

P.O.Box 8718, Beijing 100080, China	Journal of Software, Sept. 2006,17(9):1949-1957
E-mail: jos@iscas.ac.cn	ISSN 1000-9825, CODEN RUXUEW, CN 11-2560/TP
http://www.jos.org.cn	Copyright © 2006 by <i>Journal of Software</i>

# 一种适合于网络处理器的并行多维分类算法AM-Trie

郑波, 林闯, 曲扬

[Full-Text PDF](#) [Submission](#) [Back](#)

郑波, 林闯, 曲扬

(清华大学 计算机科学与技术系, 北京 100084)

作者简介: 郑波(1978—), 男, 博士生, 主要研究领域为分网络处理器, 网络传输控制, 系统性能评价, 无线网络安全. 林闯(1948—), 男, 教授, 博士生导师, CCF高级会员, 主要研究领域为系统性能评价, 计算机网络, 随机Petri网, 逻辑推理模型. 曲扬(1978—), 男, 博士生, 主要研究领域为系统性能评价, 网格计算, workflow模型.

联系人: 郑波 Phn: +86-10-62772487, Fax: +86-10-62771138, E-mail: bzhen@csnet1.cs.tsinghua.edu.cn

Received 2005-10-27; Accepted 2006-01-09

## Abstract

Nowadays, many high speed Internet applications require high speed multidimensional packet classification algorithms. Based on the uniqueness of Network Processor, this paper presents a multidimensional classification algorithm—AM-Trie (asymmetrical multi-bit trie). AM-Trie is a high speed, parallel and scalable algorithm and very fit for the "multi-thread and multi-core" feature of the Network Processor. A heuristic field division algorithm is also presented, and it is proved theoretically that it can find out the minimum storage cost solution when the height of the AM-Trie is given. Finally, a prototype is implemented based on Intel IXP 2400 Network Processor. The performance testing result shows that AM-Trie is a high-speed and scalable algorithm; the throughput of the whole system is influenced little by the size of rules and it can reach 2.5 Gbps wire speed.

Zheng B, Lin C, Qu Y. AM-Trie: A parallel multidimensional packet classification algorithm fitting for network processor. *Journal of Software*, 2006,17(9):1949-1957.

DOI: 10.1360/jos171949

<http://www.jos.org.cn/1000-9825/17/1949.htm>

## 摘要

针对当前高速网络应用对分组分类算法的要求以及网络处理器体系结构的特点,提出了一种高速多维分组分类算法——AM-Trie算法(asymmetrical multi-bit trie,非对称多权Trie树).该算法具有搜索速度快,并行性、可扩展性良好的特点,特别适合于在网络处理器上实现.同时,给出了一种空间最优的启发式分类字段分段算法,并从理论上证明其在确定AM-Trie树层数的情况下使得存储空间最小.最后,基于Intel IXP2400网络处理器设计并实现了该算法.性能实测表明,该算法性能良好并具有很好的可扩展性,算法速度受规则库大小的影响很小,在各种情况下均达到了2.5Gbps的线速.

基金项目: Supported by the Major Research Plan of the National Natural Science Foundation of China under Grant No.90412012 (国家自然科学基金重大研究计划重点项目); the National Grand Fundamental Research 973 Program of China under Grant No.2003CB314804 (国家重点基础研究发展规划(973)); the Juniper Research Grant (Juniper公司研究基金); the Intel IXA University Research Plan (Intel IXA大学研究计划)

## References:

- [1] Gupta P, McKeown N. Packet classification on multiple fields. In: Proc. of the ACM SIGCOMM 1999. 1999. 147?160. <http://tiny-tera.stanford.edu/~nickm/papers/Sigcomm99.pdf>
- [2] Baboescu F, Varghese G. Scalable packet classification. In: Proc. of the ACM SIGCOMM 2001. 2001. 199?210. <http://www.cs.ucsd.edu/groups/sysnet/miscpapers/p2-baboescu.pdf>

- [3] Singh S, Baboescu F, Varghese G, Wang J. Packet classification using multidimensional cutting. In: Proc. of the ACM SIGCOMM 2003. 2003. 213?224. <http://www.sigcomm.org/sigcomm2003/papers/p213-singh.pdf>
- [4] Baboescu SSF, Varghese G. Packet classification for core routers: Is there an alternative to cams? In: Proc. of the IEEE INFOCOM 2003. 2003. 53?63.
- [5] Lakshminarayanan ARK, Venkatachary S. Algorithms for advanced packet classification with ternary cams. In: Proc. of the ACM SIGCOMM 2005. 2005. 193?204.
- [6] Network processing forum (npf). <http://www.npforum.org/>
- [7] Network systems design conference. <http://www.networkprocessors.com/>
- [8] Wolf T, Franklin MS. Design tradeoffs for embedded network processors. In: Proc. of the ARCS 2002. 2002. 149?164.
- [9] Shah N. Understanding network processors. Technical Report, 2001. <http://www.gigascale.org/pubs/338.html>
- [10] McAuley AJ, Francis P. Fast routing table lookup using CAMs. In: INFOCOM (3). 1993. 1382?1391.
- [11] Srinivasan V, Varghese G. Faster IP lookups using controlled prefix expansion. In: Measurement and Modeling of Computer Systems. 1998. 1?10.
- [12] BGP routing table analysis reports. <http://bgp.potaroo.net/>