

# SMARTEDGE

MULTI-SERVICE EDGE ROUTERS  
(CARRIER-CLASS, SCALABLE, VERSATILE)



Integrate the edge of the IP network  
(Edge Routing, Subscriber Management, Ethernet  
Aggregation, and Advanced Services);  
Deliver residential and business services on the  
same platform; Integrate in Ericsson's end-to-end  
solutions. Deploy for fixed-mobile convergence



ERICSSON

## Key benefits

- Consolidated functionality at the edge of the IP/MPLS network enables economies of scale, reducing the need for sparing, extra ports, and power
- Carrier-Grade Design: Engineered to standards for deployment in carrier networks worldwide – NEBS and RoHS compliant
- Resilient software architecture: Modular design provides stability and protects against crashes and protocol errors
- High performance programmable packet forwarding: Based on a Packet Processing ASIC (PPA) developed by Ericsson
- Session level reliability: Supports Non-Stop Forwarding and keeps Subscriber Sessions running uninterrupted during a Route Processor fail-over
- Supports up to 256,000 active Multi-Play subscribers, 256,000 PPP/DHCP subscribers, 256,000 VLAN cross-connects and 1.5 million MAC addresses
- Compact platforms (2 RUs to 16 RUs), capable of delivering services to up to 1.2 millions of subscribers in one rack, using minimal power per subscriber served
- High scale control plane with support for up to 8000 MPLS L2/L3 VPN, with 1280 BGP, 1280 t-LDP peers and up to 2.5 million BGP routes
- Advanced services for VoIP with Border Gateway Function, Security, and P2P applications analysis and traffic management
- Optional A/C power shelf (SE400 and SE600)

## Technical Overview

Ericsson's SmartEdge Multi-Service Edge Router platforms is a set of highly scalable, compact platforms that deliver multiple functions at the edge of the IP/MPLS network to reduce the network's physical topology. The edge of the IP network has been evolved to require additional functionality beyond edge routing. The SmartEdge MSERs deliver all of the necessary functionalities in one compact form factor. These functions are: IP/MPLS edge routing, Broadband Remote Access Server (B-RAS), Ethernet aggregation, Mobile IP, Border Gateway Function, Security (IPSec) and P2P traffic analysis and management. These functions can be deployed in any combination for a variety of today's bandwidth intensive and revenue-generating applications. SmartEdge's versatility enables deployment in any type of network architecture, e.g., the traditional multi-edge overlay architecture with an Ethernet aggregation layer in between access nodes and B-RAS / IP edge routers or a fully consolidated architecture where the Ethernet aggregation, B-RAS and L2/L3 PE routing functions are consolidated in a single platform.

Its B-RAS function supports both IPv4 and IPv6 subscriber management and offers a very wide range of protocols such as PPPoA, PPPoE, DHCP, AAA with RADIUS, L2TP, dynamic service selection, multiple contexts, static and dynamic bindings, over-provisioning, bandwidth management and subscriber flow control. In addition, SmartEdge supports Clientless IP (CLIP) subscribers without requiring PPPoE usernames for DHCP environments.

Edge Routing capability is supported in hardware with a full suite of IP routing protocols, Multi-Protocol Label Switching (MPLS), with hierarchical Quality of Service (H-QoS). The IP edge routing function virtualizes the SmartEdge in two ways:

1. Routing Context which is a virtual or "logical" router with its own routing and administrative domain. Each Context runs independently from other Contexts and has its own interfaces. SmartEdge supports up to 8000 routing contexts.
2. BGP/MPLS VRF (acting as Contexts). Each VRF supports VPNs and other IP services such as broadband Internet access, and is independent of the underlying transport technology. Up to 8000 VRFs are supported in SmartEdge.

SmartEdge's Ethernet aggregation and L2 PE function are based on MPLS L2 technologies. These include MPLS pseudo-wires or VLL (virtual leased line) for point-to-point connectivity and VPLS (virtual private LAN service) or Hierarchical VPLS for multipoint connectivity. These L2 technologies could be used to deliver enterprise L2 services or they could be used to backhaul triple play traffic from the access nodes (such as DSLAMs) to the IP service edge. SmartEdge's L2 pseudo-wire termination and the IP interface termination functions can be processed simultaneously. This feature is called IPoE over MPLS pseudo-wire termination. This allows carriers to combine metro Ethernet head-end routers with SmartEdge.

SmartEdge's Advanced Services include i) Border Gateway Function for IMS-based voice applications such as video-based telephony calls, ii) Mobile IP supporting Home and Foreign Agent functions and its application for WiMax connectivity plus support from all of the SmartEdge's B-RAS functionality iii) Peer-to-Peer (P2P) packet analysis via Deep Packet Inspection and Heuristic Analysis iv) IPSec for establishing secure tunneling communication including the use in wireless-based connections.

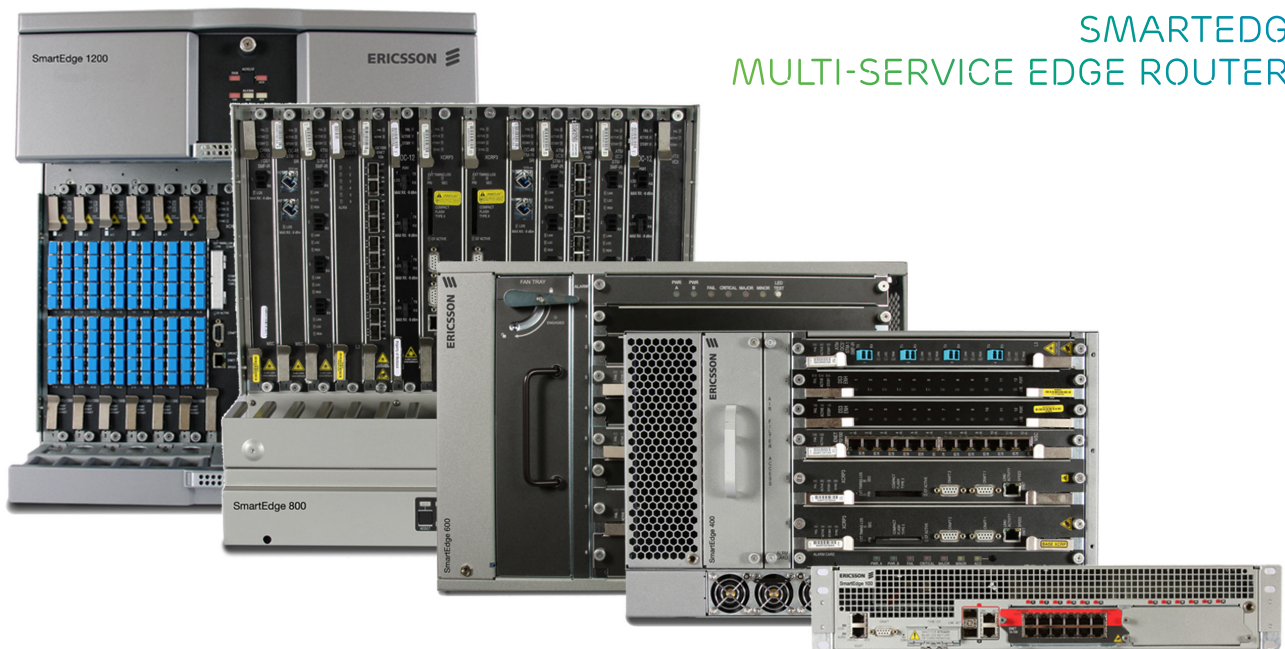
SmartEdge supports separation of control and forwarding planes via separate line cards and controller cards (Cross-connect Routing Processor Card – XCRP). XCRPs are run by Ericsson's highly resilient, modular operating system, SEOS. Control plane resiliency is offered via deployment of two XCRPs (Active, Standby mode) where the active XCRP4 is protected by the standby XCRP4 but a switchover does not necessarily occur in case of an application failure, e.g., OSPF. Under SEOS, all processes are restartable, individually, without the need to restart the entire system or the board. Process restarts do not affect data forwarding or bring down subscriber sessions. SEOS has the necessary code extensions to support routing and MPLS signaling protocol "restart" and provides hitless operation. Each process is an independent task (thread) with its own local memory. This provides rapid process fault isolation, and recovery. Software patches are only introduced into the necessary process while all active subscriber sessions continue to stay up.

Offering high scalability, the SmartEdge MSERs enable the highest ratio of subscriber to size and energy consumption – with up to 256,000 subscribers (any combination of PPP, DHCP, or Clientless IP) consuming from 5.5mWatts to 37.5mWatts per subscriber when fully loaded.

High throughput is achieved by a scalable architecture where each line card slot can deliver up to 20Gbps full duplex. All SmartEdge MSER interface modules are hot-swappable and highly resilient with full session and stateful redundancy in the event of a failure or replacement.

SmartEdge MSERS support a variety of line cards and corresponding interfaces (some are model-dependent). These include E1s, E3s, DSx, and ATM, PoS and Ethernet interfaces. The majority of the line cards can be used across multiple platforms and are backward-compatible. This interoperability results in easy upgrade and re-use of current resources.

SmartEdge MSERs offer advanced traffic engineering and management on a per port basis including options to mixing of PWFQ and MDDR on the same GE interface for different data circuits (flows) for maximum flexibility in service offering. Hierarchical QoS, policing, shaping and granular rate limiting can be configured on a per subscriber per service basis. Differentiated, tiered services enables the operator to set itself apart from its competitors while enabling differentiated Quality of Service (QoS) settings is common among the vendors, enabling the subscribers to set their own QoS levels is not. This is possible with SmartEdge with NetOp as the subscriber can modify its service levels on demand anytime.



## SMARTEDGE MULTI-SERVICE EDGE ROUTERS

Product	SE100	SE400	SE600	SE800	SE1200 <sup>1</sup>
Capacity	12G	80G	240G	240G	480G
Subscribers	8,000	128,000	256,000	256,000	256,000
Dimensions (H x W x D)	3.5" x 17.5" x 19.6"	8.75" x 17.5" x 16" (AC); 10.5" x 17.5" x 16" (DC)	12.2" x 17.3" x 16.6"	15.75" x 17.5" x 16"	24.5" x 17.5" x 16"
Rack Units	2	5 (AC) or 6 (DC)	7	9	16
Number of Slots and line cards	Modular Interface Cards (MIC) only	6;4	8;6	14;12	14;12
Power Consumption - Maximum	300W	700W	2736W	1920W	SE1200 <sup>2</sup> : 3840W
Power Consumption per Subscriber	37.5mW	5.5mW	10.7mW	7.5mW	15mW
FEATURES/BENEFITS	Ideal for deployment in rural areas, co-location, and managed services	Layer 3 access aggregation for medium sized networks, WiMax, and multi-access aggregation (TDM, SONET/SDH, ATM), 10 Gig slot architecture; main platform for IP RAN solution	High subscriber count in a compact form factor, deployment in large scale access networks, 20 Gig slot architecture	Main platform for MPBN, integrated support for legacy interfaces (TDM, SONET/SDH, ATM), 10 Gig slot architecture; supports low speed interfaces DS1, E3	The flagship product, 20G-slot architecture, and ideal for fixed/mobile convergence; Also used in Ericsson's M-PBN solutions and ideal for dual use for IP RAN and M-PBN

	SE100	SE400	SE600	SE800	SE1200
Cards - Interface Types	• 12 10BASE-T, 100BASE-TX, 100BASE-FX	OC-12 to DS3 or DS1/DS3	• 1 port OC-12/STM-4c (ATM)	• 1 port Channelized OC-12 to DS3 or DS1/DS3	• 1 port OC-12/STM-4c (ATM)
	• 2 Gigabit Ethernet ports (TX and FX supported)	• 12 port Channelized DS3 (336 channels)	• 4 port OC-3/STM-1c (ATM)	• 12 port Channelized DS3 (336 channels)	• 4 port OC-3/STM-1c (ATM)
	• ATM - 2-port OC-3/STM-1 cards	• 12 port Clear Channel DS3	• 8 port OC-3/STM-1c (ATM)	• 12 port Clear Channel DS3	• 1 port OC-192 PoS
		• 3 port Channelized STM-1 (336 channels)	• 4 port OC-48	• 3 port Channelized STM-1 (336 channels)	• 12 port 10/100TX Ethernet
		• 24 port Channelized E1 (336 channels)	• 8 port OC-3 PoS	• 24 port Channelized E1 (336 channels)	• 80 port 10/100TX Ethernet
		• 6 port Clear Channel E3	• 1 port OC-192 PoS	• 6 port Clear Channel E3	• 4 port Gigabit Ethernet (GBIC or SFP)
		• 4 port OC-12c/STM-4 (POS)	• 12 port 10/100TX Ethernet	• 4 port OC-12c/STM-4 (POS)	• 5 port Gigabit Ethernet (GBIC or SFP)
		• 8 port OC-3c/STM-1 (POS)	• 80 port 10/100TX Ethernet	• 8 port OC-3c/STM-1 (POS)	• 10 port Gigabit Ethernet with SFP
		• 1 port OC-48c/STM-16 (POS)	• 4 port Gigabit Ethernet (GBIC or SFP)	• 1 port OC-48c/STM-16 (POS)	• 20 port Gigabit Ethernet with SFP
		• 1 port OC-12c/STM-4 (ATM)	• 5 port Gigabit Ethernet (GBIC or SFP)	• 1 port OC-12c/STM-4 (ATM)	• 1 port 10-Gigabit Ethernet with XFP
		• 4 port OC-3c/STM-1 (ATM)	• 10 port Gigabit Ethernet with SFP	• 4 port OC-3c/STM-1 (ATM)	• 4 port 10-Gigabit Ethernet with XFP
		• 12 port DS3 (ATM)	• 20 port Gigabit Ethernet with SFP	• 12 port DS3 (ATM)	
		• 12 port 10/100TX Ethernet	• 1 port 10-Gigabit Ethernet with XFP	• 12 port 10/100TX Ethernet	
		• 4 or 10 or 20 (2-slot) port Gigabit Ethernet	• 4 port 10-Gigabit Ethernet with XFP	• 4 or 10 or 20 (2-slot) port Gigabit Ethernet	
		• 1 port 10 Gigabit Ethernet		• 1 port 10 Gigabit Ethernet	

<sup>1</sup>1200 is the base chassis; 1200H for higher power requirements

<sup>2</sup>1200H: 5856W

## Innovations

SmartEdge MSERs benefit from multiple areas of innovation. These include the internal architecture for inter-card connectivity which is achieved via advanced ASICs that enable a Mesh Architecture: SmartEdge packet mesh architecture uses no central switching fabric, common connectivity modules, or active backplane components. This architecture eliminates single point of failures and provides for a much smaller foot print relative to competitive platforms of the same capacity. Furthermore, in-house designed, highly advanced ASICs are used for fast packet forwarding with the capability of up to four 10G interfaces per line card.

SmartEdge uses a highly resilient operating system (SEOS). SEOS is a carrier-class, distributed, and modular OS which supports multiple powerful processors, and has been designed with a common infrastructure. It is resilient and capable of hitless restart. This means that when a software task goes down the system will continue to operate as the task is restarted independently. It provides session level reliability with non-stop forwarding and keeping subscriber sessions alive during a control plane switchover.

## Applications

SmartEdge's versatility allows its deployment for a variety of networking applications, including differentiated Triple Play, business VPNs (L2 and/or L3), technology migration (e.g., ATM/Frame Relay to Ethernet, IPv4 to IPv6), and fixed/mobile convergence. Simultaneous support for these applications enables service providers to architect their network with minimal number of devices and reduce network and device overlay resulting in simpler network topology and operation. SmartEdge can be deployed in many advanced applications, e.g., as a major component of an IMS infrastructure providing security, call control, and high speed routing.

By converging wired and wireless networks, SmartEdge enables any network to deliver any service to any Internet-enabled device regardless of how the user is connected to the network. They pave the way for Fixed/Mobile Convergence by providing a stable IP point-of-presence for all users regardless of mobility within or between access technologies.

## Management

SmartEdge MSERs can be managed by Ericsson's NetOp Management Suite. The NetOp Suite is comprised of three basic elements:

1. NetOp Policy Manager can be used for enabling personalized subscriber services such as on-demand service modifications. The NPM supports per subscriber policy and session control, subscriber authentication and service authorization, and subscriber usage accounting via RADIUS.
2. NetOp EMS (Element Manager) can be used to provision routing and metro-Ethernet services. The EMS is the configuration manager for SmartEdge. Some of its main functions include Fault and Alarm Management, Software upgrades, and real-time performance monitoring
3. NetOp NSM (Network Services Manager) can be used for VPN provisioning. The NSM layer 2 based Point to Point and Multipoint VPN Provisioning (based on VLAN, VLL and VPLS) in addition to layer 3 based multipoint VPN Provisioning (based on BGP VPN) are supported. It also provides IPSec site-to-site circuit provisioning. The NSM greatly reduces service provisioning time resulting in high customer satisfaction.

## SmartEdge in Ericsson's End-to-End Solutions

SmartEdge MSERs have been integrated in several Ericsson's end-to-end solutions. Ericsson adheres to high standards and very strict methodologies when integrating a system within its e2e solutions. Systems are subjected to detailed testing, functionality requirements, and a minimum of 5 9s reliability levels before they are accepted as part of the solution. SmartEdge has been integrated in Ericsson's Mobile Packet Backbone Network (M-PBN), IP RAN, IPTV and Multimedia Telephony (MMTEL) solutions.

In M-PBN, a field-proven IP-based backbone for wireless network infrastructure, SmartEdge is used as an edge router in primary and secondary sites. Its evolutionary path to a Converged Packet Gateway offers additional functions such as SAE (System Architecture Evolution), and LTE support with mobility GSM/WCDMA networks.

In Ericsson's IP RAN solution, SmartEdge is deployed at the edge of the RAN backhaul transport network and the BSC/RNC sites and used to direct and transport GSM and WCDMA traffic to BSCs or RNCs. SmartEdge deployment can be shared between an M-PBN and IP RAN solution to take advantage and full use of its functions. This approach will decrease Total Cost of Ownership for the wireless network operator.

For the IPTV solution, SmartEdge is the designated edge router and subscriber management system. SmartEdge offers policy control, QoS, traffic separation (per subscriber per service VLANs as an example). The use of Dual Join PIM in SmartEdge IP services offers additional reliability not available in conventional PIM services.

The MMTEL solution offers SIP-based IMS-based telephone services. SmartEdge is used as the focal point in terminating multiple access technologies and communicate with other servers to perform policy enforcement and NAT-ing functions using its Core Border Gateway Function (C-BGF).

Please refer to Ericsson's literature to additional information on each of the above solutions.

## Specifications

### Route processor module

- 2 per chassis (other than SE100)
- 1:1 redundancy
- Compact Flash slot for secondary storage (not in SE100: Route/Switch engine with two programmable ASICs)
- Management ports XCRP3: 2 craft ports: DB-9/RS-232, Asynchronous modem port, Ethernet 10/100TX. XCRP4 : 1 craft ports: DB-9/RS-232, Asynchronous modem port, 2 Ethernet 10/100/1000TX

### Line cards

- -- All but SE100: -- Dual Packet Processing ASICs (PPA2/3/4); 1 for ingress, 1 for egress
- Fully meshed backplane – no slots used for switch fabric card

### High availability and redundancy (except SE100)

- 1+1 for all common CPUs, clock and independent power to each line card
- Hot standby route processors
- Restartable software processes (for example PPP, BGP, SNMP, etc.)

### Application services

- Border Gateway Function (BGF)
- Heuristic based P2P Application Detection, e.g., Bit Torrent, Gnu Tella, Jabber IM, eDonkey, and other leading instant messaging services (not available in SE100)

### Operating environment

Temperature: 5 to 40 C degrees (long term), 5 to 55C (short term)

- Humidity: 5-95% non-condensing
- NEBS Level III, CE Mark, SR-3580, UL 1950, GR-63 Core, GR-1089 Core, ETS 300 386-2 FCC Part 15, EN55022 class A, ETS 300 386-2
- RoHS-5 compliance

## Software

### Architectural features

- Modular Operating System, with separation of control, data and services planes; independent tasks with its own thread and memory space

### Broadband subscriber management

- RADIUS Authentication, Authorization, and Accounting (AAA), dynamic circuit binding, CoA
- Dynamic / Static Clientless IP (CLIPs)

### Encapsulations

- PPP/HDLC, cHDLC, Ethernet, IEEE 802.1q, RFC 1490 routed IP over Frame Relay, MPLS, MLPPP, 802.3ad
- PPP over Ethernet (RFC 2516), PPP over ATM, RFC 1483 bridged and routed IP over ATM

### Multicast protocols

- PIM-SM (RFC 2362 + IETF Draft), PIM-DM (IETF Draft), IGMPv1, v2, v3 (RFC 3376), SSM (RFC 3569), MBGP (RFC 2858), MSDP (RFC 3618), IGMP snooping, IGMP filtering

## IPv6

- o SmartEdge IPv4 to IPv6 mapping
  - Dual stack – 6in4 6to4 and IPv6 over GRE Tunneling
- o B-RAS Features
  - IPv6 subscribers dual stack support
  - IPv6 over PPP (RFC 5072)
  - RADIUS support for IPv6 (RFC 3162, 4818)
  - Dual stack PPPoE sessions over Ethernet
  - IPv6 over PPP (RFC 5072)
  - DHCP-PD server (RFC 3315, 3633)
  - Stateless DHCPv6 server (RFC 3736, 3646)
  - ND (RFC 4861)
  - SLAAC (RFC 4862)

- RPF check
  - RADIUS based prefix assignment
  - Redistribution of subscriber prefixes in IPv6 routing protocols
  - LI for IPv6/Dual stack
  - IPv6 ACL on static circuit
  - IPv6 Admin ACL
  - QoS support (queuing, metering, policing and propagation)
  - Support on Ethernet cards
- o L2/L3 Features
- BGP4+
  - OSPFv3
  - IS-IS
  - RIPNG
  - IPv6 static routing
  - Dual stack support
  - 6PE
  - 6VPE

## Routing Protocols

- BGP-4 (RFC 1771), IS-IS (RFC 1195 & ISO/IEC10589), OSPFv2/v3, RIP v2, RIPng, VRRP (RFC 2338), LDP, RSVP
- LDP tunneling over RSVP LSPs (RFC 3209); BFD for OSPF, ISIS, BGP, static routes and individual links in 802.3ad link group
- OSPF V3, RIPNG
- Mobile IP (Home and Foreign Agents), WiMAX Forum AAA Attributes for MIP Home Agent

## Configuration and network management

- Command Line Interface (CLI) support via telnet or SSH
- RADIUS, TACACS+
- SNMP v1/2/3
- L2 Control Protocol (L2CP) with support for DSL Sync Rate with Dynamic QoS change and ATM Ping command to DSLAM
- NetOp EMS support for event logs, SNMP traps, interface statistics for troubleshooting and performance monitoring, port views and chassis views.

## MPLS features & Virtual Private Networking

- Traffic Engineering, RSVP (RFC 3209), LDP (RFC 3036, 3478), L2 VPN(martini) VPLS, H-VPLS, Transport Independent (MPLS VPN over soft GRE), Multicast over MPLS VPN
- MPLS VPNs (RFC 4364 previously known as 2547bis), Carrier of carriers and Inter-AS, MPLS VPN (options A, B, C) MPLS FRR, EoMPLS.

## Layer 2 non-MPLS VPN:

- GRE, Soft-GRE
- L2TP (RFC 2661) LAC, LTS, LNS
- 802.1Q Virtual LAN (VLAN) support with 802.1QinQ - with CoS mutation, 802.1Q tunneling with VLAN mapping
- 802.1ag Connectivity Fault Management
- Ethernet OAM – CPE Ping
- Virtual Circuit Connection Verification (VCCV)
- MPLS Ping and Traceroute
- Bridge Virtual Interface (BVI) (routing and bridging on the same interface)
- RSTP
- CSPF

## Quality of service

- 802.1p Class of Service (CoS), Differentiated Services Code Point (DSCP) ToS, IP Precedence, and MPLS EXP bits
- Packet classification (RFC 2474, 2475, 2597, 2598); DiffServ packet marking by ACL, ingress policing, or BGP attribute based QoS; class-based ingress policing and egress shaping; priority queuing and EDRR; RED and WRED; Hierarchical Scheduling aligned with DSL forum's WT-92 and TR-59 specifications.

## Security

- Reverse Path Forwarding (RPF), Secure ARP, MD5 support for routing protocols, key rollover, RADIUS, TA CACS+; Administrative ACLs, packet mirroring and sampling, Secure Shell (SSH) Protocol, SNMPv3, IGMP filtering, SSHv2, VLAN ACLs, IP security router ACLs, subscriber-based ACLs
- IPSec
- Lawful Intercept (CALEA)

### Subscriber awareness

- Subscriber Name, Session, IP Address
- Address Management
- DHCP Relay, DHCP Proxy, IPCP parameter negotiation, IP pools, RADIUS

### Advanced features

- H.248 MGCP (ITISpan compliant Ia profile)
- Multiple contexts with inter-context routing
- Premium Service Insertion
- Bulk stats
- Network Address Translation (NAT)
- Dynamically Verified Static Routing
- Policy routing

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