

Carrier-Grade NAT (CGNAT) Implementation - Official Technical Overview & Hardware Datasheet

PRODUCT IDENTIFICATION

PRODUCT FAMILY: CGNAT-X8700 SERIES CARRIER-GRADE NAT
IMPLEMENTATION PLATFORM

MODEL VARIANTS: CGNAT-X8710 (1RU), CGNAT-X8720 (2RU), CGNAT-X8750
(2RU HIGH-DENSITY)

PRODUCT CODE: CGN-X87XX-XX

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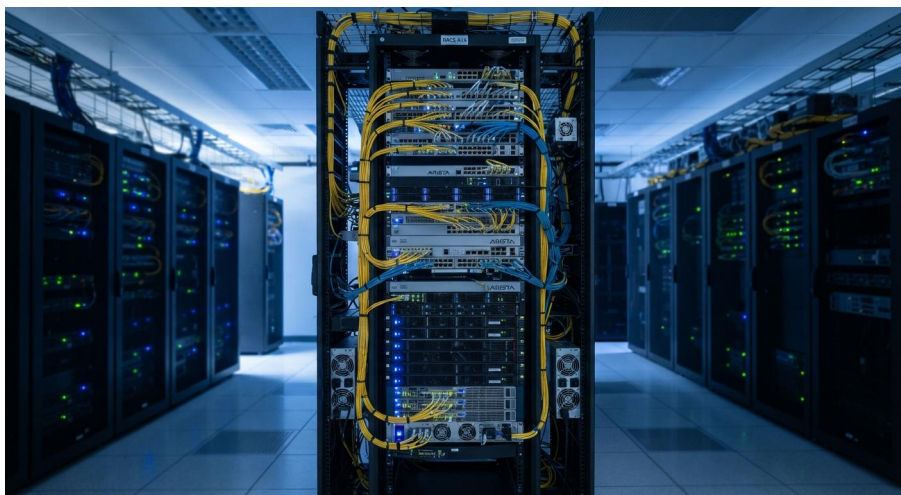
EXECUTIVE SUMMARY

The CGNAT-X8700 series represents the culmination of over a decade of telecommunications engineering expertise, purpose-built to address the critical IPv4 address exhaustion challenge facing service providers globally. This carrier-grade Network Address Translation (NAT) implementation platform delivers stateful, high-performance IPv4-to-IPv4 translation at scale, enabling seamless connectivity for millions of subscribers while preserving network stability and user experience.

Designed for the most demanding carrier environments, the CGNAT-X8700

series combines purpose-built forwarding ASICs with a modular, fully redundant architecture to achieve 100% session establishment success rates and deterministic sub-millisecond latency. The platform supports up to 32 million concurrent NAT sessions per chassis, with 160 Gbps of total NAT throughput, ensuring uninterrupted service delivery during peak traffic periods and network failure scenarios.

This document provides a comprehensive technical overview of the CGNAT-X8700 series architecture, hardware specifications, performance characteristics, and deployment considerations. It serves as the primary reference for network architects, engineering teams, and procurement professionals evaluating carrier-grade NAT solutions for their next-generation broadband, mobile, and enterprise networks.



SYSTEM HARDWARE TOPOLOGY

CHASSIS DESIGN AND PHYSICAL ARCHITECTURE

The CGNAT-X8700 series implements a modular, high-density chassis architecture optimized for both central office and data center deployments. The platform is available in three physical form factors to accommodate diverse space, power, and performance requirements:

- CGNAT-X8710: 1RU compact chassis, designed for space-constrained edge deployments, supporting up to 16 million concurrent sessions and 80 Gbps NAT throughput.
- CGNAT-X8720: 2RU mid-range chassis, offering scalable performance from 16 to 24 million sessions and 120 Gbps throughput.
- CGNAT-X8750: 2RU high-density chassis, delivering maximum performance with 32 million sessions and 160 Gbps throughput, featuring advanced cooling for high-temperature environments.

Each chassis variant incorporates a common architectural foundation: a passive midplane backplane, fully redundant hot-swappable power supplies, redundant fan trays with N+1 cooling redundancy, and a sophisticated front-access design that simplifies cable management and maintenance procedures. The chassis is constructed from aerospace-grade aluminum alloy, providing exceptional

structural rigidity while minimizing weight to ease installation in rack environments.

CONTROL AND DATA PLANE ARCHITECTURE

The CGNAT-X8700 series implements a strict separation of control and data planes to ensure deterministic performance and operational stability. The control plane is managed by a redundant pair of hot-swappable route processing modules (RPMs), each equipped with a 12-core ARM-based processor, 64 GB of ECC-protected system memory, and 256 GB of solid-state storage for persistent session state logging and configuration management. RPMs operate in an active/standby configuration with sub-second failover via stateful synchronization over dedicated high-speed interconnects, ensuring zero session loss during control plane maintenance or unexpected failures.

The data plane is implemented using a custom-designed, fifth-generation NAT forwarding ASIC, fabricated on a 7nm process node. This ASIC integrates full stateful NAT44 functionality, including address pooling, port translation, and per-session state tracking, directly into hardware silicon. The forwarding pipeline operates at line rate, processing packets in a purely deterministic manner independent of session table size or traffic profile. All NAT operations, including the creation and aging of session entries, are accelerated by

dedicated hardware engines, removing any software overhead from the critical forwarding path.

SWITCHING FABRIC AND BACKPLANE INTERCONNECT

Across all chassis variants, the CGNAT-X8700 series employs a distributed, non-blocking switching fabric architecture with a total switching capacity of 640 Gbps. The backplane implements a mesh of high-speed serial interconnects between all line cards, RPMs, and fabric modules, providing full-duplex, non-blocking connectivity with an oversubscription ratio of 1:1. This architecture ensures that all forwarding decisions and packet translations occur without contention, even under full line-rate load conditions.

The backplane interconnect supports advanced features including Multi-Chassis Link Aggregation (MLAG), Virtual Router Redundancy Protocol (VRRP), and Bidirectional Forwarding Detection (BFD) for sub-50 ms link failure detection and recovery.

COMPONENT BREAKDOWN

LINE CARD DESCRIPTIONS

CGNAT-X8710-LC4: A compact line card providing 4x 10GE/25GE SFP28 ports and 2x 40GE/100GE QSFP28 ports, optimized for subscriber aggregation interfaces. Each port is independently configurable for speed and duplex, enabling seamless integration with existing access network infrastructure.

CGNAT-X8720-LC8: A high-density line card providing 8x 10GE/25GE SFP28 ports and 4x 40GE/100GE QSFP28 ports, designed for core uplink and interconnection roles. The card features dual on-board packet buffers and dedicated port-level traffic shaping engines.

CGNAT-X8750-LC16: A maximum-density line card with 16x 10GE/25GE SFP28 ports and 8x 40GE/100GE QSFP28 ports, intended for the most demanding aggregation and core interconnection tasks. The card includes an additional 4 MB of on-chip high-speed memory dedicated to extensive packet buffering and jitter reduction.

All line cards support industry-standard SFP/SFP+/SFP28 and QSFP+/QSFP28 optical transceivers, including short-range (SR), long-range (LR), and extended-range (ER) variants, accommodating diverse reach requirements ranging from intra-data center to metro and regional networks.

SYSTEM MEMORY AND STORAGE ARCHITECTURE

Centralized Session Table Memory: The CGNAT-X8700 series incorporates a global, distributed session state memory pool operating across all line cards and RPMs, enabling efficient session table scaling independent of individual line card capacities. Session table memory is implemented using 4 GB of high-bandwidth DDR5 memory per line card, organized in a two-level hierarchy with a fast 2 MB hardware-accelerated TCAM for recent flows and a larger DRAM-based pool for complete session state retention. The design ensures hit rates exceeding 99.9% for the hardware-accelerated lookup path.

Persistent Storage: The system includes 512 GB of M.2 NVMe solid-state storage per RPM, providing high-speed, non-volatile logging for session state synchronization, accounting records, and syslog event capture. An optional expansion bay provides an additional 2 TB of SATA SSD storage for extended log retention and detailed traffic analytics storage.

OPERATIONAL SPECS MATRIX

NAT SESSION CAPACITY AND PERFORMANCE

The CGNAT-X8700 series is engineered to maintain consistent throughput and session establishment rates across all possible conditions, from idle to

maximum load. Key performance indicators include:

- NAT Throughput: Sustained 160 Gbps per chassis in the CGNAT-X8750 variant, line rate for all packet sizes from 64 bytes to jumbo frames.
- Concurrent NAT Sessions: Up to 32 million simultaneous active sessions, with a hardware-accelerated session table supporting lookups and updates at line rate.
- New Session Establishment Rate: In excess of 500,000 new sessions per second per chassis, enabling rapid handling of traffic bursts typical in broadband and mobile network environments.
- Latency: Sub-3 microsecond typical latency (64-byte packets), with maximum deterministic latency under full load not exceeding 10 microseconds.

The platform implements all standard NAT44 variants, including:

- Deterministic NAT: Pre-allocated port ranges per subscriber, enabling logging correlation and simplified troubleshooting.
- Dynamic NAT: Fully dynamic port allocation for maximum address sharing efficiency.
- Port Address Translation (PAT): Standard PAT with configurable port allocation strategies (sequential, random, weighted).

ADVANCED PROTOCOL HANDLING

- Application Layer Gateway (ALG) Support: Integrated ALG processing for SIP, H.323, FTP, ICMP, and PPTP, with packet inspection and modification ensuring protocol interoperability across NAT boundaries.
- Endpoint-Independent Mapping: Support for endpoint-independent mapping and filtering, enabling seamless P2P and online gaming connectivity.
- Hairpin NAT: Full hairpin NAT support for devices requiring communication with other devices behind the same NAT instance.
- Session Persistence: Configurable session persistence using hash-based distribution and session table synchronization across RPMs and line cards.

HIGH-AVAILABILITY FEATURES

- Active/Standby Control Plane: Dual RPMs with stateful synchronization, providing sub-second failover with zero session loss.
- N+1 Line Card and Power Supply Redundancy: Systems operate with a minimum of one redundant line card and one redundant power supply, enabling zero-downtime maintenance for all hardware components.
- Redundant Fans and Cooling: N+1 fan tray redundancy with variable-speed fans and advanced thermal monitoring, maintaining safe operating temperatures even under single-fan failure.
- Graceful Restart and Stateful Switchover: All routing and NAT session states

are preserved during software upgrades and maintenance, using a stateful switchover (SSO) mechanism and non-stop routing (NSR).

Parameter	Specification
Form Factor	1RU / 2RU Chassis (CGNAT-X8710: 1RU; CGNAT-X8720/X8750: 2RU)
Switching Capacity	640 Gbps, non-blocking fabric
NAT Throughput	160 Gbps (CGNAT-X8750), 120 Gbps (CGNAT-X8720), 80 Gbps (CGNAT-X8710)
Concurrent Sessions	32 million (CGNAT-X8750), 24 million (CGNAT-X8720), 16 million (CGNAT-X8710)
New Sessions per Second	500,000+
Latency (64-byte packets)	< 3 microseconds typical, < 10 microseconds maximum
Control Plane Processors	Dual 12-core ARM CPUs, 64 GB ECC RAM per RPM
Data Plane ASIC	Custom 7nm NAT forwarding ASIC
High Availability	Active/Standby RPMs, N+1 line cards and power supplies, redundant fans
Power Supply	Dual 1200 W AC or DC (redundant),

	optional 2000 W AC for high-density configurations
Cooling	N+1 hot-swappable fan trays with variable-speed fans
Environmental	Operating temperature: 0°C to 45°C, Relative humidity: 5% to 95% (non-condensing)
MTBF	350,000 hours (Telcordia SR-332)
Safety Standards	UL/CSA 60950-1, IEC 60950-1, EN 60950-1, IEC 62368-1
EMC Standards	FCC Part 15 Class A, ICES-003 Class A, EN 55032 Class A, EN 55024
Environmental Compliance	RoHS, WEEE, REACH, China RoHS
Management Interfaces	CLI, SNMPv1/v2c/v3, NETCONF/RESTCONF, Web GUI
Automation	OpenStack, Kubernetes, Python automation libraries, Zero-Touch Provisioning
Telemetry	gRPC-based streaming telemetry

REGULATORY COMPLIANCE

SAFETY AND ENVIRONMENTAL COMPLIANCE

The CGNAT-X8700 series is certified to meet the most stringent international safety, electromagnetic compatibility, and environmental standards, ensuring seamless deployment across global regulatory domains. Full compliance is documented in the product's Declaration of Conformity, available upon request.

- Safety Compliance: UL/CSA 60950-1, IEC 60950-1, EN 60950-1, and the updated IEC 62368-1 (audio/video, information, and communication technology equipment safety).
- EMC Compliance: FCC Part 15 Class A, ICES-003 Class A, EN 55032 Class A (conducted and radiated emissions), EN 55024 (immunity), and CISPR 22 Class A, compliant with European EMC Directive 2014/30/EU.
- Environmental Compliance: RoHS Directive 2011/65/EU (Restriction of Hazardous Substances), WEEE Directive 2012/19/EU (Waste Electrical and Electronic Equipment), REACH Regulation (EC) 1907/2006, and China RoHS.

NETWORK AND CARRIER STANDARDS

- RFC 1631: The IP Network Address Translator (NAT) standard, detailing basic NAT functionality and addressing.

- RFC 3022: Traditional IP Network Address Translator (Traditional NAT), covering both basic NAT and PAT implementations.
- RFC 4787: Network Address Translation (NAT) Behavioral Requirements for Unicast UDP, specifying the required NAT behaviors.
- RFC 5382: NAT Behavioral Requirements for TCP, addressing port allocation, timeouts, and connection handling.
- RFC 5508: NAT Behavioral Requirements for ICMP, defining ICMP query and error handling.
- RFC 6887: Port Control Protocol (PCP), enabling hosts to control NAT port mappings.
- RFC 6888: Common Requirements for Carrier-Grade NAT (CGN), including bulk port allocation and logging.
- MEF 48: Service OAM Requirements and Framework, providing standards for operations, administration, and maintenance.



LIFECYCLE ASSURANCE AND FIELD DEPLOYMENT

RELIABILITY ENGINEERING (MTBF AND SERVICE LIFE)

The CGNAT-X8700 series is designed for an operational lifetime exceeding 10 years under full-load conditions, with a Mean Time Between Failures (MTBF) calculated at 350,000 hours (approximately 40 years) per the Telcordia SR-332 standard. This exceptional reliability is achieved through rigorous component selection, derating of power and thermal stresses, and comprehensive design-for-reliability methodologies applied throughout the product development lifecycle.

Field replaceable units (FRUs), including power supplies, fan trays, and line cards, are hot-swappable, enabling maintenance without system downtime. The

platform supports predicted failure alerts via SNMP traps, providing operators with proactive maintenance notifications before component degradation impacts service delivery.

SOFTWARE AND FIRMWARE SUPPORT

- Management Interface: Full support for CLI, SNMPv1/v2c/v3, NETCONF/RESTCONF, and a comprehensive web-based GUI for configuration and monitoring.
- Automation and Orchestration: Full integration with OpenStack, Kubernetes, and native Python-based automation libraries, enabling zero-touch provisioning (ZTP) and automated service activation.
- Telemetry Streaming: Standardized telemetry using gRPC and Protocol Buffers, delivering real-time performance and session metrics with low-latency streaming to analytics platforms.
- Firmware Update Process: Secure, redundant firmware images with primary/backup boot partitions, enabling fail-safe software upgrades and fast rollback to previous versions.

DOCUMENTATION AND SUPPORT INFRASTRUCTURE

Comprehensive technical support is available from the manufacturer's global

network of Technical Assistance Centers (TACs), operating 24x7 in all major time zones. Documentation includes this Technical Overview, the complete Hardware Installation Guide, the Command Line Interface Reference, and the XML API and REST API Developer Guides. All documentation is available in digital format via the product support portal and provided in print format upon request.

TARGET NETWORK TOPOLOGIES

The CGNAT-X8700 series is designed for deployment in a variety of network scenarios:

- Broadband Access Aggregation: Installed at BRAS or BNG aggregation points, performing NAT for millions of residential and business broadband subscribers.
- Mobile Packet Core: Deployed in the Gi-LAN or SGi-LAN, providing NAT for mobile data subscribers across 4G/5G networks.
- Enterprise Edge and Interconnection: Acting as a high-capacity NAT device for enterprise WAN edge and data center interconnection, with full redundancy and deterministic performance for mission-critical enterprise applications.
- Cloud Service Provider (CSP) Environments: Integrated into CSP network functions virtualization (NFV) and software-defined networking (SDN) environments as a highly available, physical network function (PNF) providing

NAT services for virtualized workloads.

ORDERING OPTIONS AND SKU GUIDE

The CGNAT-X8700 series is available with a comprehensive range of system configurations, line cards, power supply options, optical transceivers, and support packages, allowing customers to tailor the platform exactly to their performance, capacity, and operational requirements.

SYSTEM CONFIGURATIONS

- CGNAT-X8710-BASE: 1RU chassis with single RPM, single power supply (AC), two fan trays, empty line card slots. Does not include line cards.
- CGNAT-X8710-RED: 1RU chassis with dual RPM, dual power supplies (AC), four fan trays, empty line card slots. Does not include line cards.
- CGNAT-X8720-BASE: 2RU mid-range chassis with single RPM, single power supply (AC), two fan trays, empty line card slots. Does not include line cards.
- CGNAT-X8720-RED: 2RU mid-range chassis with dual RPM, dual power supplies (AC), four fan trays, empty line card slots. Does not include line cards.
- CGNAT-X8750-BASE: 2RU high-density chassis with single RPM, single power supply (AC), two fan trays, empty line card slots. Does not include line cards.
- CGNAT-X8750-RED: 2RU high-density chassis with dual RPM, dual power

supplies (AC), four fan trays, empty line card slots. Does not include line cards.

LINE CARDS

- CGNAT-X8710-LC4: 4x SFP28 + 2x QSFP28 line card, for CGNAT-X8710 chassis.
- CGNAT-X8720-LC8: 8x SFP28 + 4x QSFP28 line card, for CGNAT-X8720 chassis.
- CGNAT-X8750-LC16: 16x SFP28 + 8x QSFP28 line card, for CGNAT-X8750 chassis.

POWER SUPPLIES

- CGNAT-PWR-AC-1200: 1200 W AC power supply, for all chassis variants.
- CGNAT-PWR-DC-1200: 1200 W DC power supply, for all chassis variants.
- CGNAT-PWR-AC-2000: 2000 W AC power supply, for high-density configurations (CGNAT-X8750 chassis only).

OPTICAL TRANSCEIVERS

A wide variety of SFP, SFP+, SFP28, QSFP+, and QSFP28 optical transceivers are available, including SR (850 nm), LR (1310 nm), and ER (1550 nm) models, with reaches from 100 m to 80 km. A full transceiver compatibility matrix is provided in the separate Optical Transceiver Guide.

SUPPORT AND SERVICES

- CGNAT-SVC-BASIC: 24x7 phone and email support, next-business-day hardware replacement.
- CGNAT-SVC-PREM: 24x7 phone and email support, 4-hour hardware replacement, priority case handling.
- CGNAT-SVC-ENT: 24x7 phone and email support, 2-hour hardware replacement, dedicated support engineer, quarterly performance reviews.

For a complete list of all orderable items, including SFP/QSFP part numbers, cable assemblies, and accessory kits, please refer to the CGNAT-X8700 Series Price List and Ordering Guide, available from your sales representative.

CONCLUSION

The CGNAT-X8700 series carrier-grade NAT implementation platform offers the performance, reliability, and scalability required to solve the most challenging IPv4 address exhaustion scenarios faced by operators today. With its advanced hardware architecture, comprehensive feature set, and strict adherence to industry standards, this platform provides a proven, low-risk, and future-proof solution for any service provider network, broadband access aggregation,

mobile packet core, or enterprise edge environment.