Hardware-Accelerated NAT64 Translation Framework for Pure IPv6 Cores - Official Technical Overview & Hardware Datasheet

EXECUTIVE SUMMARY

The Hardware-Accelerated NAT64 Translation Framework for Pure IPv6 Cores represents a paradigm shift in carrier-grade network infrastructure, delivering line-rate IPv6-to-IPv4 protocol translation entirely within dedicated silicon. As service providers and large enterprises accelerate their transition to pure IPv6 core architectures, the critical challenge of maintaining seamless interoperability with legacy IPv4 endpoints must be solved without compromising throughput, latency, or operational simplicity. This platform addresses that challenge head-on by embedding the NAT64 translation function directly into the forwarding ASIC, eliminating the performance penalties and CPU bottlenecks associated with software-based translation solutions. The result is a purpose-built hardware appliance that enables true pure IPv6 core deployment while preserving ubiquitous reachability to the global IPv4 internet and private IPv4 resources.



HARDWARE ARCHITECTURE & SILICON

At the heart of the Hardware-Accelerated NAT64 Translation Framework lies a custom-designed, multi-stage packet processing pipeline implemented in advanced 7nm silicon. The architecture is built around a dedicated Translation Forwarding Engine (TFE) that operates in parallel with the main switching fabric, ensuring that NAT64 operations never contend with standard Layer 3 forwarding resources. The TFE maintains a high-capacity stateful translation table in on-chip TCAM and high-bandwidth HBM memory, supporting millions of concurrent translation sessions at wire speed. The pipeline consists of four distinct stages: ingress parsing and IPv6 header validation, stateful translation lookup and address/port mapping, IPv4 header construction and checksum offload, and egress scheduling with strict QoS enforcement. Each stage is fully pipelined and non-blocking, enabling deterministic latency of under 2.5

microseconds for the complete translation process. The platform supports both stateless NAT64 (RFC 6145) and stateful NAT64 (RFC 6146) modes, with hardware-accelerated fragmentation handling and ICMPv6-to-ICMPv4 error translation. The silicon also integrates a dedicated Security Engine that performs hardware-based MACsec encryption and IPsec offload, ensuring that translated traffic maintains end-to-end confidentiality and integrity without additional processing overhead.

KEY FEATURES & ROUTING LOGIC

- Hardware-Accelerated Translation: Full NAT64 function offloaded to dedicated ASIC, delivering 3.2 Tbps of translation throughput with zero CPU intervention.
- Stateful Session Management: On-chip translation table supports up to 16 million concurrent sessions with hardware-based aging and refresh mechanisms.
- Deterministic Low Latency: Sub-2.5 microsecond translation latency ensures compliance with stringent SLA requirements for voice, video, and real-time applications.
- Dual-Stack Fallback: Intelligent routing logic automatically detects native IPv4 paths and bypasses translation when available, optimizing resource utilization.
- Fragmentation Handling: Hardware-accelerated IPv6-to-IPv4 and IPv4-to-IPv6 fragmentation and reassembly, including support for jumbo frames up to 9216

bytes.

- ICMP Translation: Comprehensive ICMPv6-to-ICMPv4 and ICMPv4-to-ICMPv6 error message translation with stateful tracking.

- High Availability: 1:1 active-standby and N:1 active-active redundancy models with sub-second failover and stateful session synchronization.

- Integrated Security: Hardware MACsec (802.1AE) and IPsec offload for translated traffic, with no performance degradation.

- Comprehensive Telemetry: Streaming telemetry and sFlow support for per-session translation statistics, latency histograms, and drop counters.

- Programmability: P4-compatible pipeline for custom translation logic and future protocol extensions.

COMPLIANCE & STANDARDS

The Hardware-Accelerated NAT64 Translation Framework is designed to meet the most demanding carrier and enterprise compliance requirements. The platform fully conforms to IETF RFC 6144 (Framework for IPv4/IPv6 Translation), RFC 6145 (IP/ICMP Translation Algorithm), RFC 6146 (Stateful NAT64), RFC 6052 (IPv6 Addressing of IPv4/IPv6 Translators), and RFC 7757 (Explicit Address Mappings). Additional compliance includes RFC 8200 (IPv6 Specification), RFC 791 (IPv4 Specification), RFC 2474 (Differentiated Services), and RFC 4594 (Configuration Guidelines for DiffServ Service Classes). The hardware is certified

to NEBS Level 3 (GR-1089-CORE, GR-63-CORE) and meets ETSI EN 300 019 environmental standards. Safety certifications include UL 60950-1, IEC 60950-1, and EN 60950-1. EMC compliance includes FCC Part 15 Class A, EN 55022 Class A, and VCCI Class A. The platform also supports MEF CE 2.0 certification for Carrier Ethernet services and is compliant with ITU-T Y.1731 for OAM performance monitoring.

TECHNICAL SPECIFICATIONS

The following table summarizes the key technical parameters of the Hardware-Accelerated NAT64 Translation Framework for Pure IPv6 Cores. All specifications are subject to change without notice and represent typical values under nominal operating conditions.

Parameter	Specification
Form Factor	1RU Standard Rackmount (19-inch EIA)
Switching Capacity	3.2 Tbps (full-duplex)
NAT64 Translation Throughput	3.2 Tbps line-rate, zero CPU intervention
Translation Latency	< 2.5 microseconds (typical, port-to-port)

Concurrent Translation Sessions	16 million (stateful), 64 million (stateless)
Translation Table Memory	On-chip TCAM + 32 GB HBM
IPv6 Forwarding Throughput	3.2 Tbps (native, no translation)
IPv4 Forwarding Throughput	1.6 Tbps (native, no translation)
Packet Buffer	128 MB shared across all ports
Interface Options	16 x 100GbE QSFP28, 4 x 400GbE QSFP-DD, 48 x 25GbE SFP28
Power Supply	Dual Hot-Swappable Redundant AC/DC (100-240V AC, -48V DC)
Power Consumption	Typical 850W, Maximum 1200W
Airflow	Front-to-Back or Back-to-Front (field-replaceable fan trays)
Operating Temperature	0°C to 45°C (32°F to 113°F)
Storage Temperature	-40°C to 70°C (-40°F to 158°F)
Humidity	5% to 95% non-condensing
Dimensions (H x W x D)	1.75 x 17.5 x 30 inches (44.5 x 444.5 x 762 mm)
Weight	32 lbs (14.5 kg) with single power supply
Redundancy	1:1 active-standby, N:1 active-active, sub-second failover

Management	CLI, NETCONF/YANG, RESTCONF, SNMPv3, gRPC Streaming Telemetry
Security	Hardware MACsec (802.1AE), IPsec offload, TACACS+, RADIUS, SSHv2
Compliance	NEBS Level 3, MEF CE 2.0, RFC 6144/6145/6146/6052/7757

ORDERING SKU INFORMATION

Customers may order the Hardware-Accelerated NAT64 Translation Framework in multiple configurations to suit specific deployment scales and redundancy requirements. The base system includes the 1RU chassis, dual redundant AC power supplies, and a single 16-port 100GbE line card. Optional expansion modules include additional 100GbE line cards, 400GbE line cards, and a dedicated service module for enhanced stateful translation capacity. All systems ship with the latest firmware image and a comprehensive documentation package. Please contact your authorized sales representative for detailed pricing, lead times, and custom configuration options.


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