Cisco Carrier Routing System

Many Services. One Network.
Limitless Possibilities.

THIS IS THE POWER OF THE NETWORK. NOW.

CISCO

Cisco CRS-1 Carrier Routing System

The Cisco® CRS-1 Carrier Routing System is the industry's only fully modular and distributed routing system that enables service providers to deliver a suite of data, voice, and video services over a highly available and highly scalable IP Next-Generation Network (NGN) infrastructure. The Cisco CRS-1 is designed to help service providers increase business profitability, service flexibility, and operational efficiency. The primary attributes of the Cisco CRS-1 include:

Unparalleled System Longevity

The Cisco CRS-1 is the industry's only carrier routing system that can scale up to 92 terabits per second (Tbps), powering the first OC-768c/STM-256c IP and dense wavelength-division multiplexing (DWDM) interfaces and supporting up to 1152 40-Gbps line cards of Packet-over-SONET (PoS), WDM, and Ethernet interfaces. The Cisco CRS-1 helps simplify today's networks while protecting investments for decades to come.

Continuous System Operation

The Cisco CRS-1 is built on Cisco IOS® XR Software, the industry's only self-healing operating system for multishelf, multiterabit carrier infrastructure. This microkernel-based operating system provides granular process independence, fault containment, and isolation. With these unique capabilities, the Cisco CRS-1 can be maintained, upgraded, enhanced, and scaled without requiring service interruptions.

Unprecedented Service Flexibility with Cisco Intelligent ServiceFlex Design

The Cisco CRS-1 combines the Cisco Silicon Packet Processor (SPP)—the world's most sophisticated 40-Gbps application-specific integrated circuit (ASIC), and Cisco IOS XR Software, with unique Cisco Service Separation Architecture (SSA) and Cisco Service-Intelligent Switch Fabric to provide maximum service flexibility and capability. With comprehensive service separation and complete line-rate feature flexibility, the Cisco CRS-1 can deliver the capabilities that enable the most advanced converged network services today and tomorrow.

System Overview

The Cisco CRS-1 includes two major elements—line card shelves and fabric card shelves. Based on these two system building blocks, the Cisco CRS-1 can be deployed in two configurations: a single-shelf system and a multishelf system (Figure 1).

A single-shelf system is built from a single line card chassis, available in 4, 8, or 16 slots. The single-shelf system delivers 320 Gbps, 640 Gbps, or 1.2 Tbps of switching capacity and 4, 8, or 16 available 40-Gbps line card slots. The multishelf system is built by interconnecting multiple line card shelves using one or more fabric shelves. Multishelf systems can scale up to 92 Tbps, and grow to as many as 72 line card shelves interconnected by eight fabric shelves. Both single-shelf and multishelf systems deliver a true unified router character to its operator and peers.

Figure 1. Cisco CRS-1 System Configurations

Single-Shelf Configuration (320 Gbps, 640 Gbps, or 1.2 Tbps)

- 4, 8, or 16 line card slots
- No fabric card shelf required

Multishelf Configuration (1.2 Tbps to 92 Tbps)

- 2 to 72 line card shelves
- 1 to 8 fabric card shelves

Foundation for Network and Service Convergence

Service providers recognize that service-specific networks, complex network architectures, and connectivity-only services do not adequately meet their business needs and customer demands. To increase efficiency and profitability, service providers must redesign their networks to cut costs, offer new services, and expand their customer reach.

To meet this challenge, service providers are embarking on a migration toward a converged IP NGN that is based on network convergence enabled by an IP/Multiprotocol Label Switching (MPLS) core that supports the integration of IP and DWDM, and service convergence driven by IP-centric services (Figure 2). The expected traffic growth from converged networks and new IP services will require service providers to rearchitect their network point of presence (POP) even more rapidly than the current interval of 3 to 5 years. The level of network complexity increases exponentially as more and more routers are inserted into traditional POP architectures to handle respective POP functions such as core, peering, aggregation, and edge. Simplifying POP architecture while delivering network and service convergence becomes a technical, operational, and business challenge to service providers (Figure 3).

The Cisco CRS-1 is the only massively scalable system that can truly integrate multiple POP functions into a single system and provide the critical reliability and flexibility required for successful network and service convergence. The Cisco CRS-1 simplifies POP architecture and management, freeing service providers from current network design limitations to capture the benefits of a single, reliable, scalable routing system not only today, but for decades to come. The Cisco CRS-1 offers integrated DWDM transponder functions at both 40 Gbps and 10 Gbps. The 40-Gbps WDMPOS module connects directly into any DWDM network and provides up to 40 Gbps of data throughput across existing 10-Gbps DWDM systems, while the 10 Gigabit Ethernet WDMPHY module provides compatibility with existing SONET/SDH operations support systems. The result is significant savings in both capital expenditures (CapEx) and operating expenses (OpEx), an overall increase in reliability and improved speed to service.

Figure 2. Migration Toward an IP NGN Infrastructure

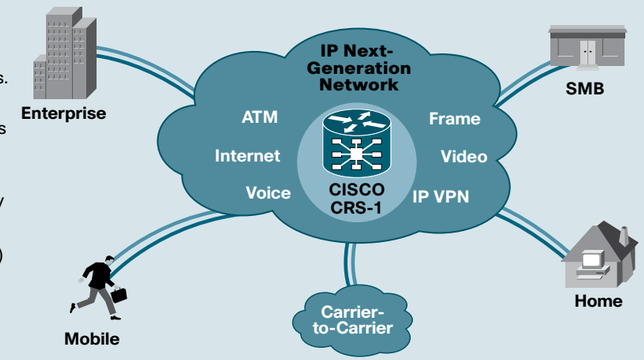
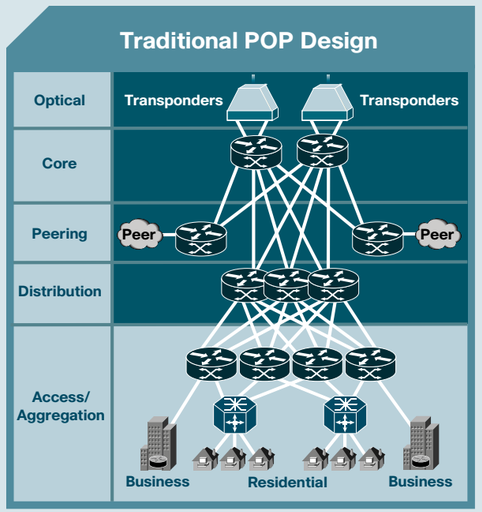
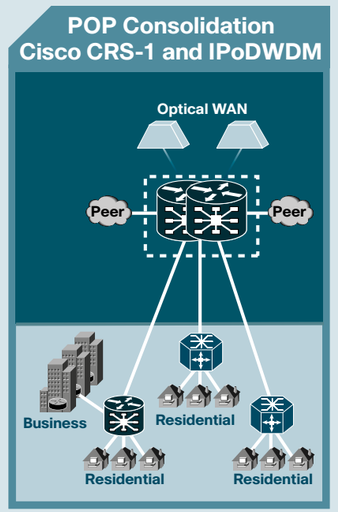


Figure 3. Cisco CRS-1 Simplifies POP Architecture





Cisco CRS-1 System Elements

Cisco CRS-1 Main Components

- Cisco CRS-1 4-Slot Single-Shelf System
- Cisco CRS-1 8-Slot Single-Shelf System
- Cisco CRS-1 16-Slot Single-Shelf System
- Cisco CRS-1 24-Slot Fabric Card Chassis

Cisco CRS-1 4-Slot Single-Shelf System

Cisco CRS-1 4-Slot Line Card Chassis

- Four 40-Gbps line card slots—Using a midplane design
- 2 dedicated route-processor slots
- 4 dedicated switch fabric card slots in the rear (which accommodate 4 switch fabric cards with two switch planes on each)
- Redundant power supplies and fans

Cisco CRS-1 16-Slot Single-Shelf System

Cisco CRS-1 16-Slot Line Card Chassis

- Sixteen 40-Gbps line card slots—Using a midplane design, the 16-slot LCC is loaded with 16 MSCs on the back of the chassis, each of which is connected, through the midplane, to an interface module on the front of the chassis.
- 2 dedicated route-processor slots
- 8 dedicated switch fabric card slots
- 2 dedicated shelf-controller slots
- Redundant power supplies and fan trays

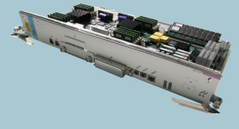
Cisco CRS-1 8-Slot Single-Shelf

Cisco CRS-1 8-Slot Line Card Chassis

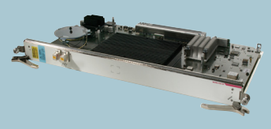
- Eight 40-Gbps line card slots—Using a midplane design, the 8-slot LCC is loaded with 8 MSCs on the back of the chassis, each of which is connected, through the midplane, to an interface module on the front of the chassis.
- 2 dedicated route-processor slots
- 4 dedicated switch fabric card slots (which accommodate 4 switch fabric cards with two switch planes on each)
- Redundant power supplies and fan trays

Cisco CRS-1 4-Port OC-192c/STM-64c POS Interface Module

Cisco CRS-1 16-Port OC-48c/STM-16c POS Interface Module



Cisco CRS 16-Slot Line-Card Chassis Performance Route Processor



Cisco CRS-1 1-Port OC-768c/STM-256c POS Interface Module

Cisco CRS-1 System Elements

Cisco CRS-1 Fabric Card Shelf

Cisco CRS-1 Fabric Card Chassis

- Backplane design
- 24 slots for up to 24 stage 2 fabric cards
- 2 dedicated slots for shelf controller
- Redundant power supplies and fan trays

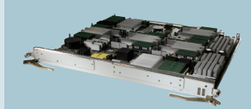
Cisco CRS-1 System Configurations

Single-Shelf System Configuration

- Single 4-, 8-, or 16-slot line card shelf
- Integrated switch-fabric card—no fabric card shelf required
- Switching capacity: 320 Gbps, 640 Gbps, or 1.2 Tbps
- Supports 4, 8, or 16 40-Gbps line cards
  - 4, 8, or 16 OC-768c/STM-256 PoS ports
  - 16, 32, or 64 OC-192c/STM-64c PoS/Dynamic Packet Transport (DPT) ports
  - 32, 64, or 128 10 Gigabit Ethernet ports
  - 64, 128, or 256 OC-48c/STM-16c PoS/DPT ports
  - 4, 8, or 16 OC-768c/STM-256 tunable WDMPOS ports
  - 16, 32, or 64 10 Gigabit Ethernet tunable WDMPHY ports

Multishelf System Configuration (CRS-1 16 slot only)

- 2 to 72 line card shelves
- 1 to 8 fabric card shelves
- Switching capacity: Up to 92 Tbps
- Support for up to 1152 40-Gbps line cards
  - 1152 OC-768c/STM-256 PoS ports
  - 4608 OC-192c/STM-64c PoS/DPT ports
  - 9216 10 Gigabit Ethernet ports
  - 18,432 OC-48c/STM-16c PoS/DPT ports
  - 1152 OC-768c/STM-256 tunable WDMPOS ports
  - 4608 10 Gigabit Ethernet tunable WDMPHY ports



Cisco CRS-1 Modular Services Card

Cisco CRS-4/8-Slot Line-Card Chassis Performance Route Processor

Cisco CRS-1 1-Port OC-768c/STM-256c Tunable WDMPOS Interface Module

Cisco CRS-1 4-Port 10 Gigabit Ethernet Tunable WDMPHY Interface Module

Cisco CRS-1 System Architecture

40 Gbps Line Cards

Each line card is separated by a midplane into two main components: the interface module and the MSC. Each Cisco CRS-1 line card maintains a distinct copy of the adjacency table and forwarding information databases, enabling maximum scalability and performance.

Interface Module
The interface module provides the physical connections to the network, including Layer 1 and 2 functions. Interface modules for the Cisco CRS-1 include: 1-port OC-768c/STM- 256c PoS, 4-port OC- 192c/STM-64c PoS, 16-port OC-48c/STM-16c PoS, 8-port 10 Gigabit Ethernet, 1-port OC-768c/STM- 256c tunable WDMPOS, and 4-port 10 Gigabit Ethernet tunable WDMPHY.

Modular Services Card
The Cisco CRS-1 Modular Services Card is a high-performance Layer 3 forwarding engine. Each Cisco CRS-1 MSC is equipped with two high-performance, flexible Cisco SPPs, one for ingress and one for egress packet processing. The card is responsible for all packet processing, including quality of service (QoS), classification, policing, and shaping, and it is equipped with three-level hierarchical queuing with a total of 16,000 queues.

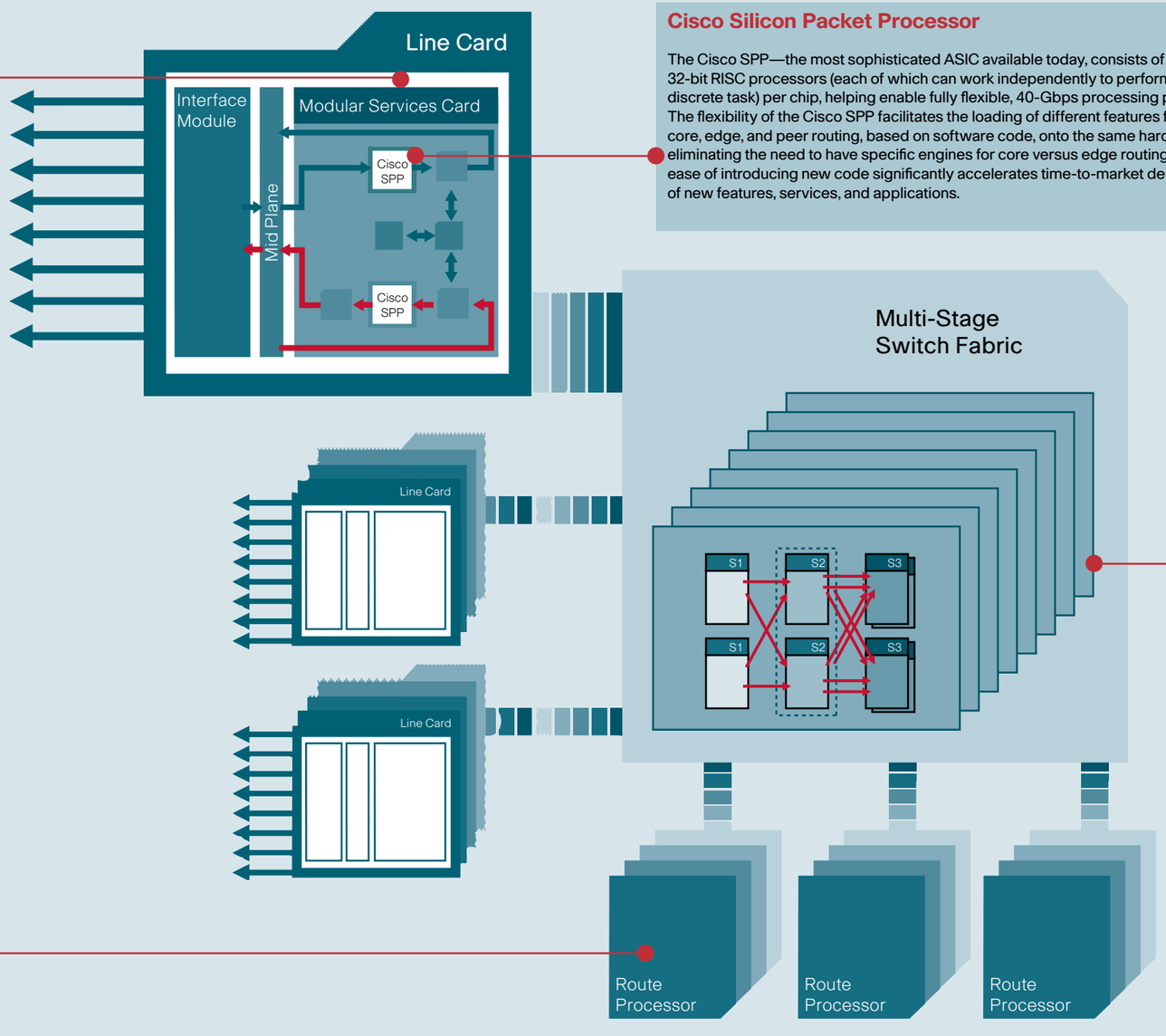
Route Processors

Each active Cisco CRS-1 4-, 8-, or 16-Slot Line Card Chassis Route Processor is available to execute control-plane features such as Intermediate System-to-Intermediate System (IS-IS), Border Gateway Protocol (BGP), MPLS, system management, and accounting. Each Cisco CRS Route Processor manages shelf-controller functions and supports up to 4 GB of dynamic random-access memory (DRAM) on RP-B and 6/12GB on PRP plus a 40-GB hard drive on RP-B or 2x32-GB solid state drive on PRP for storing software images.

A unique Cisco CRS-1 Distributed Route Processor (DRP) can be placed in any available line card slot, and help avoid memory or processing bottlenecks by scaling the control plane or adding new services as needed. The Cisco CRS-1 DRP provides double the processing power of traditional route processors, using two dual PowerPC symmetrical multiprocessing central processing unit (CPU) clusters in a symmetrical multiprocessing configuration. The Cisco CRS-1 Route Processors and CRS-1 DRPs support an N:M redundancy scheme whereby the function of each active Cisco CRS-1 Route Processor or CRS-1 DRP can be performed by a Hot-Standby Router Protocol (HSRP) or a designated Cisco CRS-1 DRP in case of failure. Both the Cisco CRS-1 Route Processors and DRPs can support any processes and line cards on any line card shelf in a multishelf configuration.

System Architecture Overview

The Cisco CRS-1 architecture is the basis of its unparalleled scalability, availability, and service flexibility.



Cisco Silicon Packet Processor

The Cisco SPP—the most sophisticated ASIC available today, consists of 188 32-bit RISC processors (each of which can work independently to perform a discrete task) per chip, helping enable fully flexible, 40-Gbps processing power. The flexibility of the Cisco SPP facilitates the loading of different features for core, edge, and peer routing, based on software code, onto the same hardware, eliminating the need to have specific engines for core versus edge routing. The ease of introducing new code significantly accelerates time-to-market delivery of new features, services, and applications.

Service-Intelligent Switch Fabric

The switch fabric that provides the communications path between line cards is a three-stage, self-routed Benes architecture (a first for IP routers) with 1296 x 1296 buffering, nonblocking switching, and 1:N fabric redundancy between fabric planes. Physically, the Cisco CRS-1 fabric is divided into eight planes over which the packets—broken into cells—are evenly dis¬tributed. Within the planes, the three fabric stages—S1, S2, and S3—dynamically route cells to their destination slots where the Cisco CRS-1 MSCs reassemble cells in the proper order to form properly sequenced packets. The Cisco CRS-1 performs 250-percent speedup and multicast replication in the switch fabric, and has separate priority queues for unicast and multicast traffic and control-plane messages.

The three stages of switching follow:

- **Stage 1 (S1)** is connected to the ingress line card, and delivers the cells across all stage 2 fabric cards.
- **Stage 2 (S2)** supports multicast replication, and delivers the cells to the appropriate stage 3 fabric cards associated with the egress line card shelf.
- **Stage 3 (S3)** is connected to the egress line card for delivery to the appropriate interface(s) and subinterface(s).

In a single-shelf configuration, the fabric cards contain all three stages, S1, S2, and S3. In multishelf configurations, from one to eight fabric shelves are required to provide the S2 stage of the Benes topology, allowing the Cisco CRS-1 to scale from 1 to 72 line card shelves.

Because of this modular fabric architecture, the Cisco CRS-1 can be scaled from 320 Gbps to 92 Tbps of system capacity.

Cisco IOS XR Software

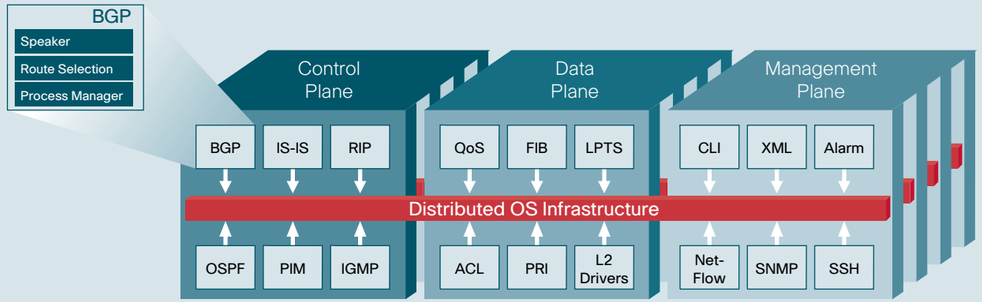
Because Cisco CRS-1 Software is built on a memory-protected, microkernel-based software architecture, only essential processing elements such as message passing, memory management, process scheduling, and thread distribution are done at the kernel level. This architecture minimizes the effect of any software failures in ancillary processes such as device drivers and file systems, and it facilitates restarting or upgrad¬ing of these processes without requiring a system-level restart. This microkernel-based architecture allows for the distribution of control-, forwarding-, and management-plane processes for efficient resource usage and maximum control-plane performance. A highly structured set of application programming interfaces (APIs) and message-passing mechanisms ensure that interprocess communications operate identically—and with identical efficiency—in both single and multiprocessor systems.

Cisco IOS XR Software Architecture

Operating System for Multishelf Carrier Infrastructure

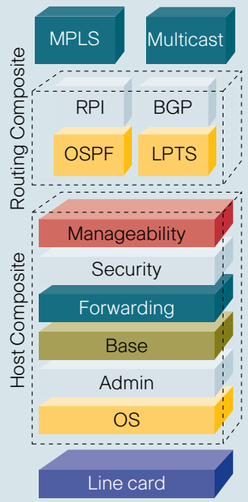
Cisco IOS XR Software, the operating system of the Cisco CRS-1, is the only fully modular, fully distributed internetwork operating system that uses a memory-protected, microkernel-based architecture and control-plane distribution that allows the system to scale from 320 Gbps to 92 Tbps. The microkernel includes only the most essential services of the operating system such as message passing, memory management, process scheduling, and thread distribution. All other elements that are part of the kernel in traditional operating systems, such as device drivers, file systems, network drivers, and system management are implemented outside the kernel (Figure 4).

Figure 4. Cisco IOS XR Software Architecture



This modern operating system architecture design is the basis upon which Cisco IOS XR Software can offer unprecedented availability and scalability as well as complete separation of the data, control, and management planes. Every operating system function runs in its own protected memory space and is divided into processes that can be distributed to any available processing resource on any shelf in the system to eliminate processing bottlenecks and to ensure that no potential hardware failure adversely affects system operation. Cisco IOS XR processes can be stopped, started, or restarted dynamically, either automatically in response to a failure or by the system operator. This granular modularity ensures that only the required processes are restarted upon process failure or during software upgrades, enabling in-service software upgrades (ISSUs).

Figure 5. Cisco IOS XR Software Packaging Architecture

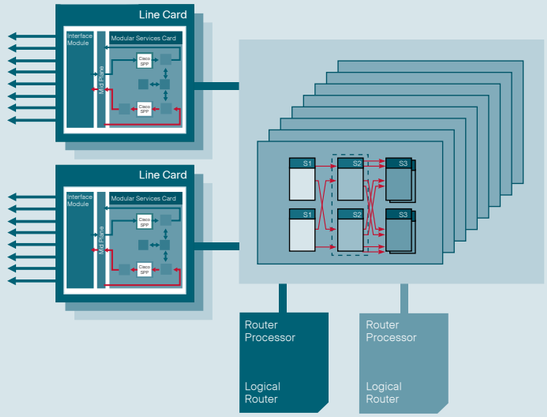


The ISSUs are further simplified through the use of a modular software-distribution mechanism that bundles similar or dependent components together so they can be upgraded as a set. If necessary, individual processes can be upgraded or patched to apply critical fixes or new features (Figure 5). This capability allows service providers to add new features or fix software defects without having to requalify a completely new operating system version.

To allow even further flexibility, Cisco IOS XR Software can segment the Cisco CRS-1 into completely distinct secure domain routers (SDRs), each with its own interfaces, processors, management interfaces, and control-plane processes (Figure 6), allowing service providers to provide complete separation of system and routing resources to support the total isolation of customers, administrative domains, or services.

Cisco CRS-1 System Attributes

Figure 6. Creation of SDRs on Cisco CRS-1



Unparalleled System Longevity

The Cisco CRS-1 scales from a single-shelf to a multishelf system without requiring service disruption, enabling service providers to plan, design, trial, and deploy services over a single system for decades to come. The Cisco CRS-1 completely separates control, data, and management planes, allowing the system to uniquely scale with the following capabilities:

- **Control Plane**
  Individual system processes can be placed on specific route processors or be given an "affinity" between a range of route processing resources in the system. DRPs can be added to any available line card slot in the system—providing nearly infinite control-plane scalability. Both the route processors and DRPs can support any processes and line cards on any line card shelf in a multishelf configuration.
- **Data Plane**
  With support for up to 1152 OC-768c/STM-256c, 4608 OC-192c/STM-64c, and 18,432 OC-48c/STM-16c interfaces, and 9216 10 Gigabit Ethernet, 1152 OC-768c/STM-256c tunable WDMPOS, and 4608 10 Gigabit Ethernet WDMPHY ports, only the Cisco CRS-1 can scale up to 92 Tbps in nondisruptive upgrades.
- **Management Plane**
  The Cisco CRS-1 management database provides native management of the system through either command-line interface (CLI) or Extensible Markup Language (XML)-based interfaces. The XML-based Craft Works Interface (CWI) is a visual management tool that can transparently manage single-shelf or multishelf systems.

Continuous System Operation

Incorporating 20 years of Cisco Systems® networking experience in hardware and software innovations, the Cisco CRS-1 delivers continuous system operation. Building upon this reliable foundation, providers can offer services over a self-healing network that is designed for continuous availability. System components, including service cards, route processors, controller cards, power units, and fans, are fully redundant. Built with Cisco IOS XR Software, the Cisco CRS-1 can be maintained, upgraded, enhanced, and scaled without requiring service interruption.

- **Self-healing software**
  Cisco IOS XR Software acts in a self-healing manner to first contain any fault or system error and then uses automated process recovery features to safely restart and restore full process operation.
- **ISSUs and enhancements**
  Cisco IOS XR Software has been architected to be highly modular in order to take maximum advantage of distributed hardware platforms such as the Cisco CRS-1. This modularity allows not only for the distribution of individual software processes within a system, but also for the modular application of software updates. Operators can upgrade distinct software subsystems such as the routing or MPLS subsystems, upgrade distinct processes such as BGP or Protocol Independent Multicast (PIM), or apply patches to individual processes to fix software defects. This capability for granular upgrades not only minimizes or eliminates any disruption to services, but also allows operators to test and qualify only new software elements instead of entire software releases, greatly reducing the operational burden and expense associated with system maintenance.
- **Self-defending system**
  The self-defending nature of the Cisco CRS-1 system allows it to automatically recognize distributed-denial-of-service (DDoS) attacks and prevent system overload even while under attack. With an embedded event manager and secure audit trails, the Cisco CRS-1 can proactively monitor and defend against attacks, while providing tools to trace network security violations.

Cisco CRS-1 System Attributes

- **In-service scaling**
  The Cisco CRS-1 system can be scaled, while in service, from 640 Gbps to 92 Tbps of switching capacity with the addition of line card shelves that are interconnected with switch-fabric shelves—all without requiring service interruptions.
- **System operation and management**
  The Cisco CRS-1 provides an enhanced CLI and Routing Policy Language (RPL); offline configuration development and error checking as well as customizable configuration rollback; automated, proactive system monitoring; and role-based management.

Cisco Intelligent ServiceFlex Design

Using the Cisco Intelligent ServiceFlex design, the Cisco CRS-1 is the leading routing system that allows service providers to reap the benefits of service-specific networks while taking full advantage of the comprehensive service flexibility and scale of IP/MPLS networks. With the Cisco CRS-1, carriers can be true to their business strategies without increasing CapEx or OpEx.

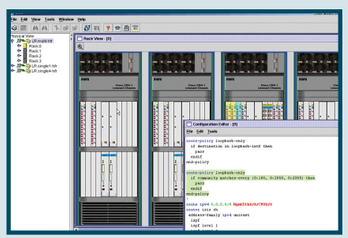
The Cisco Intelligent ServiceFlex design includes:

- **Cisco Service Separation Architecture**
  The Cisco Service Separation Architecture (SSA) uses hardware and Cisco IOS XR designs of the Cisco CRS-1 to provide total separation of traffic and network operations on a per-service or per-customer basis. This unique implementation allows carriers to isolate the control, data, and management planes along with associated line cards and route processors to create SDRs that operate independently from the rest of the system. The Cisco SSA gives carriers the flexibility to test, deploy, and implement a comprehensive offering of converged services with the confidence that they can meet customer service-level agreements (SLAs).
- **Speed-to-service elements**
  The pairing of the 40-Gbps Cisco SPP, the world's most sophisticated ASIC, with Cisco IOS XR Software provides unprecedented service capabilities that speed service delivery to customers. Each Cisco SPP combines 188 32-bit RISC processors onto a single, fully programmable chip. Cisco SPP implements massively parallel processing on the chip for flexible service delivery with virtually no compromise in performance. The highly modular software of the Cisco CRS-1 accelerates service delivery with individual packaging of feature sets to reduce qualification and test time.
- **Service-intelligent switch fabric**
  The Cisco CRS-1 boasts a three-stage switch fabric, based on a Benes architecture, enhanced for packet-based networking. This service-intelligent switch fabric is unique because it enhances a traditional three-stage Benes architecture with native multicast replication and integrated priority queues. With native multicast replication, service providers can efficiently scale to deliver one service to a large number of customers (such as video broadcast) without affecting system or network performance. Additionally, the switch fabric incorporates traffic speedup, which increases the flow of traffic 250 percent to prevent system congestion in the Cisco CRS-1.

Operationally Efficient Management

The Cisco CRS-1 has been engineered from its inception with management efficiency as a primary design goal Emphasis was placed on providing a single-router view, even in large, multishelf installations. The CWI takes full advantage of the XML interface on the Cisco CRS-1 to provide a standalone, multishelf router management tool. The CWI provides intuitive GUI-based configuration and alarm management tools, along with a full-screen configuration text editor. In addition, Cisco IOS XR Software uses an element management system (EMS).

The EMS is a set of management elements that help enable a self-monitoring, self-healing network and provide a consistent interface and consistent functions regardless of the access method—a CLI, XML, or Simple Network Management Protocol (SNMP). Based on Cisco Transport Manager, the EMS uses the same management system as Cisco optical systems, enabling network managers to deploy the same EMS for both optical transport and IP/MPLS routing.



System Specifications

Chassis

16-Slot Single-Shelf System

Design, Slots, and Capacity
- Midplane design
- Line Card: 16 x 40 Gbps slots
- Switch Fabric Card: 8 dedicated slots
- Route Processor: 2 dedicated slots
- Fan Controller: 2 dedicated slots

Dimensions
- (H x W x D) 84 x 23.6 x 36 in (213.36 x 59.94 x 91.44 cm)
- With cable management and front cover—(H x W x D) 84 x 23.6 x 39.71 in (213.36 x 59.94 x 100.84 cm)

Weight
- 939 lbs (425 kg) as shipped, chassis only with build in rack and fan trays installed
- 1008 lbs (457 kg) chassis only as shipped, including power shelves, without power modules, and with build in rack
- 1595 lbs (723 kg) chassis fully configured, using all card slots, power shelves, cosmetics, and with build in rack

Power
- Maximum DC power needed when chassis is fully configured with line cards with traffic running: 9.63kW
- Chassis power supply maximum DC output : 13.2kW

8-Slot Single-Shelf System

Design, Slots, and Capacity
- Midplane design
- Line card: Eight 40-Gbps slots
- Switch-fabric card: 4 dedicated slots
- Route processor: 2 dedicated slots
- Fan tray: 2 fan trays

Dimensions
- (H x W x D) 38.5 x 17.5 x 36.6 in (97.79 x 44.45 x 92.964 cm) with base cosmetics
- With cable management and front cover—(H x W x D) 38.5 x 17.5 x 40.5 in (97.79 x 44.45 x 102.87 cm)

Weight
- 330.8 lb (148.86 kg) chassis with fan, PDU and blanks (as shipped)
- 650lb (292.5 kg) chassis as shipped, including power shelves, and all line cards and route processors

Power
- Maximum DC power needed when chassis is fully configured with line cards with traffic running: 4834W
- Chassis power supply maximum DC output : 7.7kW

4-Slot Single-Shelf System

Design, Slots and Capacity
- Midplane design
- Line card: Four 40-Gbps slots
- Switch fabric card: 4 dedicated slots
- Route processor: 2 dedicated slots
- Fans: 4 fans, 1 fan tray

Dimensions
- (H x W x D) 30 x 17.643 x 30.28 in (76.2 x 44.813 x 76.91 cm) without doors and cosmetics

Weight
- 260 lb (117.93 kg) chassis with fan, power modules and blanks (as shipped)
- 380 lb (172.37 kg) chassis as shipped, including power shelf, fabric cards, and all line cards and route processors

Power
- AC input = 4700VA @ 16000 BTU/HR
- DC input = 4750W @16200 BTU/HR

Fabric Card Chassis

Design, Slots and Capacity
- Midplane design
- Switch Fabric Card: 24 slots
- Shelf Controller: 2 dedicated slots

Dimensions
- Without cable management and front cover—(H x W x D) 84 x 23.6 x 35 in (213.36 x 59.94 x 88.9 cm)
- With cable management and front cover—(HxWxD) 84 x 23.6 x 41 in (213.36 x 59.94 x 104.2 cm)

Weight
- 644 lbs (292 kg) as shipped, chassis only with fan trays installed
- 712.8 lbs (323 kg) chassis only as shipped, including power shelves, without power modules
- 1559 lbs (707 kg) chassis fully configured

Power
- Maximum DC = 8.8kW @ 31,050 BTU/hr
- Maximum AC = 10.4kW @ 32,668 BTU/hr

Memory

Modular Services Card
- 2 GB of default route memory
- 1 GB of packet buffer memory per side (2 GB total per line card [ingress and egress])

Performance Route Processor
- 6 or 12 GB of ECC DDR3 route memory
- Two 32-GB Solid State Drive (SSD)

Route Processor Rev. B
- 4 GB of route memory
- One 2/4GB PCMCIA Flash & One 40-GB Hard Drive

Features and Functions

IP Features
- Control-plane packet handling
- IPv4
- IPv6
- (X)ACLs
- QoS/class of service (CoS) using Modular QoS CLI (MQC)
- IP packet classification and marking
- Queuing (both ingress and egress)
- Policing (both ingress and egress)
- Diagnostic and network management support

Routing Features
- Multiprotocol BGP Version 4 (MP-BGPv4)
- Open Shortest Path First Version 2 (OSPFv2)
- OSPFv3
- IS-IS
- Static routes
- RPL
- Multicast
- MPLS
- High availability
- Security
- Manageability

IP-over-DWDM Features
- GFEC: standard G.975 Reed-Salomon algorithm
- EFEC: standard G.975.1 two orthogonally concatenated BCH super FEC code
- Full C-band tunable laser with 50-GHz spacing
- Router-to-router SONET/SDH-like operations, administration, maintenance, and provisioning (OAM&P)

Note: For a full listing of features and functions, refer to Cisco CRS-1 data sheets at http://www.cisco.com/go/crs.

Cisco Network Lifecycle and Support Services

Cisco offers services that address the entire network lifecycle to assist in planning, design, implementation, operation, and optimization of the Cisco CRS-1 Carrier Routing System deployments. These service offerings include:

- Advanced services teams, using methodology and templates based on previous Cisco CRS-1 deployments, deliver and deploy the system in service provider environments.
- Technology support services are available for Cisco CRS-1 replacement, warranty, and spares for next-business-day or onsite hardware replacement support.
- Specially trained Cisco Technical Assistance Center (TAC) engineers provide global 24-hour support on the Cisco CRS-1 with practical experience on the support and features of the product.

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