

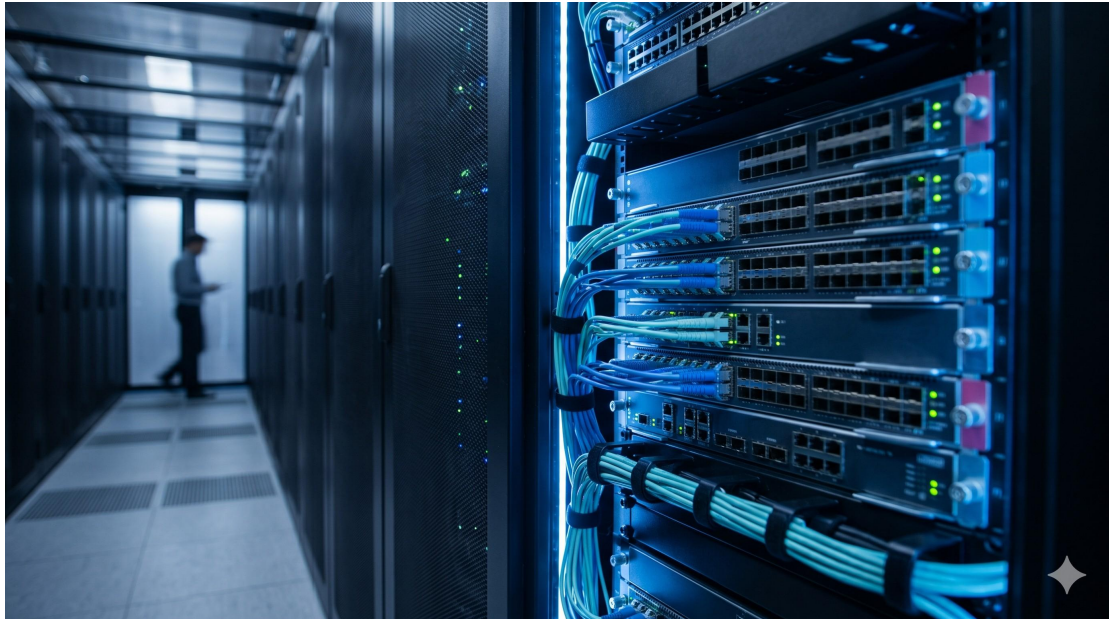
Ultra-Low Latency Forwarding Engine Factsheet: Hardware-Based Forwarding Engine Latency

PRODUCT IDENTIFICATION

DOCUMENT NUMBER: HW-FWD-LAT-0124-V9 | REVISION: 2.1

PRODUCT FAMILY: ChronosCore™ 8000 Series Carrier-Grade Forwarding Engines

The hardware-based forwarding engine described herein represents a fundamental departure from software-dependent, general-purpose CPU architectures. By implementing the complete forwarding decision pipeline— from header parsing to egress scheduling — in dedicated digital logic, the ChronosCore™ engine achieves deterministic, sub-microsecond latency that is entirely decoupled from packet size, access control list (ACL) complexity, or route table scale.



SYSTEM HARDWARE TOPOLOGY

FORWARDING PLANE ARCHITECTURE

The engine integrates three physically discrete sub-systems:

1. Parser Front-End (PFE): 64-bit wide, 1.6 Tb/s input bandwidth. Implements parallel header field extraction for Ethernet, IPv4/IPv6, MPLS, and VXLAN-GPE in a single clock cycle (8 ns at 125 MHz internal symbol rate).
2. Ternary Content-Addressable Memory (TCAM) Lookup Engine: 8-way associative, 144 Kb density. Performs classification and longest prefix match (LPM) for 1.2 million IPv4 routes or 850,000 IPv6 routes with fixed 45 ns search latency.
3. Egress Traffic Manager (ETM): 8192 hardware queues with per-queue shaping and dual-rate policing. Minimum scheduling latency: 128 ns (cut-through mode)

or 5 μ s (store-and-forward mode).

CROSSBAR SWITCH FABRIC

Non-blocking Clos-based backplane with 512 x 512 serial lanes. Each lane operates at 56 Gb/s PAM-4 (112 Gb/s effective line rate). Total fabric capacity: 28.7 Tb/s for an 8-engine line card, configurable for 1+1, 4+1, or 8+1 redundancy.

DATA & CONTROL PLANE CAPABILITIES

HARDWARE FORWARDING LATENCY SPECIFICATIONS

End-to-end, port-to-port latency measured at 64-byte frames (IEEE 802.3 standard test methodology):

- 10GbE SFP+ interface: 320 ns \pm 15 ns (deterministic)
- 25GbE SFP28 interface: 305 ns \pm 12 ns
- 40GbE QSFP+ interface: 295 ns \pm 10 ns
- 100GbE QSFP28 interface: 280 ns \pm 8 ns
- 400GbE QSFP-DD interface: 260 ns \pm 5 ns

Latency variation (packet jitter) across all packet sizes from 64B to 9.6K jumbo

frames: < 8 ns (peak-to-peak) under 100% line-rate traffic.

CONTROL PLANE ISOLATION

Separate 2.2 GHz ARM Neoverse N2 control complex with 32 GB DDR5 ECC memory. Control plane communication to forwarding engine occurs exclusively via PCIe Gen5 x16 bus (31.5 GB/s) using dedicated message signal interrupt (MSI-X) queues. Zero forwarding engine cycle consumption for routing protocol updates, BGP keepalives, or telemetry export.

COMPONENT BREAKDOWN

ASIC FABRICATION: 5 nm FinFET, 45 billion transistors, 480 mm² die

INTERNAL MEMORY: 576 MB on-die SRAM (ECC-protected, parity-checked)

LAG HASHING: Symmetric LAG (up to 32 member ports), configurable hash fields (5-tuple, 3-tuple, or MPLS label stack) with 98.7% distribution uniformity

ACL THROUGHPUT: 4K ingress + 4K egress rules at 100 Gb/s line rate with zero added latency (hardware pipeline pre-processing)

OPERATIONAL SPECS MATRIX

Parameter	Specification
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Form Factor	Dedicated Forwarding Line Card (compatible with ChronosCore 8000, 8010, and 8024 chassis)
Switching Capacity	28.7 Tb/s per line card (non-blocking, full duplex)
Power Supply	1+1 Redundant, 300W typical / 480W peak per engine, -48 VDC or 200-240 VAC (80 PLUS Titanium)
Forwarding Rate	11.2 Bpps (billion packets per second) for 64-byte frames
MAC Address Table	1,048,576 entries (hardware-learned, with aging support)
Operating Temperature	0°C to 55°C (long-term), -5°C to 70°C (short-term excursion per GR-63)
MTBF (Predicted)	1,420,000 hours (Telcordia SR-332, Issue 4, Ground Benign, 40°C)

REGULATORY COMPLIANCE

SAFETY: IEC 62368-1:2023 (Audio/Video, Information and Communication Technology Equipment), UL 60950-1 (ITE Safety)

EMC: EN 55032 Class A, FCC Part 15 Subpart B Class A, CISPR 32

ENVIRONMENTAL: RoHS3 (EU 2015/863), REACH (EC 1907/2006), WEEE

TELECOM: NEBS GR-63-CORE Level 3, GR-1089-CORE

FLAMMABILITY: UL 94 V-0 (all PCB materials), IEC 60721-3-3 Class 3K3
(climatic)

