SmartEdge™ 800 Router

Delivering Highly Available, Scalable and Feature-Rich IP Services to the Intelligent Edge

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SmartEdge™ 800 Router – Availability, performance and flexibility for delivering carrier-class IP services.

Key Features

- **Routing protocols:** Built from the ground up for high availability, scalability and flexibility to support new protocols such as MPLS
- **Highly redundant hardware:** Engineered to carrier standards and deployed in carrier networks worldwide
- **High performance programmable packet forwarding:** Based on a customized Packet Processing ASIC (PPA) with the aggregate packet forwarding of 65 Mpps per SmartEdge 800
- **Unmatched port density:** Up to 3,360 DS1s ports in an extremely compact chassis that occupies less than one fourth of a standard 7-foot rack
- **Familiar Command Line Interface:** Simplifies provisioning and speeds time to service

The SmartEdge™ 800 Router, a member of the Nokia Intelligent Edge family of carrier-class networking platforms, is targeted at IP edge applications such as dedicated access services, Layer 3 and Layer 2 VPNs and selective backbone core applications. The product is distinguished by a number of features for providers that focus on delivering highly available IP services today with flexibility to support new IP services in the future.

System Architecture

The SmartEdge 800 Router packs considerable performance into an extremely compact form factor. The system operates at 60 Gbps with sustained packet forwarding rates of 60 Mpps. All packet-forwarding functions are implemented with a specialized network processor called Packet Processing ASICs (PPA), which resides in every line card. With dedicated packet processors for incoming and outgoing traffic and its rich set of packet processing features (ACLs, rate limiting, etc.) turned on, the SmartEdge 800 can support high-performance forwarding both on the access side (toward the customer) and the backbone side.

The chassis houses 14 slots, two for route processors and 12 for line cards.

Interface Type	Ports per Slot	Ports per Chassis
DS1 (optical)	336	3,360
E1 (optical)	189	1,890
E1 (copper)	24	240
DS-3 (optical)	12	120
DS-3 (copper)	12	120
OC-3	8	80
OC-12	4	40
OC-48	1	10
OC-3 ATM	2	20
OC-12 ATM	1	10
Fast Ethernet	12	120
Gigabit Ethernet	4	40
Numbers above assume two slots dedicated to uplink cards.		

Purpose-built for high availability. Both hardware and software are designed for high availability and engineered for scalability to support next-generation requirements. The SmartEdge 800 Router supports a hot standby route processor with fast fail over with a minimal interruption to forwarding. An Active Component Upgrade feature allows individual routing protocols to be upgraded in crisis situations, with no interruption to forwarding.

Software modularity and process restartability. The SmartEdge OS is highly modular to improve system reliability. Every protocol (BGP, OSPF, IS-IS and RIP) is implemented as a separate process. The Routing Information Base and configuration UI are also separate processes. Failure of one process has no impact on any other process. For example, if a network event crashes BGP it does not affect any other protocols and does not cause a system crash.

Non-stop forwarding. Software for the SmartEdge 800 is designed to support packet forwarding in the absence of the network control functions that populate the forwarding tables. This means that interfaces remain available and packets continue to be forwarded, even through failure and restart of routing processes or the RIB. Business customer traffic and SLAs are not affected by control plane transitions.

Separation of route determination and forwarding. The route determination and forwarding functions in the SmartEdge 800 are strictly separated. The route processor card is dedicated exclusively to processing route updates and route calculation. There is no forwarding code on the route processor and there is a single forwarding path in the system.

Graceful Restart. The SmartEdge 800 supports Graceful Restart for BGP, OSPF, LDP and IS-IS. Graceful Restart is a mechanism that minimizes the impact of restarting routing protocols. With Graceful Restart, a router's peers do not immediately recognize that a session went down. This gives a router time to restart the protocol and refresh routing information. Graceful Restart works in tandem with the forwarding plane stability introduced by non-stop forwarding to support a new measure of control plane stability.

Distributed forwarding. Forwarding functions in the SmartEdge 800 are distributed on every line card. A failure of one line card has no impact on packet forwarding for any other line card. In contrast to most existing platforms, the forwarding path of the SmartEdge 800 Router is fully programmable, so it can forward any packet type, with any encapsulation, without intervention by the Route Processor. Thus, there is no central point of failure for packet forwarding, even for specialized packet types.

Quality of Service Features

The SmartEdge 800 Router has a full complement of packet processing features that can be used to enable IP services. These include extensive packet classification/filtering capabilities based on ingress port/circuit, source/destination IP address and/or TCP port or protocol. Packets can be marked per the Diffserv specification or the Type of Service bits can be set. Access Control Lists are supported to permit or deny packets based on the same filter criteria.

Traffic control functions include rate limiting, whereby incoming and outgoing traffic is rate limited to meet a mutually agreed upon traffic profile, typically a sustained bandwidth value plus a specified burst tolerance. Traffic shaping works on egress packet streams to "shape" traffic to meet a mutually agreed upon profile. The SmartEdge 800 also supports sophisticated queuing and scheduling. There are up to 1k queues available per line card and the number and use of the queues is configurable. Priority scheduling is used in conjunction with rate limiting to manage bandwidth. For congestion control, the SmartEdge 800 uses Random Early Detect (RED) and Weighted Random Early Detect (WRED), the two most commonly employed techniques available today.

Support for Multiple Contexts

A unique service-enabling capability of the SmartEdge 800 Router is support for multiple routing contexts, which allow a provider to partition a chassis with software to create "contexts" or virtual routers. Each context appears to the service provider (and end customer) as a full-featured router with a console along with all of the monitoring and configuration features they would expect to see in a dedicated router. The use of context in combination with MPSL or GRE VPNs provides a powerful VPN model that allows for increased customer visibility into VPNs.

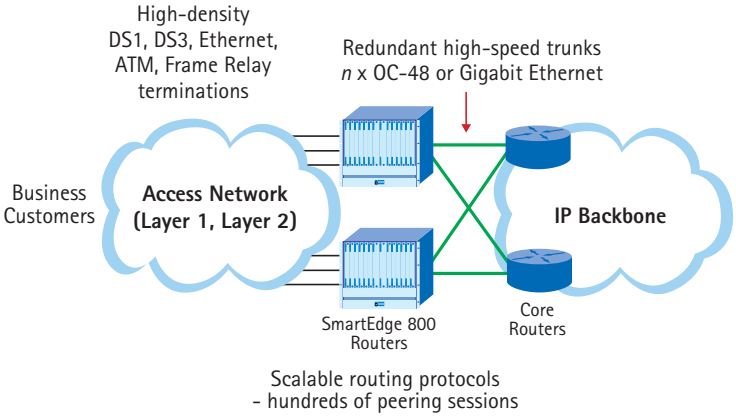
Virtual Private Network Support

Virtual private networks (VPNs) allow carriers to offer new services that leverage existing infrastructure investments. The SmartEdge 800 supports VPNs in conjunction with multiple contexts to create a flexible and powerful service offering. Each VPN gets its own IP address space, routing table, protected network traffic, user authentication, and other attributes. VPNs can be built across a carrier network with a variety of different technologies, including BGP/MPLS (RFC 2547), GRE tunneling, and Layer 2 switching. The customer can be terminated into the VPN with a variety of different methods, including ATM, frame relay, Ethernet, and leased line. Because of the SmartEdge 800's support of virtual interfaces, customers can be easily switched between different types of VPNs with only one configuration line change.

Key Applications

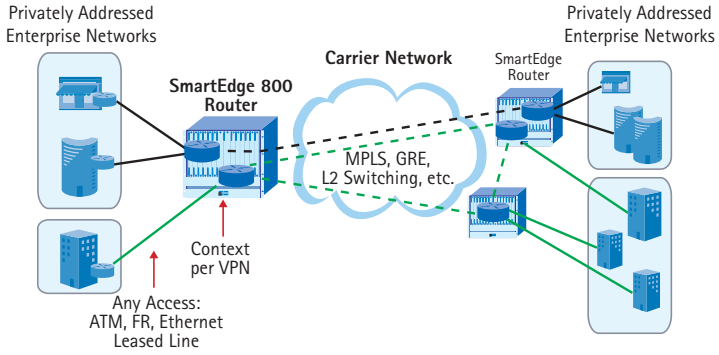
IP Aggregation

The SmartEdge 800 Router supports a variety of interfaces including DS1/E1 and DS3/E3, Ethernet, OC-3c/STM-1 and OC-12c/STM-4 for IP access services. Redundant high-speed OC-48c/STM-16 or Gigabit Ethernet trunk interfaces can be used in dense POPs to support 3,360 DS1 customers and 120 DS3/E3 customers in a chassis with nominal oversubscription of the service.



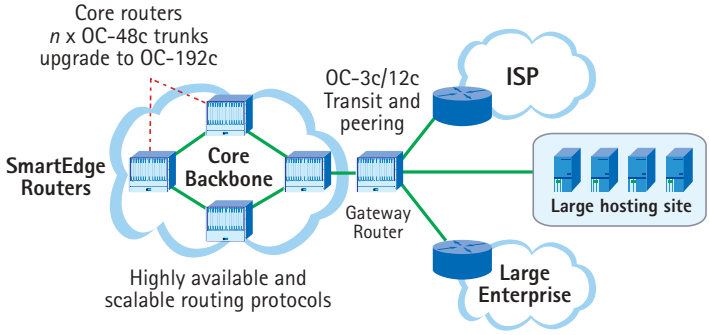
Virtual Private Networks (VPNs)

The SmartEdge 800 Router supports VPNs, which can be provisioned across a network in multiple ways, including BGP/MPLS (RFC 2547), GRE tunneling and Layer 2 switching. The SmartEdge 800's support of virtual interfaces allows customers to be easily switched between different types of VPNs. VPNs work in conjunction with multiple contexts to support separate IP address space, routing table, protected network traffic, and user authentication for each VPN.



Core/Wholesale

For core and wholesale applications, the SmartEdge 800 Router supports OC-3c/STM-1 through OC-48c/STM-16 interfaces. The 4-port OC-12c/STM-4 and 8-port OC-3c/STM-1 interfaces yield chassis densities of 40 OC-12c/STM-4 or 80 OC-3c/STM-1 connections when used with redundant high-speed OC-48c/STM-16 or Gigabit Ethernet trunk line interfaces.



SmartEdge 800 Router Product Specifications

Hardware

Chassis

- 15.75" (H) x 17.5" (W) x 16" (D) (40 cm x 44.45 cm x 40.64 cm)
- 19" (48.26 cm) and 23" (58.42 cm) rack mountable (front)
- 14 slots, 2 for Route Processors; 12 universal slots for line cards,
- Weight: 50 lbs (22.73 kg) unloaded; 90 lbs (40.91 kg) fully loaded
- Connectors on chassis: Power A, B; dual BITS synchronization inputs and outputs; alarm output, status input.

Route Processor Module

- 2 per chassis (1 working + 1 hot standby) Power PC 750
- 768 MB memory per Route Processor
- PC card slot for 1 GB Microdrive for secondary storage
- BITS clock sources (2) for external stratum clock inputs
- Stratum 3 Oscillator
- Management ports: 2 craft ports: DB-9 RS-232, Rear async modem port, Ethernet 10/100TX

Line Cards

- Dual Packet Processing ASICs (PPA); 1 for ingress processing, 1 for egress processing
- Packet mesh ASICs

Interfaces

- 1 port Channelized OC-12 to DS3
- 1 port Channelized OC-12 to DS1/DS3 (336 channels)
- 12 port Channelized DS3 (336 channels)
- 12 port Clear Channel DS3
- 1 port OC-48c/STM-16
- 4 port OC-12c/STM-4
- 8 port OC-3c/STM-1
- 1 port OC-12c/STM-4 ATM
- 2 port OC-3c/STM-1 ATM
- 12 port 10/100TX Ethernet
- 4 port Gigabit Ethernet

Redundancy

- 1+1 for all common CPUs, Clock and independent power to each line card
- Hot standby route processors
- Restartable routing processes

Operating Environment

- Temperature: 41°F to 104°F (5°C to 40°C)
- Humidity: 5-85% RH
- Power: -48 V DC

Compliance

- NEBS Level III in process, CE Mark, UL 1950, GR-63 Core, GR-1089 Core, ETS 300 386-2
- FCC Part 15, EN55022 class A, ETS 300 386-2

Software

Features

- Restartable routing processes
- Nonstop forwarding
- Hot standby route processors
- Active Component Upgrade
- Multiple Contexts
- Premium Service Insertion
- VPN support for GRE, MPLS VPNs
- MPLS Traffic Engineering
- Access Control Lists
- Virtual Router Redundancy Protocol (VRRP)
- Quality of Service: Packet classification, DiffServ AF1-4 & EF packet marking; priority queuing with rate limiting, traffic shaping and policing; RED and WRED; BGP attribute based QoS
- Security: Denial of Service Logging, SSH, MD5 support for routing protocols, key rollover, RADIUS, TACACs+; Administrative ACLs

Encapsulations

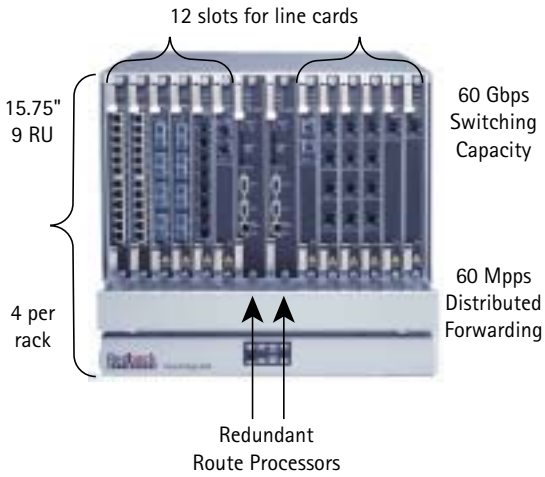
- PPP/HDLC, cHDLC, Ethernet, IEEE802.1q, RFC 1483 bridged and routed IP over ATM, RFC 1490 routed IP over Frame Relay

Protocols

- BGP-4 (RFC 1771), IS-IS (RFC 1195 & ISO/IEC 10589), OSPF v2 (RFC 2328),
- PIM Sparse Mode (RFC 2362), IGMP v1, v2 (RFC 2236), MBGP (IETF Draft), MSDP (IETF Draft), RSVP (RFC 2205)
- MPLS-TE , RSVP (RFC 3209), LDP (RFC 3036)
- MPLS VPNs (RFC 2547)

Configuration and Network Management

- Industry familiar Command Line Interface (CLI) support via telnet or Secure Shell (SSH)
- Multiple user groups or access levels with definable access privileges
- User authentication via RADIUS, TACACS+, local file
- Transaction based configuration against a configuration database including commits, aborts, and ability to roll back unintended changes
- NetOp EMS support for event logs, SNMP traps, interface statistics for troubleshooting and performance monitoring, port views and chassis views



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