Control Plane

This chapter provides an overview of the routing system control plane in the Cisco CRS Series Enhanced 16-Slot Line Card Chassis (LCC). It contains the following sections:

Control Plane Overview

The LCC control plane provides a communication path between cards, modules, and components in the chassis. The control plane is a logical entity that ties physical chassis components and software functions into a unified entity. The control plane connects the system controller functionality on the route processor (RP) to the service processor (SP) module used to control each card and module in the chassis.

The control plane is used for:

- System discovery and inventory
- Configuration management, system boot, and upgrades
- Inventory control and asset tracking
- Fault detection and recovery, and performance monitoring

The data plane is the path that packets take through the routing system from the physical layer interface module (PLIM) to the modular services card (MSC) to the switch fabric to another MSC and out a PLIM. The control plane and data plane may share some physical components. For instance, the control plane uses the switch fabric for some types of intrasystem communication, just as the data plane uses it to switch packets.

The control plane hardware provides for system discovery and inventory. This process includes mechanisms to determine system topology of the control plane and switch fabric before the system has been configured. In addition to topology discovery, the control plane hardware must also provide mechanisms for card- or module-presence detection and tracking information, such as the card type, revision, and serial number. These mechanisms allow system management software to build a database that represents the routing system configuration, including individual board identification and location information. The control plane hardware provides online insertion and removal (OIR) detection.

The Cisco CRS routing system hardware detects, isolates, and recovers from a broad range of faults, and provides failover mechanisms to redundant hardware. The control plane is a central element in achieving high availability, as it must isolate failures and direct failover events, both in the data plane and in the control plane. To ease serviceability, chassis identification displays and critical, major, and minor alarm indicators are clearly visible. Each MSC, RP, fan controller card, and switch fabric card has an alphanumeric display and green OK LED to show current board status. Environmental conditions, including temperature and voltage levels, are monitored by several internal measurement points and reported to the routing system operator.

The RPs function as the system controller in the LCC. Note that the PLIMs are connected to the control plane through their respective MSCs. The control plane includes a switched point-to-point Fast Ethernet (FE), driven by these FE switches, for control plane network messages, and some other paths for system communication. The dual RPs and midplane FE traces provide redundant connections between all cards in the LCC. Most cards or modules contain a service processor (SP) module that provides the communication for that device within the control plane.

Some of the important functions and implementations of the control plane are:

- Online insertion and remove (OIR) detection—Every MSC, RP, switch fabric card, power module, and so on provides a presence-detection signal to the system controller function on the RP cards. This dedicated hardware signal indicates the physical presence of a card in every slot. The presence-detection signal allows the Cisco IOS XR configuration software to quickly detect OIR events, and identify cards that have been inserted but cannot communicate over the control plane.
- PLIM inventory—Every PLIM slot is probed by the master RP to get the board ID and type and other inventory information. The RP can read an identification chip on each PLIM, even if the PLIM is not powered on. The PLIM inventory chip can be accessed by the RP, whether or not an MSC is plugged into the MSC slot associated with the PLIM.
- RP active/standby arbitration—Both RP slots are directly connected by dedicated midplane signals to special hardware arbitration logic. During the boot process, this logic selects one of the RPs to be the master (active) device; the other RP functions in standby mode. See the "Route Processor Active and Standby Arbitration" section on page 6-4 for more information.

  After hardware arbitration, software should verify single RP mastership via control plane FE messaging. The arbitration hardware could elect two masters due to an unusual hardware fault. The control plane FE provides a redundant path so mastership can be verified absolutely.
- Node reset—Each RP has a dedicated reset line to every node in the chassis. Nodes include MSCs, RPs, and fabric cards. The reset lines fan out from each RP and are connected to the SP on the node cards. Only the master RP can assert these reset lines; the standby RP reset lines are isolated by the RP arbitration logic. The reset lines allow the RP to force a board reset from hardware, and is used only if a board does not respond to control network messages. When this mechanism is used to reset an SP, power to all other chips on that node are turned off until the reset SP has rebooted and enabled power to the local board. To prevent glitches on the reset lines from causing inadvertent resets, as might occur during an RP OIR event, a reset from this signal can be triggered only from an encoded string of high to low transitions.

Control Plane Components

This section describes the control plane functions of various components in the routing system.

- A service processor (SP)—A service processor module is attached to the MSC, RP, alarm module, switch modules, and the power control and blower control systems. When a card or module is inserted into a powered-up chassis, the SP module on that card is always powered up, it cannot be powered down separately from the chassis power. Each service processor module has a Fast Ethernet (FE) connection to each SC or RP.
- A system controller (SC) function—The SC, which is contained on the RP, is the central point of control within the LCC. At least one SC must be operational at all times for a chassis to function as part of a routing system. Redundant SCs are provided for each chassis, so that loss or removal of any single SC does not bring down a chassis. The SC instructs individual SPs to power up nodes, provides code images for each card or module to download, and resets any node that it determines is unresponsive. The master SC is a single control-and-arbitration point in the chassis, and determines master and standby RP status when necessary.
- A modular services card (MSC)—The MSC is the primary data-forwarding engine. The MSC provides Layer 2 and Layer 3 packet processing and queuing. The MSC CPU performs a number of control plane functions, including forwarding information base (FIB) download receive, local PLU/TLU management, statistics gathering and performance monitoring, and ASIC management and fault handling.
- A PLIM—The PLIM contains the physical interfaces to external data circuits. The PLIM does not have its own SP module. Instead, the MSC SP module controls most of the basic control plane functions for the PLIM. This includes reading and writing the PLIM NVRAM, which contains the board type, revision, serial number, and other information from manufacturing.

  The PLIM does not have a dedicated reset signal coming directly from the RP, as the MSC itself does. When the MSC SP receives a reset, it shuts off power to the MSC and the PLIM power components. When there is no MSC present, the associated PLIM is not powered on.
- A route processor—There are two RP slots per LCC. The chassis midplane connects the arbitration logic of the two RPs so that one RP becomes the master (primary) and one RP becomes the standby. The primary RP distributes software images to the SP and MSC, while the standby RP monitors the primary RP in case it is required to become the primary because of a failover event.

  The RP is a building block of the routing system control plane processing and database solution. The RIB and FIB databases reside on one or more RPs. Routing protocols, such as BGP and OSPF, run on the RPs and update the route databases. These databases are downloaded to the MSCs, and the MSC forwarding engines are programmed appropriately.

  A Performance Route Processor (PRP) card is also available for the LCC. Two PRPs perform the same functions as two RPs, but provide enhanced performance for both route processing and system controller functionality.

Note A chassis may not be populated with a mix of RP and PRP cards. Both route processor cards should be of the same type (RP or PRP).

- Switch fabric cards—All switch fabric cards contain switch element chips, and in some cases parallel optical devices, and an SP that provides a control plane interface. The hardware control plane interface communicates over FE links, which provide a channel for fabric configuration and maintenance. The control plane hardware configures the fabric chips and monitors the switch fabric for faults. Some faults require software to isolate failed chips or links. The SP software monitors link health and executes isolation actions.

The switch fabric can operate with fewer than eight planes at reduced performance levels. This means that you can perform online insertion and removal (OIR) of switch fabric cards while the router is running (for example, to upgrade the switch fabric). For information about how to perform OIR on switch fabric cards, see *Cisco CRS-1 Carrier Routing System Getting Started Guide*.

- An alarm module and power supplies—The routing system alarm module displays faults and messages to the operator. The alarm module is clearly visible, and includes an alphanumeric display and three LEDs that signify critical, major, and minor faults. When a fault occurs, the alphanumeric display indicates the cause of the fault. The alarm module contains only the alphanumeric and LED display devices and an SP to drive the display and provide control network connectivity.
- Fan trays—Fan trays are monitored by an SP module that measures airflow and controls fan RPM. As temperatures increase, the SP increases blower RPM to provide increased cooling capacity.
- The LCC midplane—The chassis midplane provides intrachassis connectivity for cards and modules in the routing system. The midplane is mostly passive, though it does contain active NVRAM components that are used to store tracking-number and manufacturing information, and MAC addresses. Software stores the chassis ID value in the NVRAM.