Access Control List (ACL) Hardware TCAM Resource Allocation Guidelines - Official Technical Overview & Hardware Datasheet

EXECUTIVE SUMMARY

This document provides comprehensive technical guidelines for the allocation and management of Ternary Content-Addressable Memory (TCAM) resources used by Access Control Lists (ACLs) within enterprise and carrier-grade switching and routing platforms. As networks scale and security policies become increasingly granular, the efficient utilization of finite TCAM hardware resources becomes critical to maintaining line-rate forwarding performance. This datasheet outlines the architectural principles, allocation methodologies, and hardware-level considerations necessary for optimal ACL deployment across high-density, non-blocking switching fabrics.



HARDWARE ARCHITECTURE & SILICON

TCAM is a specialized type of high-speed memory used in network switching ASICs to perform parallel pattern-matching operations. Unlike standard RAM, which returns data stored at a specific address, TCAM searches its entire memory space in a single clock cycle and returns the address of the first matching entry. This architectural characteristic makes TCAM ideal for implementing ACLs, policy-based routing (PBR), and Quality of Service (QoS) classification. Each TCAM entry stores a key (the matching pattern) and a mask (which bits to compare), along with an associated action or result. The hardware ASIC pipelines these lookups at wire speed, ensuring that enabling complex ACLs does not degrade forwarding performance, provided sufficient TCAM resources are available. The total TCAM capacity is typically measured in entries or bits and is partitioned per ASIC or per pipeline stage.

KEY FEATURES & ROUTING LOGIC

- Parallel Lookup Engine: Executes ACL, PBR, and QoS lookups simultaneously across multiple TCAM banks, ensuring deterministic low-latency forwarding.
- Flexible Entry Allocation: Supports configurable carve-outs for IPv4, IPv6, MAC, and MPLS ACLs, allowing administrators to balance resources based on deployment needs.

- Hierarchical ACL Support: Enables multi-level ACL processing, where an outer ACL can direct traffic to an inner ACL for deeper inspection.
- Hit-Count Monitoring: Provides per-entry hit counters via hardware registers, enabling real-time audit and optimization of TCAM utilization.
- Atomic Updates: Allows rule insertion and deletion without disrupting traffic, using hardware-assisted table management.

COMPLIANCE & STANDARDS

This platform complies with relevant IEEE and IETF standards for packet classification and forwarding. TCAM resource management aligns with the following:

- IEEE 802.1Q for VLAN-based ACLs.
- IEEE 802.1X for port-based access control.
- IETF RFC 2474 for Differentiated Services (DiffServ) classification.
- IETF RFC 4594 for configuration guidelines for DiffServ service classes.
- MEF 10.3 for Carrier Ethernet QoS and policy enforcement.

TECHNICAL SPECIFICATIONS

The following table summarizes the key hardware and operational parameters for TCAM resource allocation.

Parameter	Specification
Form Factor	1RU Fixed / Modular Chassis
TCAM Total Capacity	16K - 64K entries per ASIC (varies by platform)
IPv4 ACL Entries	Up to 16K entries (shared)
IPv6 ACL Entries	Up to 8K entries (shared)
MAC ACL Entries	Up to 4K entries
MPLS ACL Entries	Up to 2K entries
Lookup Latency	< 300 ns (wire speed)
Power Supply	Dual Hot-Swappable Redundant AC/DC
Management Interface	1x RJ45 Console, 1x 10/100/1000 Mgmt
Operating Temperature	0°C to 45°C (32°F to 113°F)

ORDERING SKU INFORMATION

- ACL-TCAM-ENT: Enterprise ACL TCAM License, enables advanced IPv6 ACL and PBR features.

- ACL-TCAM-CAR: Carrier-Grade ACL TCAM License, includes MPLS and

hierarchical ACL support.

- MEM-UPG-TCAM: TCAM memory expansion module for modular chassis platforms.

