

# Abstract

We propose two mathematical models with weighted utility functions for the fair bandwidth allocation and QoS routing in communication networks which offer multiple services for several classes of users. The formulation and numerical experiments are carried out in a general utility-maximizing framework. In this work, instead of being fixed, the weight for each utility function is taken as a free variable. The objective of this thesis is to find the structure of optimal weights that maximize the weighted sum of utilities of the bandwidth allocation for each class. We solve it by proposing two models in terms of fairness. Model I and II are constructed to compare different choices for optimal weights. For Model I, the structure of optimal weights form a vector which consists of one for a class and zero otherwise. For Model II, the form of optimal weights is that each weight of utility function is equally assigned. The results are proved and illustrated by software GAMS numerically.

## 中文摘要

我們以公平頻寬配置考慮網路上多重等級與多重服務品質的效用函數，利用權重效用函數提出兩種數學最佳化模型。這兩個模型的目標都是要尋找權重效用函數總和值的最大值。本篇論文特別以權重為決策變數，研究最佳權重的行為模式，並求得最佳權重分佈公式。我們發現模型I的總權重效用只看重某個效用值最大的等級，完全忽略其他效用值較小的等級；即最大效用函數的最佳權重為1，其他效用較小的最佳權重為0。在最佳化過程中，模型II的數值資料呈現出最佳權重架構為：最佳權重中的每個權重均相等，且總和為1。我們隨後證明這些結果，並利用GAMS軟體來呈現數值資料。