called 2-level hybrid modeling method for capacity planning and call level operation planning. Complex call level operation is realistically modeled as a simulation model. Cell level performance is approximately modeled by a mathematical queueing network. The call level simulation model can capture realistic virtual path configuration and routing, and various call admission control and service protection rules. The call level simulation model computes the time average proportion of the number of calls of each class in progress at each link as well as call level performance like call blocking probabilities. The information on the offered load of calls of each class at each link and associated cell traffic processes are used by the cell level model. For cell level performance modeling, the cell traffic of each call in progress at a link is approximated by a Markov

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modulated Bernoulli traffic process and aggregated into a discrete time batch Markovian arrival process(D-BMAP). Then, each link is analyzed by a D-BMAP/D/1/K queueing model, and cell loss probabilities and mean delays are computed. The cell level analysis can be flexibly performed for an appropriate focused interval or a link set where call traffics are overloaded, or at a specific epoch from which the calls in progress are frozen. The proposed 2-level hybrid model not only computes accurate call level performance estimates but also gives more accurate cell level performance estimates since the call level model that realistically models complex cell level operation provides accurate cell level offered loads to each link.. Since the cell level modeling that requires tremendous memory and computation time for simulation is performed by the mathematical model, the 2-level hybrid model computes the performance for large public ATM networks in an affordable time. Since a network operator has more concern with call level network operation than cell level performance and can not control cell operation like cell traffic management, our approach that can accurately analyze call level performance but reasonably approximate cell level performance is a realistic engineering solution for network operators.