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## **Abstract**

For reducing network information to achieve scalability in large ATM networks, ATM Private Network-to-Network Interface (PNNI) adopts hierarchical routing. Consequently, although routing complexity is significantly reduced, numerous issues in PNNI routing require further study to achieve more efficient, accurate, scalable, and QoS-aware routing.

In the first year, we proposed several methods to achieve efficient, scalable, and QoS-aware ATM PNNI routing. First, an efficient aggregation scheme, referred to as Asymmetric Simple, is proposed. The aggregated routing information includes available bandwidth, delay and cost. Second, two approaches for defining link costs are investigated, namely, the Markov Decision Process (MDP) approach and the Competitive On-Line (COL) routing approach, and these are compared with the Widest Path (WP) approach. Third, a dynamic update policy, referred to as the dynamic cost-based update (DCU) policy, is proposed to improve the accuracy of the aggregated information and the performance of hierarchical routing, while decreasing the frequency of re-aggregation and information distribution. Finally, we proposed CIS (Crankback Information Stack) and CT (Cost Threshold) approaches to reduce crankback overhead.

Simulation results demonstrate that the proposed Asymmetric Simple aggregation scheme yields very good network utilization while significantly reducing the amount of advertised information. Between these two link cost functions, the MDP approach provides a systematic method of defining call admission function and yields better network utilization than the COL approach. The proposed DCU policy also yields an enhanced network utilization while significantly reducing the frequency of re-aggregation. Meanwhile, the proposed CIS and CT approaches reduce crankback overhead significantly. Especially, the combination of CIS and CT approach achieves further improvement.

**Keywords:** Hierarchical routing, Aggregation scheme, PNNI, COL, MDP, Update policy, Hysteresis, Crankback, CIS, CT.

## 中文摘要

ATM Private Network-to-Network Interface (PNNI) 提出階層式選徑通信協定來減少網路資訊，以實現一大型 ATM 網路的可擴展性；必然地，降低了選徑的複雜度，但是如何使 PNNI 網路提供一更高效率、正確資訊、擴展性與服務品質保證的選徑問題是需要更多的研究。

第一年，本計劃提出四項方法以實現一更高效率、正確資訊、擴展性與服務品質保證的 PNNI 選徑機制。第一、提出一高效率且低複雜度的聚集方法，稱之為 Asymmetric Simple 聚集法；第二、提出以馬可夫理論(MDP)為基礎的鏈路成本定義機制，並將此法與線上競爭法(COL)和最寬頻寬法(WP)作效能比較；第三、提出以成本為機礎的動態資訊更新政策(DCU)，以提高資訊正確性的同時減少資訊更新頻率，降低了選徑的複雜度；最後，以 CIS 與 CT 方法減少 crankback overhead。

結果顯示 Asymmetric Simple 聚集法可有效提供良好的網路使用率，同時減低網域劇集的複雜度。MDP 方法提供系統化的 call admission 機制且考慮 call 到達率，因此與 COL 和 WP 方法相比，MDP 具有良好的網路使用率與高效率。再者，DCU 方法適用於動態網路流量，因此可得良好網路使用率同時明顯減少網路資訊更新頻率。而所提出的 CIS 與 CT 方法明顯降低 crankback overhead，尤其以結合兩者時更為顯著。

關鍵詞：階層式選徑、聚集方法、馬可夫理論、線上競爭法、更新政策、遲滯。

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