# Modeling and Algorithm for Cost Effective ATM LAN Design

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## Abstract

In this article, we provide a heuristic algorithm for the optimal design of an ATM LAN. Our scope of the ATM LAN design contains the optimal location of ATM switches and determining the link capacities, and we mainly focus on the connection-oriented traffic transmission. A general cost function can be used in the proposed algorithm, which enables us to generalize the problem modeling scope. The computational complexity of our algorithm is $O(n^4)$ and a computational result obtained for a test problem shows that out algorithm can generate a high-quality ATM LAN backbone network.

Asynchronous transfer mode (ATM) is a communication architecture based on switching or relaying small fixed length packets called cells. Initially, ATM was primarily developed in the area of Optical Network (SONET)-based wide area networks as an international standard. Interest in ATM came from the traditional telecommunications carriers and their suppliers. However, there has been emerging interest in applying ATM technology in LAN and campus environments. That is, attractiveness of ATM technology for LANs has resulted in ATM LANs appearing well in advance of long-haul ATM services. An ATM LAN is a LAN that applies the ATM technology and the two systems use the identical ATM technology. Like ATM networks, ATM LANs have ATM switches and interconnection which are of high price. Hence the optimal design of an ATM LAN is

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of great importance for the reduction of its construction and operation cost. There have been several researches on the optimal design of an ATM network or a LAN. Also there have been several researches on the optimal design of a LAN. Researches on ATM networks was focused on the connection-oriented data services which can be summarized as the transmission of cells through virtual path and researches on LANs were focused on the routing-based data services that are based on the datagram packet network technology.

The design of an ATM LAN requires considering both connection-oriented and routing-based data services. However, in most cases the design of an ATM LAN is not a zero-base design. We only need to attach ATM switches and additional links to the existing LAN. Since the routing-based data services already have been provided in the existing LAN, it is natural that we mainly focus only on the connection-oriented traffic in the optimal design of an ATM LAN.

There have been several studies on the design requirements of ATM LANs. Also, recently, Liu et al. provided two integer programming (IP) formulations for the optimal network design in an ATM PNNI environment that is similar to an ATM LAN and provides mixed type of data-services to users. Using the schemes as that in their work can give an optimal solution to the network designers with time efficiency for small-scale design problems. In large-scale problems, however, this algorithm would have heavy computational complexity due to its IP formulation. Furthermore, in a system with general form of set-up costs, this algorithm is hardly applicable.

In this article, we suggest an efficient heuristic algorithm that can be applied in a practical ATM LAN design and is applicable to the problems with general form of cost functions. The proposed algorithm starts with a large network that includes all candidate links and nodes. The algorithm then construct a subnetwork by finding the minimum cost paths between all O-D pairs. Since this algorithm solves only the Shortest Path Problems iteratively, it is computationally efficient. Our algorithm is also very flexible so that general form of link cost and switch cost functions other than linear or step functions can be handled through this algorithm.