Line-Rate Packet Forwarding Architecture Reference Document: Cisco ASR 1002-HX Edge Router Line-Rate Encryption Engine Capabilities

SYSTEM OVERVIEW

The Cisco ASR 1002-HX Edge Router represents a purpose-built, 2-rack-unit (2RU) aggregation platform engineered to deliver predictable, line-rate service performance at the network edge. Unlike traditional edge routers that suffer significant throughput degradation once encryption, firewall, or NAT services are enabled, the ASR 1002-HX integrates a dedicated hardware encryption engine capable of sustaining up to 25 Gbps of IPsec throughput without compromising forwarding capacity. This architectural separation of control, data, and service planes ensures that cryptographic processing does not become a bottleneck in WAN aggregation, Internet edge, or Data Center Interconnect (DCI) deployments. The platform supports a total system bandwidth scalable from 44 Gbps to 100 Gbps via software-activated performance licenses, providing a pay-as-you-grow economic model for enterprises and service providers alike.



INTERNAL PACKET ENGINE & ASIC

At the core of the ASR 1002-HX lies a tightly coupled forwarding and service architecture. The Embedded Services Processor (ESP) handles packet classification, queuing, and scheduling, while a dedicated crypto engine offloads symmetric encryption and decryption operations from the main forwarding path. This design allows the router to maintain line-rate throughput even when IPsec, MACsec, or comprehensive firewall state tracking is applied to every packet. The platform utilizes the Cisco QuantumFlow Processor (QFP) heritage for deep packet inspection and flexible QoS enforcement, ensuring that encrypted traffic receives the same deterministic treatment as cleartext flows. Hardware-assisted jitter and latency minimization mechanisms are integral to the forwarding logic, making the 1002-HX suitable for latency-sensitive applications traversing secured tunnels.

SMART COOLING & THERMAL DESIGN

The thermal envelope of the ASR 1002-HX is managed through a front-to-back airflow architecture utilizing a single field-replaceable fan tray. This design aligns with standard datacenter cold-aisle/hot-aisle containment practices and ensures that the high-performance crypto ASIC and forwarding silicon remain within nominal operating temperatures even under sustained line-rate encryption loads. The chassis is rated for nominal operation at 0° to 40°C (32° to 104°F), with short-term tolerance up to 50°C (122°F), accommodating the environmental variability typical of branch and edge colocation facilities. Power is delivered through dual hot-swappable AC or DC power supplies, providing N+1 redundancy without requiring additional chassis hardware.

LINE-RATE LIMITS

The ASR 1002-HX establishes clear performance boundaries between non-cryptographic forwarding and encrypted traffic. Total system bandwidth scales to 100 Gbps for plaintext forwarding, while the integrated crypto engine sustains up to 25 Gbps of IPsec throughput when licensed for maximum encryption performance. This 4:1 ratio between forwarding capacity and encryption capacity is a deliberate engineering trade-off: the platform is

optimized for edge roles where the majority of traffic may be inspected or encrypted, rather than for pure high-density peering. IPsec tunnel scale reaches 8,000 concurrent sessions, sufficient for large enterprise branch aggregation or managed CPE deployments. The platform also supports MACsec on select interfaces for hop-by-hop link encryption, complementing the end-to-end IPsec data path.

PARAMETER REGISTRY

Parameter	Specification
Form Factor	2RU rack-mountable chassis
Total System Bandwidth	44 Gbps to 100 Gbps (license-activated)
Encryption Throughput	Up to 25 Gbps IPsec
IPsec Tunnel Scale	8,000 tunnels
Embedded Ports	4x 1GE + 4x 10GE built-in; upgradeable to 8x 1GE + 8x 10GE via license
Expansion Slots	1 Ethernet Port Adapter (EPA) slot; 1 NIM slot (single or double-wide)
Power Supplies	Dual redundant, hot-swappable AC or DC
Airflow	Front-to-back, single field-replaceable fan tray
Dimensions (H x W x D)	3.5 x 17.3 x 22.0 in (88.9 x 439.42 x 558.8 mm)

| Weight | 34 lb (15.42 kg) fully loaded |

| Operating Temperature | 0° to 40°C nominal; 0° to 50°C short-term |

| Max Power Consumption | 400 W |

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GLOBAL SUPPORT CAPABILITIES

The ASR 1002-HX is supported by Cisco ' s global technical assistance infrastructure, including SMARTnet and Solution Support service tiers. Software maintenance releases for Cisco IOS XE ensure ongoing security patching and protocol compliance updates throughout the product lifecycle. The platform' s modular licensing model allows encryption throughput to be increased in the field via simple software activation, eliminating the need for hardware replacement as bandwidth demands grow. For deployments requiring high availability, the router supports software redundancy using dual IOS XE instances, providing sub-second failover for control-plane functions without requiring a second physical chassis.

