

**A Ternary Unification Framework for Optimizing Tcam-Based Packet Classification Systems**

**Abstract:**

Packet classification is the key mechanism for enabling many networking and security services. Ternary Content Addressable Memory (TCAM) has been the industrial standard for implementing high-speed packet classification because of its constant classification time. However, TCAM chips have small capacity, high power consumption, high heat generation, and large area size. This paper focuses on the TCAMbased Classifier Compression problem: given a classifier *C*, we want to construct the smallest possible list of TCAM entries *T* that implement *C*. In this paper, we propose the Ternary Unification Framework (TUF) for this compression problem and three concrete compression algorithms within this framework. The framework allows us to find more optimization opportunities and design new TCAM-based classifier compression algorithms. Our experimental results show that the TUF can speed up the prior algorithm TCAM Razor by twenty times or more and leads to new algorithms that improve compression performance over prior algorithms by an average of 13.7% on our largest real life classifiers.

**Existing System:**

The high speed that TCAM offers for packet classification does not come for free. First, a TCAM chip consumes a large amount of power and generates lots of heat. This is because every occupied TCAM entry is tested on every query. The power consumption of a TCAM chip is about 1.85 Watts per Mb [3], which is roughly 30 times larger than an SRAM chip of the same size. Second, TCAM chips have *large die area* on line cards - 6 times (or more) board space than an equivalent capacity SRAM chip. Area efficiency is a critical issue for networking devices. Third, TCAMs are *expensive* - often costing more than network processors. This high price is mainly due to the large die area, not their market size.

Finally, TCAM chips have small capacities. Currently, the largest TCAM chip has 72 megabits (Mb). TCAM chip size has been slow to grow due to their

extremely high circuit density. The TCAM industry has not been able to follow Moore’s law in the past, and it is unlikely to do so in the future. In practice, smaller TCAM chips are commonly used due to lower power consumption, heat generation, board space, and cost. For example, TCAM chips are often restricted to at most 10% of an entire board’s power budget; thus, even a 36 Mb TCAM may not be deployable on many routers due to power consumption reasons.

**Proposed System:**

In this paper, we propose the Ternary Unification Framework (TUF) for TCAM classifier compression, which consists of three basic steps. First, TUF converts the given classifier to its BDD representation. Second, TUF collapses the BDD, converting leaves into sets of equivalent ternary data structures and combining these at internal nodes to produce a set of ternary data structures that represent the classifier.

Finally, TUF converts the ternary data structures to TCAM rules and chooses the smallest as the final result. Broadly, the two decisions that define a specific TUF algorithm are (1) the ternary data structure to represent the intermediate classifiers and (2) the procedure to combine intermediate classifiers. TUF advances the state of the art on TCAM classifier compression from two perspectives.

First, it is a general framework, encompassing prior tree based classifier compression algorithms as special cases. Because of the structure that TUF imposes on tree based classifier compression algorithms, it allows us to understand them better and to easily identify optimization opportunities missed by those algorithms. Second, this framework provides a fresh look at the TCAM classifier compression problem and allows us to design new algorithms along this direction.