High Speed Route Lookup for Variable-Length IP Address

Wanli Zhang, Xiangyang Gong, Ye Tian, Jifan Tang

Beijing University of Posts and Telecommunications
Background

IP addresses are facing more and more problems
- Address exhaustion
- Low packet efficiency
- Low flexibility

Why?
- Fixed-length design
New IP

- Variable-length and structured addresses
- Address space smoothly expands

1.2.3.4.5
New IP Communication

- Short address
- Long address
Contribution 1

Analogy with IPv4

- Large address space:
  - $2^{32} \approx 4 \times 10^9$

- Small routing table:
  - $9 \times 10^5$

Active BGP entries (FIB)

Plot Range: 30-Jun-1988 1430 to 09-Oct-2020 0109
Contribution 1

New IP Address
- Structured design
- Assign IP based on geographic location

New IP can aggregate better
- BCAMs: Map each segment of New IP to a shorter segment
- TCAMs: Longest prefix matching
Contribution 2

Contribution 1
- TCAM width should be more than the longest address length
- Waste TCAM storage space

- Most addresses are much shorter than the longest address
- Long address shortening method
- Reduce TCAM storage space consumption
Long Address Shorten

- TCAM1: Stores short addresses
- TCAM2: Stores long addresses
Long Address Shorten

Short addresses lookup
- Only TCAM1

Long addresses lookup
- TCAM1 and TCAM2
Evaluation

Lookup latency

- BCAM+TCAM: Two clock cycles
- Pipeline: One clock cycle

TCAM storage space consumption

- Random 1 million New IP address
- TCAM width for IPv6 : Always 128

- The router can choose appropriate TCAM width based on the size of its routing table.