Data Center ToR Switch Architecture Design - Official Technical Overview & Hardware Datasheet

EXECUTIVE SUMMARY

This document serves as the official technical datasheet and architectural reference for the Next-Generation Data Center Top-of-Rack (ToR) Switch Architecture. Designed to address the exponential growth in East-West traffic, artificial intelligence (AI) / machine learning (ML) workloads, and the stringent requirements of software-defined networking (SDN), this platform redefines the standard for access layer switching. The architecture delivers a sophisticated balance of high-density 400G/800G Ethernet ports, deep packet buffers, and ultra-low latency, all while maintaining the operational efficiency critical for large-scale cloud and enterprise data centers. This document details the hardware specifications, architectural innovations, and performance benchmarks that solidify this platform as the premier choice for modern data center fabrics.

ARCHITECTURE & CHASSIS DESIGN

The platform employs a fixed-form-factor 1RU (Rack Unit) chassis designed for high-density deployments. The mechanical design prioritizes front-to-back airflow to optimize thermal efficiency within cold-aisle/hot-aisle containment strategies. The chassis is constructed from high-strength, lightweight aluminum with a precision-machined steel chassis frame for EMC (Electromagnetic Compatibility) shielding and structural integrity.

Central to the architecture is a fully non-blocking, cell-based Clos switching fabric. This fabric is realized through a system of high-performance merchant-silicon ASICs, providing a switching capacity of up to 25.6 Tbps. The design incorporates a sophisticated shared packet buffer architecture that dynamically allocates memory across all ports, effectively mitigating

micro-burst congestion. A primary control plane is managed by a high-performance x86 CPU complex running a carrier-grade network operating system (NOS), enabling advanced telemetry and robust management interfaces.

HARDWARE FEATURES

Port Configuration: The system supports a flexible port configuration model, accommodating up to 32 x 400G QSFP-DD (Quad Small Form-Factor Pluggable Double Density) ports, or 64 x 200G, or 128 x 100G/50G/25G/10G via breakout cables. This flexibility ensures seamless migration from legacy 10G/25G server infrastructure to next-generation 400G compute and storage nodes.

Power and Cooling: The chassis is equipped with dual, hot-swappable, redundant power supplies (1+1) supporting both AC and DC power inputs. Cooling is provided by N+1 redundant, hot-swappable fan modules with variable-speed fans that automatically adjust to ambient temperature and system load, ensuring optimal energy efficiency.

Management and Timing: Management ports include a dedicated 1Gbe out-of-band management port, a console port (RJ45 and USB), and a USB storage port for software upgrades and log collection. The platform features an

integrated high-precision IEEE 1588v2 (PTP) and SyncE timing engine, critical for 5G and financial trading environments.

COMPLIANCE & STANDARDS

The Data Center ToR Switch Architecture is designed and tested to meet the rigorous demands of global telecommunications and enterprise standards. It adheres to the following specifications:

Network Standards: IEEE 802.3 (Ethernet), IEEE 802.1Q (VLAN), IEEE 802.1p (CoS), IEEE 802.1D (STP), IEEE 802.1w (RSTP), IEEE 802.1s (MSTP).

Data Center Standards: RoCEv2 (RDMA over Converged Ethernet) for lossless networking, Data Center Bridging (DCB) protocols including Priority Flow Control (PFC) and Enhanced Transmission Selection (ETS).

Security & Environmental: FCC Part 15 (Class A), CE (EN 55022, EN 55024), VCCI Class A, AS/NZS CISPR 22. The hardware is RoHS (Restriction of Hazardous Substances) compliant and WEEE (Waste Electrical and Electronic Equipment) compliant.

Parameter	**Specification**

Form Factor	1RU Fixed Chassis (19-inch rack mountable)
Switching Capacity	25.6 Tbps (Full-Duplex, Non-Blocking)
Power Supply	1+1 Redundant AC/DC, Hot-Swappable (up to 2 x 2000W)
Cooling	N+1 Redundant Fan Tray, Front-to-Back Airflow
Management Ports	1 x 1Gbe (RJ45), 1 x Console (RJ45), 1 x USB 2.0 Type-A
Typical Power Consumption	850W (with 32 x 400G SR8 optics)
Operating Temperature	0°C to 45°C (Short-term up to 55°C)
Weight	~9.5 kg (19 lbs) with PSUs and Fan Trays

ORDERING OPTIONS

The platform is available in a variety of pre-configured and customizable bundles to suit diverse deployment scenarios. The ordering model is designed to streamline procurement, ensuring that the correct hardware, software licenses, and accessories are specified for the project.

Base Systems: The base SKU includes the 1RU chassis, motherboard, and system firmware. Options are available for 400G QSFP-DD and 100G QSFP28 port configurations.

Power Accessories: Customers can select between AC (PWR-AC-2KW) and DC (PWR-DC-2KW) power supply modules. The chassis requires two modules for 1+1 redundancy.

Transceiver and Cable Kits: A comprehensive range of OEM-qualified optics and cables is available, including 400G SR8/DR4/FR4, 100G SR4/LR4, and AOC (Active Optical Cables) and DAC (Direct Attach Copper) cables of various lengths.

Software Licensing: Advanced software features are activated through a flexible licensing model. This includes the base Operating System (OS), SDN Agent licenses for integration with controllers, and Network Insights licenses for advanced telemetry and monitoring.

Please consult your account representative to configure a solution optimized for your specific network topology, power density, and throughput requirements.