A Priority TCAM IP-Routing Lookup Scheme

Po-Chou Lin and Chung-Ju Chang, *Senior Member, IEEE*

***Abstract*—A priority TCAM IP-routing lookup scheme, which combines a priority ternary content addressable memory (TCAM) technique with a compact IP-routing lookup scheme, is proposed in this letter. It not only completes an IP-routing lookup with two memory accesses but also achieves small lookup table size and fast table reconstruction time.**

***Index Terms*—IP-routing lookup, ternary content addressable memory (TCAM).**

I. Introduction

HARDWARE IP-routing schemes can be classified into three categories: mutliway search, direct TCAM match, and indirect lookup. Lampson, Srinivasan, and Vargheseet [1] showed how multiway search can be adopted for solving the IP-routing problem. Its advantage is the small lookup table size. However, it suffers the disadvantage of large memory accesses per lookup and long routing table reconstruction time. Direct TCAM matching ASICs are available recently [2]. But TCAM with sufficient capacity for IP routing is still not cost effective. Gupta, Lin, and Mckeown [3] proposed an indirect lookup mechanism with 9 Mbytes memory and three memory accesses per lookup. Huang and Zhao [4] decreased the next hop array (NHA) size to 470 Kbytes. Wang, Chan, and Chen [5] further reduced the lookup time to two memory accesses with a little more memory.

In this letter, we propose a *priority TCAM IP-routing lookup scheme*, which combines a priority TCAM technique with a compact IP-routing lookup scheme. The priority TCAM IP-routing lookup scheme can complete an IP routing lookup with two memory accesses, reduce IP-routing lookup table size, and especially, decrease IP-routing lookup table reconstruction time.

II. The Priority TCAM IP-Routing Lookup Scheme

Although the number of Internet hosts grows exponentially, the routing prefixes with a router are still in sparse distribution. There are less than 45 000 routing prefixes over total 2^{16} segments in today's backbone routers. And except the default routing entry, there are few or even no routing prefix to define the next hop for most segments. Thus, we utilize this sparse distribution property to reduce IP-routing lookup table size.

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P.-C. Lin is with the Wireless Communication Technology Laboratory, Telecommunication Laboratories, Chunghwa Telecom Company Ltd., Taoyuan 326, Taiwan, R.O.C. (e-mail: pochou@cht.com.tw).

C.-J. Chang is with the Department of Communication Engineering, National Chiao Tung University, Hsinchu 300, Taiwan, R.O.C. (e-mail: cjchang@cc.nctu.edu.tw).

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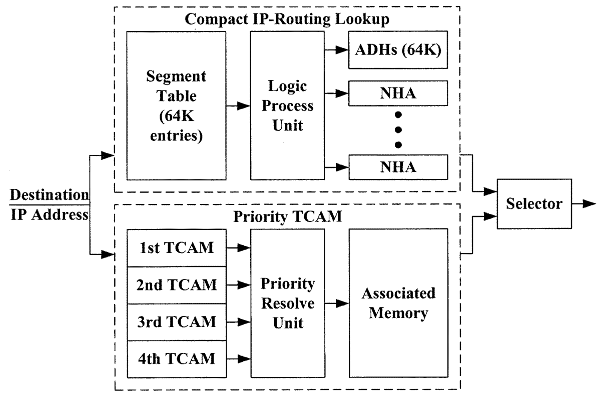

Fig. 1. Block diagram of the priority TCAM IP-routing lookup scheme.

TABLE I
Routing Prefixes of the 192.168 Segment

Entry i	Routing Entry $p_i/l_i/h_i$	$p_i(x,y)$ x=17,y=24	Compact IP-routing lookup or priority TCAM
0	192.168/16/0	xxxxxxxxb	Compact IP-routing lookup
1	192.168.20/22/1	000101xxb	Compact IP-routing lookup
2	192.168.84/22/2	010101xxb	Compact IP-routing lookup
3	192.168.68/23/3	0100010xb	Compact IP-routing lookup
4	192.168.68.16/28/4	01000100b	priority TCAM
5	192.168.68.16/32/5	01000100b	priority TCAM

Let l_i and h_i be the length and the next hop of a routing prefix p_i, respectively, and $p_i(x,y)$ represent the bit pattern from the xth bit to the yth bit in p_i. Table I shows an example of routing prefixes of the 192.168 segment, where entry 0 is the default prefix. Due to the maximum length $l_5 = 32$, the segment requires $2^{(32-16)}$ NHA entries if using Huang's algorithm. In this letter, the proposed *priority TCAM IP-routing lookup scheme* partitions the routing entries at prefix length equal to 24 and processes those routing entries greater than 24 by a TCAM technique, which will be discussed later. Fig. 1 shows the block diagram of the proposed priority TCAM IP-routing lookup scheme. The *compact IP-routing lookup* block is designed to process the IP-routing entries with $l_i \leq 24$. The *priority TCAM* block is designed to process the IP-routing entries $l_i > 24$. Therefore, at most $2^{(24-16)}$ NHA entries are required for the compact Ip-routing lookup. For entries entries 1 to 3 in Table I, the 24th bit of routing prefixes can be ignored, and NHA entries can be further reduced to $2^{(24-16-1)}$. Moreover, by further examining the pattern $p_i(17,24)$ (except the default prefix) with $l_i \leq 24$, the 17th, 19th, 21st, and 22nd bits are the same. This means that only a 3-bit (the 18th, 20th and 23rd bits) pattern with 2^3 NHA entries is needed to record. Notice that the more common bits there are, the fewer NHA entries will be. If both the compact IP-routing lookup block and the priority TCAM block match the incoming destination IP address, the *selector* block chooses the priority TCAM due to its longer prefix length.