Merchant Silicon vs Custom ASIC Switches - Official Technical Overview & Hardware Datasheet

EXECUTIVE SUMMARY

This document provides a comprehensive technical evaluation of two distinct forwarding engine architectures dominating modern carrier and datacenter network infrastructure: Merchant Silicon (Commercial off-the-shelf switching chips) versus Custom Application-Specific Integrated Circuits (ASICs). Network architects, procurement engineers, and CTOs must understand the trade-offs between time-to-market, power efficiency, feature flexibility, and total cost of ownership (TCO). This datasheet delivers a hardware-level comparison, forwarding engine behavioral analysis, and deployment-specific recommendations.



HARDWARE ARCHITECTURE & SILICON

Merchant Silicon Switches leverage standardized switching chipsets from third-party silicon vendors (e.g., industry-available pipeline engines). These devices utilize fixed-function or partially programmable packet processors, commodity memory subsystems, and generic SerDes interfaces. Custom ASIC Switches are purpose-built by networking vendors, incorporating proprietary forwarding pipelines, on-chip buffering algorithms, and application-optimized traffic managers. The fundamental distinction lies in control over instruction sets: merchant silicon offers rapid procurement cycles (6–12 months to market), while custom ASICs require 24 – 36 months of development but enable differentiated telemetry, custom encapsulation, and ultra-low deterministic latency.

KEY FEATURES & ROUTING LOGIC

- Feature Velocity: Merchant silicon supports standard IETF/IEEE protocols at chip availability. Custom ASICs allow in-house extensions (e.g., segment routing over IPv6 (SRv6) with custom TLVs, in-band network telemetry (INT) beyond P4 limitations).
- Power Efficiency: Custom ASICs typically achieve 30 – 50% lower watts per gigabit due to elimination of unused logic gates and optimized floorplanning.

Merchant silicon consumes more power per port but benefits from process node scaling across high volumes.

- Buffer Architecture: Merchant silicon uses shared, static buffer pools (typically 4–32 MB per chip). Custom ASICs can implement hierarchical buffer allocation, dynamic packet prioritization, and congestion-aware thresholds tuned for specific queue depths (e.g., 500ns cut-through).

- Forwarding Determinism: Custom ASICs guarantee sub-microsecond latency variance (± 5%) under full line-rate load. Merchant silicon exhibits higher variance (±20%) due to arbitration cycles in crossbar fabrics.

- Programmability: Merchant silicon increasingly includes P4-programmable pipelines (e.g., Tofino-class). Custom ASICs offer full RTL-level control enabling proprietary encapsulations, crypto offload (MACsec/IPsec), and in-line telemetry.

COMPLIANCE & STANDARDS

Both architectures conform to mandatory carrier and enterprise interoperability standards. Merchant silicon devices are certified for IEEE 802.1Q bridging, 802.3ae (10GE), 802.3bs (200GE/400GE), ITU-T G.8032 Ethernet Ring Protection, and MEF 3.0 Carrier Ethernet. Custom ASIC switches extend compliance with vendor-specific validation for OpenConfig YANG models, gNMI telemetry, and proprietary link-layer encryption (e.g., Layer 1 AES-256). All listed hardware

SKUs meet NEBS Level 3, ETSI EN 300 019, and FCC Part 15 Class A emissions.

TECHNICAL SPECIFICATIONS

Parameter	**Merchant Silicon Specification**	**Custom ASIC Specification**
Forwarding Engine Type	Fixed-function or P4-programmable (limited pipeline stages)	Full RTL-custom programmable (unlimited depth)
Typical Switching Capacity	1.2 Tbps – 12.8 Tbps per device	6.4 Tbps – 204.8 Tbps per chassis
Latency (64-byte frame)	450ns – 1.2µs (cut-through)	350ns – 600ns (deterministic cut-through)
On-chip Buffer per ASIC	16 MB – 64 MB shared	64 MB – 512 MB hierarchical
Power Consumption (per 100GE)	3.5W – 5.0W	1.8W – 2.5W
Time-to-Market (new SKU)	6 – 12 months	24 – 36 months
Minimum Order Quantity (MOQ)	1 unit (off-the-shelf)	10 units (engineering NRE applies)

Typical Deployment TCO (3-year)	Baseline (1.0x)	0.65x – 0.80x (higher density, lower power)

ORDERING SKU INFORMATION

SKU Prefix: MS-7000 (Merchant Silicon Series) – Fixed-configuration 1RU/2RU platforms supporting 48x25GE + 8x100GE uplinks. Typical switching capacity: 2.0 Tbps to 12.8 Tbps.

SKU Prefix: CAS-9000 (Custom ASIC Series) – Modular chassis (3RU to 21RU) supporting 144x400GE line cards. Typical switching capacity: 25.6 Tbps to 204.8 Tbps. Requires advanced feature licenses for custom telemetry pipelines.

All SKUs include dual hot-swappable AC/DC power supplies, N+1 fan redundancy, and lifetime hardware warranty with advanced replacement (NBD). Custom ASIC SKUs include on-site engineering support for pipeline microcode updates.

